

Northeastern Bulrush
(Scirpus ancistrochaetus)

**5-Year Review:
Summary and Evaluation**



Photo credit: The Nature Conservancy

U.S. Fish and Wildlife Service
Pennsylvania Field Office
State College, PA

Fall 2008

5-YEAR REVIEW

Species reviewed: Northeastern Bulrush / *Scirpus ancistrochaetus*

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U.S. FISH AND WILDLIFE SERVICE 5-YEAR REVIEW

Species reviewed: *Scirpus ancistrochaetus* (Northeastern Bulrush)

1.0 GENERAL INFORMATION

Section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA), requires that the U.S. Fish and Wildlife Service (USFWS) review the status of species it has listed as endangered and threatened at least once every 5 years. This review of the status of the northeastern bulrush is an assessment of the best scientific and commercial data available to date.

1.1 Reviewers

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1.2 Methods Used to Complete the Review

USFWS personnel compiled this status review, focusing on the data that have become available since approval of the 1993 Recovery Plan. We contacted representatives in the eight States that have extant or historic *Scirpus ancistrochaetus* occurrences and obtained data detailing the status of individual occurrences of the species in their respective States (Table 1, Appendix 2). For each species occurrence, these data included the site (Element Occurrence or EO) rank, site description, species information, date last surveyed, date last observed, and landowner information. This information was used to get an overall sense of population status range-wide and to determine the need for additional surveys and research.

We also gathered literature documenting research conducted on the northeastern bulrush. The available literature consisted almost entirely of papers written by Dr. Kendra Lentz, Assistant Professor of Biology at Wilmington College. Dr. Lentz studied the species extensively in Pennsylvania during her graduate work at the Pennsylvania State University in the 1990s. Lentz's papers provide the most recent available research on this species, particularly with regard to the effects of hydrology, shading, herbivory, and nutrients on germination and plant growth.

From each State, we requested information on how wetlands occupied by listed species are regulated at the State level as a means of determining the level of protection the species currently receives. We also used the Recovery Plan and the *Federal Register* to compare past and present information and to update the threats/five-factor analysis data. Finally, we have made recommendations for further actions to benefit this species.

1.3 Background

1.3.1 Federal Register Notice announcing initiation of this review: 70 FR 38976 (July 6, 2005): Initiation of a 5-Year Review of 5 Listed Species: The Virginia Northern Flying Squirrel (*Glaucomys sabrinus fuscus*), Delmarva Peninsula Fox Squirrel (*Sciurus niger cinereus*), Northeastern Bulrush (*Scirpus ancistrochaetus*), Chittenango Ovate Amber Snail (*Novisuccinea chittenangoensis*), and Virginia Round-Leaf Birch (*Betula uber*)

1.3.2 Listing history:

Federal Register (FR) Notice: 56 FR 21091-21096: Determination of Endangered Status for *Scirpus ancistrochaetus* (northeastern bulrush)

Date listed: June 6, 1991

Entity listed: Species

Classification: Endangered

The USFWS has not revised the original listing.

1.3.3 Associated rulemakings/actions: None.

1.3.4 Review history: No formal 5-year reviews have been conducted for the northeastern bulrush since its listing in 1991; however, the 1993 recovery plan included an assessment of its status.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 14 (TESS database). The northeastern bulrush is ranked as a species with low threats and high recovery potential. The rationale for the threat category "low" is that this species is mostly found in forest areas on public lands where threats are infrequent and often indirect. The rationale for the recovery potential category "high" is the occurrence of many populations of this species on public lands, which creates a favorable atmosphere for reducing threats and carrying out conservation actions.

1.3.6 Recovery plan:

Name of plan: Northeastern Bulrush (*Scirpus ancistrochaetus*) Recovery Plan

Date issued: August 25, 1993

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment Policy

2.1.1 Is the species under review a vertebrate? No, the species is a plant; therefore, the distinct population segment policy is not applicable.

2.2 Recovery Criteria

2.2.1 Does the species have an approved recovery plan containing objective, measurable recovery criteria? Partially. The 1993 plan for recovery of the northeastern bulrush contains criteria for reclassifying the species from endangered to threatened (i.e., downlisting); however, delisting criteria were not included in this plan due to a need for more information about the life history and habitat requirements of the species.

2.2.2 Adequacy of recovery criteria:

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. Additional information is now available suggesting that some populations may not be as stable or vigorous as previously supposed, despite their presence on relatively secure State-owned and managed lands. The recovery criteria do not adequately address management needs to address recently identified threats (*e.g.*, herbivory, shading), although they do address the need for long-term monitoring, which for the most part, has not been undertaken.

2.2.2.2 Are all listing factors relevant to the species addressed in the recovery criteria? No. The criteria primarily address listing factor A (the present or threatened destruction, modification, or curtailment of habitat or range). Factors C-E (disease or predation, inadequacy of existing regulatory mechanisms, or other natural or manmade factors affecting the species' continued existence) should be revisited to address herbivory, shading, hydrology changes, and the impacts of project types that are not captured under current regulatory mechanisms (*e.g.*, timber harvesting, development in uplands). Factor B (overutilization) is not applicable to this species. Although the recovery plan generally describes threats to the species and its habitat (pp.34-37), threats are better understood now than they were when the plan was developed.

2.2.3 Discussion of how each criterion has or has not been met: According to the 1993 Recovery Plan, reclassification of this species from endangered to threatened will be considered when the following conditions have been met:

1. Long-range protection is secured for 20 populations.
2. Annual monitoring over a 10-year period shows that a sample of 20 representative populations is stable or increasing.
3. Life history and ecological requirements are understood sufficiently to allow for effective protection, monitoring and, as needed, management.

These criteria have been partially met. An example of a new protected population lies at New Hampshire's Fall Mountain. The Nature Conservancy holds a conservation easement that ensures sound forest management practices to protect the northeastern bulrush and other sensitive ecological features (TNC 2006). However, at this time there are very few populations that are permanently protected. Monitoring has occurred since the Recovery Plan was published, but sites have not been monitored on a consistent basis, and many sites have not been visited since 1995. Additional research has occurred since the Recovery Plan was published, particularly by Lentz. Still, several factors, including genetic variation between ponds, the effects of herbivory, the effects of shading, and the role of seed banking need to be better understood.

2.3 Updated Information and Current Species Status

2.3.1 Biology and habitat:

2.3.1.1 New information on the species' biology and life history: Northeastern bulrush populations are affected by a number of environmental conditions. One environmental factor known to influence plant growth, reproduction and distribution is light availability (Boardman 1977). Since northeastern bulrush typically grows in open seasonal pools surrounded by woodlands, encroaching shade can be a factor affecting its ability to thrive. Lentz and Cipollini (1998) found that light levels strongly affected growth and biomass allocation. It was found that shaded plants are often taller, but at the expense of the roots and other organs. A pond that contains northeastern bulrush with infringing shade could have weaker populations. Therefore, in some cases, it may be helpful to manage the habitat surrounding these sites by selectively removing larger trees to reduce canopy cover increase light exposure.

Another environmental factor affecting this species is hydrology. Significant increases and decreases in water levels were found to adversely affect plant growth. An increase in water level through such practices as logging could adversely affect existing populations by causing leaves to senesce at a faster rate (Lentz and Dunson 1998). Conversely, a decrease in water level due to an impact such as groundwater pumping could detrimentally affect this species (Lentz and Dunson 1998). This species may be a poor competitor in dry soils, and a decrease in water level may allow species that are not as tolerant of inundation to dominate (Grace and Wetzel 1981, Bertness 1991).

Lentz and Johnson (1998) found that northeastern bulrush seeds exhibit high germination success under laboratory conditions. Under optimal conditions, which included a period of dry storage followed by stratification at 3 or 8° C for eight to 12 weeks, germination success was approximately 80 percent.

2.3.1.2 Abundance, population trends, demographic features and/or trends:

When the northeastern bulrush was first listed, there were only 33 extant populations known. As of 2007, there were 113 extant populations range-wide, most of which were found in Pennsylvania and Vermont (Table 1).

To document the status and quality of individual plant occurrences (= element occurrence or EO), the Heritage Network has developed EO rankings. The general qualitative definitions of the various EO ranks can be found in Appendix 1. Quantitative and qualitative rank definitions specific to the northeastern bulrush are defined as follows (it is believed that all States are using the same ranking criteria):

- A – an average of 1000 stems (fertile and vegetative) over a 5-year period; buffer and hydrology more-or-less undisturbed
- B – an average of 251-1000 stems (fertile and vegetative) over a 5-year period; buffer and hydrology more-or-less undisturbed; OR more than 1000 stems over a 5-year period, with the buffer and hydrology having considerable disturbance
- C – an average of 51-250 stems (fertile and vegetative) over a 5-year period; buffer and hydrology may have considerable disturbance
- D – an average of 50 or fewer stems (fertile and vegetative) over a 5-year period; buffer and hydrology may have considerable disturbance

As represented in Table 1, most northeastern bulrush occurrences fall in the B to C range, meaning that most of the extant populations are small to moderate in size. The C and D ranked sites are quite small and may be subject to some level of disturbance.

Table 1. Northeastern bulrush occurrences by State and rank in 2007.

| RANK | MA | MD | NH | NY | PA | VA | VT | WV | TOTAL |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|
| A / AB¹ | 0 | 0 | 3 | 0 | 6 | 4 | 0 | 0 | 13 |
| B / BC | 0 | 0 | 3 | 0 | 20 | 2 | 7 | 2 | 34 |
| C / CD | 1 | 1 | 3 | 0 | 16 | 0 | 15 | 0 | 36 |
| D | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 1 | 10 |
| E | 0 | 0 | 0 | 0 | 19 | 1 | 0 | 0 | 20 |
| F | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| H | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 3 |
| X | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 4 |
| TOTAL | 1 | 1 | 9 | 1 | 77 | 8 | 22 | 3 | 122 |
| TOTAL EXTANT² | 1 | 1 | 9 | 0 | 70 | 7 | 22 | 3 | 113 |

¹ Designations combined where States used alternative notation.

² Does not include occurrences with a rank of F, H, or X.

Of the 113 extant populations occurring range-wide, the status of 38 populations is unknown (Table 2 and Appendix 2). Most of these 38 populations have not been observed for 10 years or more, and follow-up surveys are needed to determine the status of these sites. Where population status has been evaluated recently, approximately half of the populations are stable or increasing (N = 36) while half appear to be declining (N = 39).

Table 2. Status of extant northeastern bulrush populations in 2007.

| Population Status | MA | MD | NH | NY | PA | VA | VT | WV | TOTAL |
|--------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------------|
| Increasing | 0 | 0 | 0 | 0 | 6 | 0 | 3 | 0 | 9 |
| Stable | 1 | 0 | 0 | 0 | 17 | 1 | 6 | 2 | 27 |
| Declining | 0 | 0 | 3 | 0 | 25 | 0 | 10 | 1 | 39 |
| Unknown | 0 | 1 | 6 | 0 | 22 | 6 | 3 | 0 | 38 |
| TOTAL | 1 | 1 | 9 | 0 | 70 | 7 | 22 | 3 | 113 |

A State-by-State summary of the status of the northeastern bulrush is presented below. Appendix 2 details the status of all northeastern bulrush occurrences range-wide.

Maryland. Only one extant occurrence (C rank) is known from Maryland. This population was last surveyed in 1990, before the northeastern bulrush was listed. This sole occurrence is located in a 0.2-acre limestone sinkhole pond in a field on private land.

Massachusetts. One extant occurrence (CD rank) is known from Massachusetts. This occurrence has a questionably stable population status due fluctuating and often low population numbers. This occurrence was discovered in 2005 and exists on private land in a small shallow pond in a bowl-like depression surrounded by forest with dense understory.

New Hampshire. Nine extant occurrences are known from New Hampshire, of which three are ranked as A, three as B, and three as C/CD. All of these occurrences were discovered after the Recovery Plan was published in 1993. These occurrences are found in habitats characterized by beaver-influenced hydrology, or in shallow, open-water ponds and wetlands, often in headwater basins. Six of these sites are located on private land and three on land owned by the State.

Pennsylvania. Pennsylvania supports the largest number (70) and percentage (62 percent) of extant northeastern bulrush occurrences. In 2007, of the 70 extant occurrences, six were ranked A or AB, 20 were ranked B or BC, 16 were ranked C or CD, nine were ranked D, and 19 were ranked E. Populations are typically found in

emergent swampy headwater wetlands, road-formed ponds, or shallow vernal pools in forested settings in gentle depressions on top of broad high forested plateaus. Most of these sites were discovered after the species was listed. Recent status information is not available for most of these populations. The status of 22 populations is unknown, typically because the sites have not been re-visited for several years. Many of the populations (50) are located on State Game Lands or State Forest Land.

In 2006, Dr. Kendra (Lentz) Cipollini re-visited several of the wetlands she had studied in Pennsylvania in the 1990s. Of the eight northeastern bulrush populations surveyed, only one had increased in size. The other seven had experienced significant declines in population area (70-100 percent) since her 1995 surveys, and showed little or no signs of flowering (Table 3). In 2007 and 2008, 46 occurrences were assessed. About half of the sites were doing fair to well and about half were doing poorly to very poorly. Even the sites noted as being in fair condition will most likely require management to prevent declines (Cipollini *in litt.* 2008).

Vermont. Vermont has 22 extant northeastern bulrush occurrences, 15 of which are ranked A or AB, and seven are ranked B or BC. All of these occurrences were located after 1993, and all have been surveyed since 2001. Northeastern bulrush habitat in Vermont can be most commonly characterized as emergent marshes (sometimes along streams) whose hydrology is influenced by beaver activity. However, there are a few sites that have no beaver influences, but contain small, perched hemlock or buttonbush swamps. Two populations are on public land, and 20 are on private land. One of the privately-owned sites is protected via a conservation easement.

Virginia. There are seven extant northeastern bulrush sites in Virginia, with two ranked as A/AB, two ranked B/BC, and one ranked E. The status of most of these sites is unknown because they have not been surveyed since the 1980s or 1990s. Habitat includes emergent ridgetop shallow ponds, shallow sinkhole depressions and mountain-side bench ponds. Four sites are located on private land, three are on public land, and ownership of one site is undetermined.

West Virginia. There are three northeastern bulrush populations in West Virginia, two of which are ranked B, and one of which is ranked D. These occurrences were surveyed and last observed in 2005. Habitat includes sinkhole ponds atop a low, flat sandstone ridge, and small seasonal ponds. Two of these sites are located on private lands, and one is located on National Forest land managed by the U.S. Forest Service.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation: No information has become available regarding genetics, genetic variation, or trends in genetic variation since the recovery plan was published.

Table 3. Changes in population size and reproduction at selected northeastern bulrush sites in Pennsylvania; all measurements are in m² (K. Cipollini, Wilmington College, *in litt.* 2006).

| Pond Name | EO# | County | Wetland Area | 1995 | | 1996 | | 1997 | | 2006 | | Percent Change from 1995 to 2006 | 2006 Field Notes |
|-----------|------|------------|--------------|-----------------|------------|-----------------|------------|-----------------|------------|-----------------|------------|----------------------------------|-------------------------------------|
| | | | | Population Area | Flowering? | Population Area | Flowering? | Population Area | Flowering? | Population Area | Flowering? | | |
| BB | 010* | Centre | 510 | 7 | Y | 4 | Y | 7 | Y | 2 | N | -71 | Highly disturbed by beaver activity |
| BK1 | 003 | Huntingdon | 940 | 228 | Y | 224 | Y | 224 | Y | 390 | Y | 71 | Flowering sparsely |
| CB | 010* | Centre | 891 | 5 | Y | 4 | Y | 2 | Y | 0.3 | N | -94 | |
| HR | 516 | Union | 220 | 41 | Y | 42 | Y | 30 | Y | 2 | N | -95 | |
| MM1 | 515 | Lycoming | 510 | 168 | Y | 33 | Y | 48 | Y | 18 | N | -89 | |
| MM2 | 515 | Union | 567 | 0.3 | Y | 0.3 | Y | 0.3 | Y | 0 | N | -100 | Not found |
| MM3 | 515 | Union | 447 | 12 | Y | 8 | Y | 1 | Y | 10 | Y | -17 | Flowering less sparsely here |
| MM4 | 515 | Union | 225 | 45 | Y | 23 | Y | 11 | Y | 2 | N | -96 | |
| PPR | 008* | Clinton | 612 | 135 | Y | 98 | Y | 70 | Y | 10 | N | -93 | |
| PR | 009 | Clinton | 736 | 309 | Y | 216 | Y | 259 | Y | 15 | N | -95 | |
| RCB | 001 | Clinton | 122,000 | 4 | Y | 4 | Y | 4 | Y | ? | - | - | Access issues |
| RR | 005 | Clinton | 425 | 65 | Y | 42 | Y | 38 | Y | ? | - | - | Access issues |
| SCE | 007 | Clinton | 541 | 96 | Y | 39 | Y | 35 | Y | ? | - | - | Could not relocate pond |
| SCW | 007 | Clinton | 286 | 286 | Y | 81 | Y | 70 | Y | 6 | N | -98 | |
| SOB | 010* | Centre | 390 | 45 | Y | 29 | Y | 52 | Y | 24 | Y | -21 | Flowering sparsely |
| STB | 010 | Centre | 5,000 | 0.3 | Y | 0.3 | Y | 0 | Y | ? | - | - | Access issues |
| WFT | 006 | Clinton | 357 | 137 | Y | 50 | Y | 52 | Y | 2 | N | -99 | |

* In 1998, these ponds were not officially numbered by PNDI as such, but are close to this element occurrence.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Scirpus ancistrochaetus was first described as a species by A.E. Schuyler in 1962. This leafy bulrush is in the sedge family (Cyperaceae), and is characterized by narrow leaves and a drooping flower head with chocolate-brown florets. There have been no changes to the taxonomy and nomenclature of the northeastern bulrush.



Photo credit: The Nature Conservancy

2.3.1.5 Spatial distribution, trends in spatial distribution, and/or historic range:

The northeastern bulrush occurs in Maryland, Massachusetts, New Hampshire, Pennsylvania, Vermont, Virginia, and West Virginia, and is historically known from New York (Figure 1). Based on the distribution of the northeastern bulrush in Pennsylvania and Vermont, the lack of documented extant occurrences in New York probably reflects a lack of surveys rather than a true break in the species distribution. It is likely that suitable habitat occurs in New York and that surveys would reveal the species' presence there, possibly in several different counties.

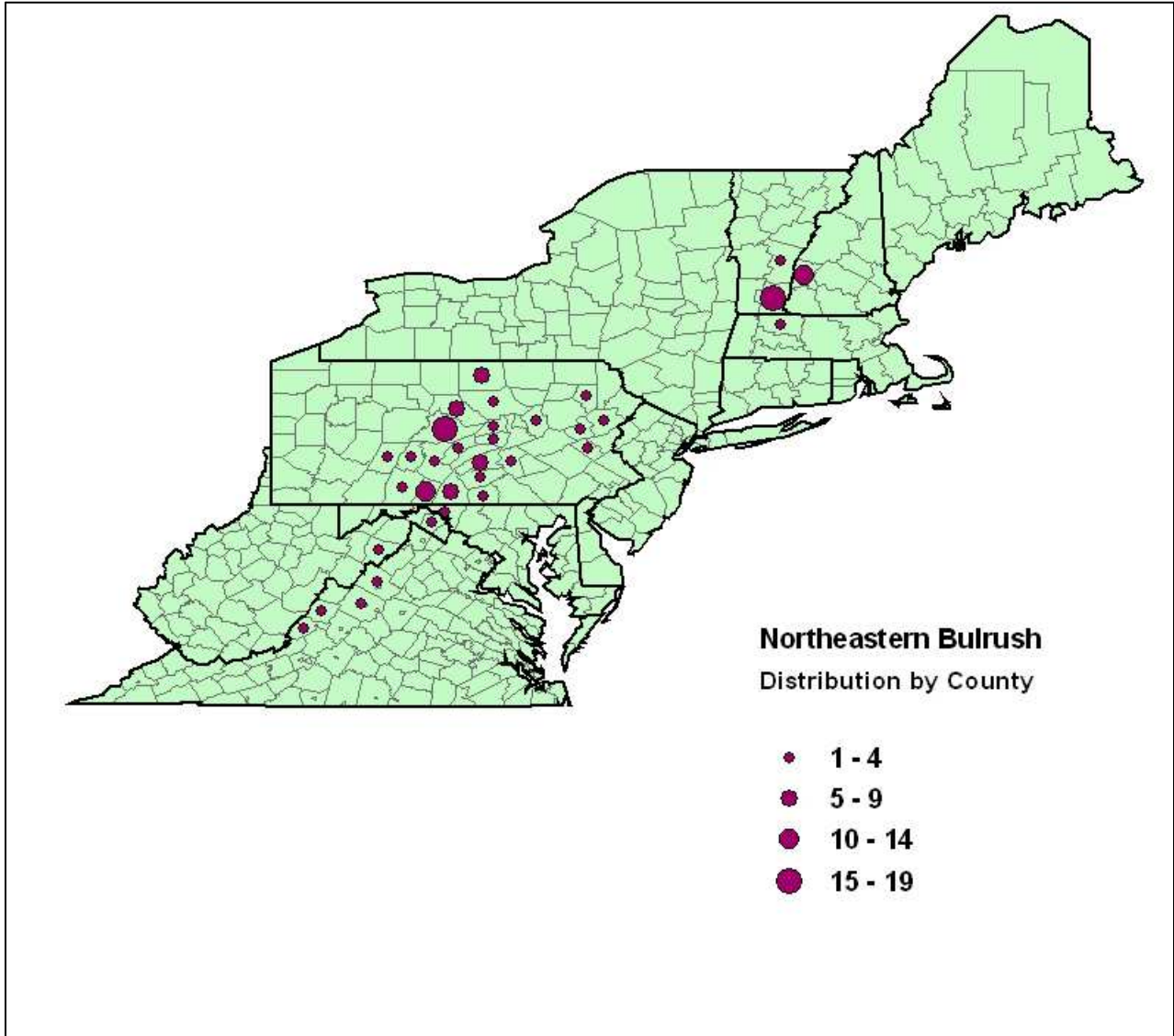
In Virginia, West Virginia, Maryland, and Pennsylvania, the species' range was limited to the Ridge and Valley Physiographic Province. However, in 2002, a large population was found in Tioga County, Pennsylvania, in the Appalachian Plateaus Province, well outside the previously known range of the species. Since then, five additional populations have been found in Tioga County. This increases the likelihood that additional populations will be found in Pennsylvania and, probably, New York.

Although additional northeastern bulrush occurrences may be found anywhere in the species' range, Massachusetts, Vermont, Virginia, and West Virginia estimate their inventories for this species to be at least 75 percent complete. On the other hand, Maryland estimates its inventories for this species are less than 50 percent complete (Comer *et al.* 2005). Based on the distribution and availability of habitat, the largest number of previously undocumented occurrences is likely to appear in Pennsylvania and New York.

2.3.1.6 Habitat or ecosystem conditions: The northeastern bulrush typically grows in palustrine emergent wetlands or vernal ponds surrounded by woodlands. These ponds typically experience a mid-summer drawdown, depending on annual precipitation quantities. This species is commonly found on mountain benches where water collects at a common drainage point.

The re-growth and re-generation of forests in some areas of the northeast and mid-Atlantic region, particularly on state-owned lands, may result in increased shading of northeastern bulrush populations. This is likely to be accompanied by a drying of the wetlands in which the species is found due to increased evapo-transpiration from

Figure 2. Distribution and abundance of extant northeastern bulrush occurrences



maturing trees ringing the perimeter of wetlands supporting the species. As a result, a wetland influenced by substantial canopy closure could have weaker bulrush populations, both due to shading and changes in wetland hydrology. Anecdotal observations suggest that shading is a concern with respect to the decline of several populations in Pennsylvania (K. Cipollini, pers. comm.). In some cases, it may be helpful to manage the habitat surrounding these sites by selectively removing larger trees to reduce canopy cover and allow for increased light infiltration. In areas where this is done to manage the

species, population monitoring is strongly recommended before and after treatments to assess the effects of tree thinning as a management tool.

2.3.2 Five-factor analysis:

2.3.2.1 Factor A. Present or threatened destruction, modification, or curtailment of the species' habitat or range:

Habitat destruction and degradation continues to be a threat to this species.

Approximately half of the northeastern bulrush populations occur on publicly owned land (Figure 2) – primarily Federal or State lands subject to multiple uses, including timber production, oil and gas leasing, and recreation. Threats to these populations include habitat destruction or degradation due to logging operations, oil and gas development, road construction, and off-trail vehicle use. Threat levels on public land are probably less than they were at the time of listing due to the awareness of land managers and use of screening procedures prior to undertaking projects involving earth disturbance.

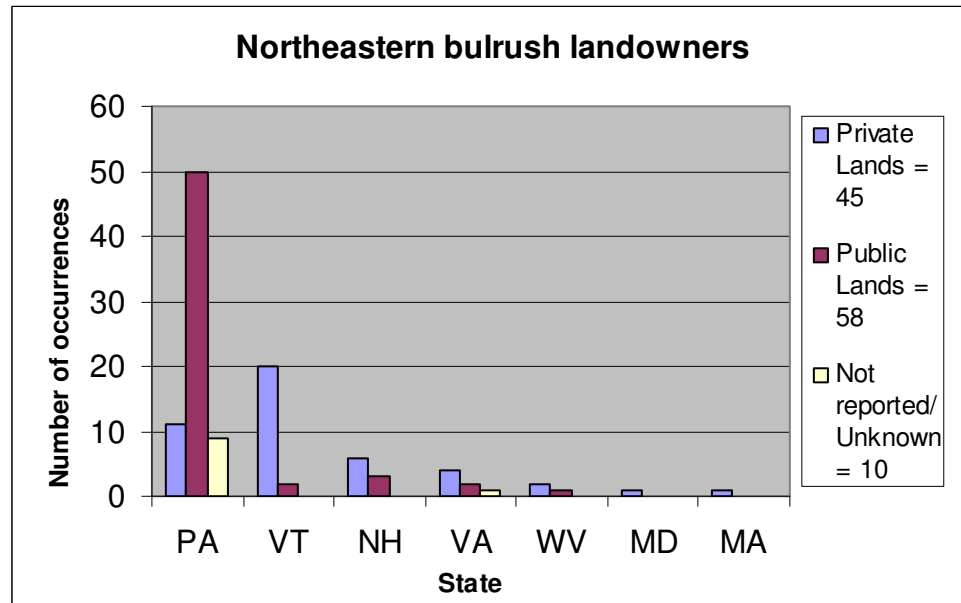
The other populations occur on privately-owned land, where threats include residential and commercial development, road construction, logging operations, agricultural activities, pipeline and power line maintenance, and off-trail vehicle use. These populations could be affected by activities occurring in or adjacent to wetland habitats. Additionally, because habitat may be seasonally dry, it may not be obvious that a wetland is present. Only one site on private land receives protection via a conservation easement. Threat levels on private land are estimated to be the same or greater than threat levels at the time the species was listed.

2.3.2.2 Factor B. Overutilization for commercial, recreational, scientific or educational purposes: Overutilization does not appear to be a factor in the species' decline or a continuing threat to this species. Few collections of this species have been documented since its listing. This could be because the northeastern bulrush lacks easily distinguishable characteristics from other non-endangered *Scirpus* species and, therefore, is not valued as highly. Because the northeastern bulrush is not showy, and has no known medicinal or market value, the species is not threatened by over-utilization.

2.3.2.3 Factor C. Disease or predation: Most threats to extant occurrences of northeastern bulrush are anthropogenic; however, it is now known that browsing by deer could be a factor in the species' decline.

Deer browsing/trampling has become an increasingly notable problem. Deer browsing was documented at a few sites (6) in Pennsylvania and, based on field experiments, clipping plants to simulate white-tailed deer grazing in 0 and 30 percent shading led to a taller plant with less biomass (Lentz and Cipollini 1998). Herbivory can adversely affect plant fitness, and future herbivory of this species could result in a population decline, especially at locations where the species population is already threatened.

Figure 3. Ownership of northeastern bulrush sites



In 2006, Lentz conducted follow-up surveys at 17 *Scirpus ancistrochaetus* ponds in Pennsylvania. Between the time of the first surveys in 1995 and those in 2006, she observed that bulrush populations at nine of 11 ponds had declined significantly and noted that the decline may have been due, at least in part, to deer browsing and trampling (K. Cippolini, pers. comm.). Although plants vary in their ability to compensate for herbivore damage, even moderate levels of damage have been shown to reduce plant growth and fitness (Rosenthal and Kotanen 1994). The threat of herbivory appears to have increased over the past 10 years, perhaps due to relatively high deer densities.

Disease has not been documented as a factor in the decline of the species. However, the northeastern bulrush often hybridizes with *Scirpus atrovirens*, which may occur in or immediately adjacent to habitat occupied by the northeastern bulrush. This hybrid is highly sterile (Schuyler 1963) leaving it weaker and more susceptible to disease.

2.3.2.4 Factor D. Inadequacy of existing regulatory mechanisms: The inadequacy of existing regulatory mechanisms continues to pose a threat to the northeastern bulrush, although most states provide for a small upland buffer around wetland sites and screen projects for the presence of endangered and threatened species. As discussed below, some activities are not screened, leaving these populations vulnerable to disturbance. Following is a list of states and their current laws and regulations regarding wetlands and buffers.

Maryland. Under Maryland's endangered species regulations, *Scirpus ancistrochaetus* is listed as endangered. Protection is afforded only to the habitat, not the plants. Under the State's Wetland Protection Act, about 200 wetlands identified as Wetlands of Special State Concern (WSSC) are legally protected. If State or federally listed species are present, a wetland must be designated a WSSC. All WSSC are regulated by Maryland's Department of the Environment and are protected by a 100-foot buffer. Although this buffer prevents most development impacts, there may be some allowances for "unavoidable" impacts such as placement of stormwater devices.

Under the Critical Area Law, all known locations of State and federally listed species are considered to be Habitat Protection Areas (HPAs). These HPAs are given various forms of protection as circumstances differ (nature of activity, underlying zoning, local ordinances, etc.), and buffers are not delineated in advance.

Massachusetts. Under the Massachusetts Endangered Species Act (MESA chapter 131 A), *Scirpus ancistrochaetus* is listed as State endangered. It is protected from take unless a permit has been issued by the Director of Fisheries and Wildlife. MESA offers protection to all State-listed endangered, threatened and special concern species, whether or not they occur on public or private lands.

Buffer zones are defined as 100 feet, and projects proposed within this area must be reviewed; however, this does not mean that work cannot occur, since individual town bylaws vary with regard to the limits of "Do Not Disturb" restrictions within the 100-foot buffer area. In addition, plants are not necessarily protected by the State's Wetland Protection Act. Currently, wetland plant species, including *Scirpus ancistrochaetus*, are given a 61-meter (ca. 200 feet) buffer around their "species habitat polygons" (*i.e.*, 61m is added to what is interpreted as the "species habitat polygon"). This establishes the "Species Regulatory Polygon" used to trigger environmental review under current regulations. Most agricultural practices, including crop production and mowing, are not reviewed by regulatory agencies. Other exemptions also exist. Only larger timber removal projects are reviewed against the Species Regulatory Polygons. Both the MESA and its regulations can be found at www.nhesp.org.

New Hampshire. *Scirpus ancistrochaetus* is listed as threatened in New Hampshire. The State Wetlands Board (Department of Environmental Services) requires review of all wetlands applications for the presence of threatened or endangered species. Steps to protect existing populations may then be recommended or required as a condition in a wetlands permit, although only certain types of wetlands require upland buffers. Additionally, individual towns can designate "prime wetlands" and these most often include a buffer in adjacent uplands. Prime wetland buffers will vary from town to town; there is no set established standard.

In general, non-regulated activities in New Hampshire that might occur in northeastern bulrush wetlands include: (1) Repair or reconstruction of certain existing legal structures; (2) mowing or cutting of vegetation in some wetlands, subject to conditions to minimize

surface disturbance; (3) culvert installation in limited flow situations; and (4) removal of beaver dams, subject to certain conditions.

New York. In New York, the northeastern bulrush is listed as State endangered. Wetlands containing threatened and endangered species are ranked as “Class 1” wetlands, which receive more stringent standards for permits. New York also regulates a 100-foot upland buffer around all wetlands (with or without threatened and endangered species).

Regulated activities in New York include: (1) Filling, including filling for agricultural purposes; (2) draining and altering water levels, except as part of an agricultural activity; (3) removing or breaching beaver dams; (4) clear-cutting trees and other wetland vegetation; (5) grading, dredging, or mining; constructing roads; (6) drilling a water well to serve an individual residence; (7) installing docks, piers, or wharfs; (8) constructing bulkheads, dikes, or dams; (9) constructing a residence or related structures or facilities; (10) constructing commercial or industrial facilities, public buildings, or related structures; installing utility services; and (11) applying pesticides

Pennsylvania. In Pennsylvania, the northeastern bulrush is listed as State endangered under the Wild Resources Conservation Act (25 Pa. Code, Chapter 82). Permits are required to collect, remove, or transplant wild plants classified as threatened or endangered; however, private landowners are exempt from these requirements.

Wetlands supporting threatened and endangered species are considered "exceptional value" wetlands under the State's wetland permitting regulations. As such, there are more stringent requirements to receive a permit to encroach into the wetland. Only encroachments for safety purposes would be considered for permitting. No upland buffers around any wetlands are regulated or protected at the State level.

Additionally, in Pennsylvania, most agricultural (crop production, tilling) and timber harvest practices are not reviewed under State wetland regulations, unless fill in the wetland is proposed (*e.g.*, for a road crossing) and a permit is sought. Upland activities that do not involve a wetland encroachment, including residential and commercial development, are typically not reviewed or regulated under State wetland laws, although some type of storm-water permit and/or earth disturbance permit may be necessary, in addition to complying with local municipal zoning requirements. Consequently, a review for endangered and threatened species is typically not done for these upland activities.

Vermont. In Vermont, the northeastern bulrush is listed as State endangered. If the listed plant occurs in a significant wetland, no additional protection is mandated. However, if the listed plant were to occur in a wetland not previously designated as significant, the presence of the plant would raise that wetland's status to significant. If a wetland is deemed significant, only certain allowed uses may occur in that wetland; all other uses would require a conditional use permit. Wetlands in Vermont receive a 50-foot buffer if they contain endangered or threatened species, and are considered significant.

Allowed uses that are exempt from review and conditional use permits, even in significant wetlands, include: (1) Silvicultural activities that comply with a plan approved by the Commissioner of Forest and Parks; agricultural activities if threatened or endangered species are protected; (2) routine repair and maintenance of existing structures; (3) recreational activities; (4) fish and wildlife management including removal of beaver dams which pose a hazard to public safety, or public or private property; (5) operation of existing hydroelectric facilities which many involve dredging, draining or altering flow; routine repair and maintenance of utility poles; (6) emergency repair of structures & facilities including roads, docks, piers, buildings, etc.; (7) routine maintenance of manmade ponds (< 2 ac.) including dredging, temporary draining, altering the flow of water; (8) control of non-native nuisance plants by hand pulling; and (9) the operation of dams provided there is no undue adverse effect on protected wetland functions (this use may involve draining or altering the flow of water). These allowed uses may occur only if the configuration of the wetland's outlet, or the flow of water into or out of the wetlands, is not altered, and no draining, dredging, filling, or grading occurs.

Virginia. In Virginia, the northeastern bulrush is listed as State endangered; however, no additional protection (*e.g.*, buffers) is afforded to wetlands supporting the species. No upland buffers are regulated or protected around any wetlands in the State. The northeastern bulrush is protected under the Endangered Plant and Insect Species Act of 1979, which prohibits take without a permit, but individual landowners are exempt from these permitting requirements.

West Virginia. The northeastern bulrush has no official status in West Virginia, and this State does not have an endangered species law. No upland buffers are regulated or protected around any wetlands in the State.

Threats to this species due to the inadequacy of existing regulatory mechanisms seem to have been reduced slightly since the recovery plan was published. Three additional States have regulated buffers around wetlands containing endangered species, and most States have screening procedures in place to identify threats to the northeastern bulrush, but typically only when wetland encroachment is proposed. The species continues to be vulnerable to projects that proceed without environmental review (*e.g.*, timber harvest) or take place immediately adjacent to occupied wetlands (*e.g.*, development, road construction, timber harvest).

2.3.2.5 Factor E: Other natural or manmade factors affecting its continued existence: The northeastern bulrush and its habitat are susceptible to floods, droughts, and general water table fluctuation. However, beaver activity may have the greatest effect on the hydrology of wetlands occupied by this species. For example, beaver-influenced hydrology has been documented at four of the nine sites in New Hampshire, and at 14 of the 22 northeastern bulrush sites in Vermont. It is known that small differences in water depth affect plant height, leaf life span, and root to shoot mass in *Scirpus ancistrochaetus* (Lentz and Dunson 1998). Specifically, studies suggest a decrease in lifespan in response to increased water level. However, it is still uncertain

whether beavers have a beneficial or negative overall impact on northeastern bulrush habitat.

Additionally, there are many small populations of this species that are vulnerable to natural, genetic, and human threats. Small, isolated populations also carry a high probability of extinction due to geographic distance, ecological factors/reproductive strategy, which may limit introduction of new genetic material. This can result in a highly inbred population with low viability and/or fecundity (Chesser 1983).

As discussed under habitat and ecosystem conditions, the species may also be threatened by shading and changes in hydrology resulting from maturing and encroaching forests immediately surrounding bulrush sites.

2.4 Synthesis

Additional surveys have led to the discovery of many previously undocumented populations of the northeastern bulrush since 1991. There are now 80 more populations known to exist than at the time the species was federally listed. For populations of known status, approximately half appear to be stable or increasing, while half are declining. Overall, the increase in documented populations suggests the species' status has significantly improved. However, declines at several sites suggest the need for management. Furthermore, long-term population monitoring is needed to better understand the species' habitat requirements and the degree to which populations fluctuate in response to environmental factors, such as light, hydrology and herbivory.

Approximately half of the extant populations are on public lands, where threats are significantly less acute than on private lands. On private lands, there is only minimal regulatory protection from direct or indirect threats. Of the eight range States, only five require a 50-100 foot buffer around wetlands containing threatened or endangered species, and one of these States is New York, which currently has only a single historic occurrence. Moreover, Pennsylvania, the State with the largest number of bulrush occurrences, does not have any wetland buffer requirements. Additional buffer protection through changes in State laws and regulations would promote recovery of this species.

Given the improved population status of the northeastern bulrush combined with continuing range-wide threats and uncertainties about the species' response to environmental factors, we conclude that the species' meets the ESA definition of threatened, that is, this species is likely to become endangered in the foreseeable future (in the absence of additional protection from threats) throughout all or a significant portion of its range.

3.0 RESULTS

3.1 Recommended Classification

Reclassify from endangered to threatened.

Rationale: Data that have become available since the 1993 Recovery Plan indicate that the number of extant populations is three times greater than when the species was listed, and approximately half of all known populations are on public lands, where threats are manageable. Furthermore, approximately half of the extant populations appear to be stable or increasing, suggesting that the species is not likely to become extinct in the foreseeable future.

3.2 Recommended Recovery Priority Number

Retain the recovery priority number of 14.

Rationale: The northeastern bulrush is facing a low degree of threat, has high recovery potential, and is taxonomically a species. A high degree of conflict with respect to proposed development activities has not occurred, probably due to the presence of many sites on State-owned lands rather than privately-owned lands. Based on these factors, a recovery priority number of 14 is appropriate.

3.3 Appropriate Listing/Reclassification Priority Number

A reclassification priority number of 6 is recommended.

Rationale: This priority number indicates an unpetitioned listing action that would have a low management impact, meaning that downlisting of the northeastern bulrush would provide little management relief relative to its current status as endangered. Although some ESA regulatory protection would be lifted due to the northeastern bulrush being a plant species, this could result in the need for more proactive conservation, thereby offsetting the goal of relieving a management burden.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

At this time, the highest priority actions are to: (1) Re-survey populations that have not been recently assessed (within the past 5 years), (2) secure protection for sites on public and private land, (3) conduct periodic surveys of a representative sample of northeastern bulrush populations to determine trends and threats, and (4) implement management tools to reduce threats and monitor the effectiveness of these recovery actions. The duration of any long-term monitoring studies be based on the need to capture natural fluctuations in populations due to precipitation, shading, herbivory, and other environmental factors.

There is also a significant need for additional protections for this species. Since it is now known that over half of the extant populations occur on public lands, establishing management and habitat protection agreements with State and Federal agencies would secure the permanent protection of this species on those lands. Also, partnering with non-governmental organizations, such as the Fall Mountain project in New Hampshire, can lead to additional protection of the species. These partnerships could help reach a recovery objective of long-range protection for 20 populations.

Surveys of appropriate habitat (*e.g.*, characteristic vernal pools) should be conducted in New York. As previously discussed, the lack of documented occurrences in New York probably reflects a lack of surveys rather than a true break in the species' range. Finding more extant occurrences of this species would assist in securing its eventual recovery, especially if these populations receive permanent

protection. Additionally, if the species were to be found in New York, its habitat would include a 100-foot buffer, since that State mandates buffers around all wetlands.

Another recovery objective listed in the Recovery Plan is to better understand the life history and ecological requirements of this species, so it can be better protected, monitored and managed. There is a need for better understanding of the role genetic variation between populations, herbivory, shading, and seed bank formation, among other things, and funding for these studies would facilitate species recovery.

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U.S. FISH AND WILDLIFE SERVICE

5-Year Review of Northeastern Bulrush (*Scirpus ancistrochaetus*)

Current classification: Endangered

Recommended classification resulting from the 5-Year Review: Threatened

Recommended Recovery Priority Number: 14

Appropriate Reclassification Priority Number: 6

Review conducted by: Pamela Shellenberger and Carole Copeyon, Pennsylvania Field Office

LEAD FIELD OFFICE APPROVAL:

Approve Cindy Tebbott Date 9-17-09
Field Supervisor, Pennsylvania Field Office, U.S. Fish and Wildlife Service

REGIONAL OFFICE APPROVAL:

Approve [Signature] Date 9/24/09
Regional Director, Region 5, U.S. Fish and Wildlife Service

Acting

Appendix 1

ELEMENT OCCURRENCE – RANK DEFINITIONS

A: Excellent occurrence. Merits quick, strong protection.

Community requirements:

1. Nearly undisturbed by humans or has nearly recovered from early human disturbance
2. Extensive, well buffered, etc. occurrence

Plant/Animal Requirements:

1. Large in area and number of individuals
2. Stable population (if not growing), and/or shows good reproduction
3. exists in a natural habitat

B: Good Occurrence. Protection of the occurrence is important to the survival of the element, especially if very few or no A-ranked occurrences exist.

Community requirements

1. Still recovering from early or recent light disturbance
 2. Will reach A-rank requirements
- OR
3. Nearly undisturbed or nearly recovered from disturbance
 4. Less than A-ranked: significantly smaller size, poorer buffers, etc.

Plant/Animal Requirements:

1. At least stable
2. In minimally disturbed habitat
3. Moderate size and number

C: Fair Occurrence. Protection of the occurrence helps conserve the diversity of a region's of county's biota, and is important to state-wide conservation if no higher-ranked occurrence exists.

Community Requirements

1. In an Early stage of recovery from disturbance
- OR
2. Structure and composition have been altered such that the original vegetation will never rejuvenate, yet with management and time, partial restoration of the community is possible

Plant/Animal Requirements:

1. In a clearly disturbed habitat
2. Small in size and/or number, and possibly declining

D: Poor Occurrence. Protection of the occurrence may be worthwhile for historical reasons or only if no higher ranked occurrence exists.

Community Requirements:

1. Severely disturbed: structure and composition has been greatly altered
2. No chance of recovery to original conditions, despite management and time

Plant/Animal Requirements:

1. Very small
2. High Likelihood of dying out or being destroyed
3. Exists in a highly disturbed and vulnerable habitat

E: Extant Occurrence

Verified as extant, but has not been given a more specific rank

F: Failed Occurrence

1. Habitat still exists for the element
2. Reasonably intensive field searches by a qualified person at the right time of year have failed to locate the occurrence

H: Historical

No recent field information

O: Obscure

1. Not found at the site reported from, but not thoroughly searched for
2. More searching needed

X: Extirpated from site

1. Not located by repeated reasonably intensive field searches
2. Habitat significantly altered and no longer suitable for maintenance of the element

Appendix 2

NORTHEASTERN BULRUSH OCCURRENCE DATA

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|------------|--------|----------------|----------|-------------|--|---|-------------|------------|----------|
| MA | Franklin | 1 | CD | 2005 | 2005 | A small, shallow pond in a bowl like depression surrounded by forest with a dense understory. Pond water levels fluctuate considerably often exposing an organic silt. Dense cutgrass occupies exposed mudflats. | 2005: 9 genets; Total of 24 culms occupying ca. 20 sq. meters. 2003: 3 mature plants; total of 17 fertile culms; 1 plant with poor vigor and possibly diseased. Not observed every year, but the site record goes back to 1928. The population numbers have fluctuated but are always relatively low, and in some years may be zero due to high water or other factors. Nevertheless, it has reappeared later at the site. One might have to declare it stable, but the extremely low numbers leave this open to doubt. | S | Private | |
| MD | Washington | 1 | C | 1990 | 1990 | 0.2 acre limestone sinkhole pond in a field | ~ 100 stems in a 3 X 3 meter patch. Flowering, fruiting, and with nodal shoots. | U | Private | |
| NH | Sullivan | 1 | A | 2005 | 2005 | Plants growing on east side of inlet near edge of open water. | 2005: 1 patch with 117 fruiting culms, ca. 40 vegetative plants. 1996: 3 patches, 389 fruiting culms. 1995: 3 patches, 427 fruiting culms. 1994: 2 patches, 504 fruiting culms | D | State | |
| NH | Sullivan | 2 | C | 1996 | 2005 | 2005: Water levels high. An emergent bench in beaver flowage. Flat aspect in partial light on upper-slope. In inundated habitat. | 2005: search conducted; no plants observed. 1996: 2 fruiting culms in a brief visit. Plants found were stressed: yellowish, with small inflorescences. 1994: 11-50 ramets, 3 genets | D | State | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|----------|--------|----------------|----------|-------------|--|---|-------------|------------|----------|
| NH | Sullivan | 3 | B | 1998 | 1998 | Beaver flowage in headwater wetland basin. Flat area with open light on mid-slope. In inundated habitat. | 1998: 96 fruiting culms in ca. 6 patches (1+ clumps per patch). 1994: 23 ramets, 8 genets covering 5-10 square yards of population area. 20 in leaf, 23 with mature fruit, 40% immature, 60% mature. Of normal vigor. | U | Private | |
| NH | Sullivan | 4 | C | 1994 | 2005 | 2005: Wetland very dry. Sedge-graminoid wetland. Little open water: 1 m wide outlet bordered by vegetation. | 2005: Searched entire wetland, no plants observed. 1998: No plants observed. 1994: 1 fruiting culm, 5 vegetative culms. 1993: 7 fruiting stems, 22 foliose shoots. 1992: 18 fruiting stems. | D | State | |
| NH | Sullivan | 5 | A | 1997 | 1996 | Headwater beaver pond, drained and completely vegetated. Soils are predominantly saturated to 5 or 6" deep in water/muck. Dominated by tall herbs. | 1997: Abundant fruiting culms. 1996: Estimated 1,530 fruiting culms and 135 genets (tussocks) within a 306-square meter area based on permanent plot sampling. 1993: over 250 fruiting stems and ca. 400 foliose shoots in 0.5-acre area. | U | Private | |
| NH | Sullivan | 6 | B | 1997 | 1996 | Beaver pond three-quarters filled in with mixed herbaceous and graminoid meadows. Low shrubs dominate the edges and become more interspersed in the north end of the meadow. | 2005: Searched wetland with binoculars, none seen. Water higher than in past. 1997: Abundant fruiting culms. 1996: 389 fruiting culms, 122 genets. 1993: 76 fruiting stems, 49 vegetative shoots. | U | Private | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|-----------------|--------|----------------|----------|-------------|---|--|-------------|--------------|----------|
| NH | Sullivan | 7 | B | 1998 | 2005 | Large wetland with 2 distinct sections divided by a beaver dam. <i>Scirpus ancistrochaetus</i> is in the upper section, consisting of a few acres of open shallow water. | 2005: Scanned through binoculars, possibly some plants present. Water level high. 1998: Abundant fruiting culms, stems upright. 1997: 425 fruiting culms in ca. 79 tussocks. 1994: 134 fruiting culms in 10 clumps. 1993: 115 fruiting stems. | U | Private | |
| NH | Sullivan | 8 | CD | 2005 | 2005 | Plants at northern edge of small open-water wetland below a beaver pond that is more of a bog, no more than 6-10 inches deep. | 2005: 1 clump with 7 fruiting culms, counted through binoculars. 1997: 2 clumps, one with 44 stems and one with just one stem. 1996: At least 3 clumps. | U | Private | |
| NH | Sullivan | 9 | A | 2005 | 2005 | Wetland has a high diversity of wetland types, including emergent unconsolidated bottom, floating sedge/sphagnum mat, and sedge/shrub flat. Numerous aged, dead tree snags testify to fluctuating water levels in the past. | 2005: >2000 fruiting culms and similar number of vegetative plants, concentrated mostly on floating mat near water's edge, with patches elsewhere throughout wetland. 9 clumps observed, with 2 largest covering extensive areas at northern end of wetland. | U | Private | |
| NY | Washington | ? | X | 1900 | | | | X | Unknown | |
| PA | Adams, Franklin | 528 | D | 1995 | 2008 | Vernal ponds on moderate to gentle slope at base of a very seep SE-facing ridge. Majority of site is combination of bare ground and blueberry scrub. Plants found inundated in partial open lighted vernal pond. | 2008: F rank recommended. 1995: 3 mature, flowering ramets with normal vigor. | F | State (DCNR) | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|---------|--------|----------------|----------|-------------|--|--|-------------|--------------|--------------------------------|
| PA | Bedford | 16 | D | 2008 | 2008 | Open ponds surrounded by shrub meadow | 2008: B rank recommended. 1995: small number of plants; in fruit; in highly altered setting | I | State (DCNR) | |
| PA | Blair | 2 | H | 1865 | | | 1865 - 1 specimen | H | State (PGC) | |
| PA | Blair | 11 | D | 1993 | 1993 | Ombrotrophic basin marsh/shrub swamp | 1993: 20 culms, 3 clumps; feeble vigor; plans in 2 meter square area. | U | Private | Threats: very close to a road. |
| PA | Blair | 542 | E | 2008 | 2008 | Hydric substrate; plants are rooted underwater. Several wetlands present in this saddle: one wet area is diffuse seepage area, to the south there are four more distinctly pond-shaped wetlands. | 2008: CD rank recommended. 2003: ~200-300 stems with normal vigor in each of 2 ponds; half of the culms have mature fruit. | D | State (PGC) | |
| PA | Cambria | 546 | E | 2008 | 2008 | | 2008: CD rank recommended. 2003: EO found in 5 wetlands. | D | State (PGC) | |
| PA | Carbon | 526 | C | 2008 | 2008 | Six vernal ponds. Habitat in well-drained oak-red maple-white pine-serviceberry woods. Ponds are in series following a drainageway downslope. No obvious signs of disturbance or threats. Woods are scrubby suggesting previous logging or fire. | 2008: CD rank recommended. 2004: 35 mature flowering and fruiting clumps with normal vigor. Found in inundated-saturated substrate in 4 ponds in open-partial light. Pond#2: 300 vegetative culms and 60 fruiting culms. Pond #3: 1 fruiting culm. Pond #5: 25 vegetative culms and 25 fruiting culms (many are nipped). Pond #6: 1 clump, 25 vegetative culms and 25 fruiting culms. | D | State (PGC) | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|--------|--------|----------------|----------|-------------|--|---|-------------|-------------|---|
| PA | Centre | 10 | D | 2006 | 2006 | Ombrotrophic basin marsh/shrub swamp. | 2006: 3 ponds with EO surveyed; population area in these ponds has declined by 21, 71, and 94% since 1995. 1995: 1 clump; population small and long-term survival does not seem promising. Plants found in deepest part of wetland. One plant in flower, but flower found toppled. 1994: 1 plant flowering, another with dried flower; 2 nearby clumps observed without flowers. 1992: 17 vegetative culms & 17 fruiting culms in 1 clump over 1-5 sq. yards, 100% mature, normal vigor, fertile culms with fruits and a few prostrate with axillary sprouting. | D | State (PGC) | Threats - deer trampling and browsing; one pond highly disturbed by beaver activity |
| PA | Centre | 12 | D | 2008 | 2008 | Wetland is shrubby; population probably kept small due to light competition. No standing water on 7/31/95. | 2008: CD rank recommended. 1995: unchanged from 1994. One site - Population small but vigorous with many flowering culms, a small amount of asexual bulblets. Other site - 5 clumps; 1 clump in flower, 4 vegetative only. Plants heavily browsed. 1994: 15 ramets observed in a 1-5 sq yd. area, small population, may have been inhibited this season by above-average water levels. | S | State (PGC) | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|--------|--------|----------------|----------|-------------|--|--|-------------|--------------|--|
| PA | Centre | 13 | B | 2008 | 2008 | Wetland; no standing water on 7/31/95. | 2008: C rank recommended. 1995: plants located in 3 areas (3x5 m each). Population appears to be doing well. 1994: approx. 500 ramets observed in a 2-acre area; population appears to be well established and stable; no recent activities on or around pond. | D | State (PGC) | |
| PA | Centre | 14 | D | 1994 | 1994 | | 1994: small population of approx. 5 flowering stems and several non-flowering in a 1-5 sq yd. area. | U | Private | |
| PA | Centre | 15 | BC | 2008 | 2008 | vernal wetlands | 2008: D rank recommended. 1995: one collection from vernal wetlands | D | State (DCNR) | |
| PA | Centre | 20 | E | 2008 | 2008 | depression swamp | 2008: BC rank recommended. 1995: 2 collections, fruits, from depression swamp | S | State (DCNR) | |
| PA | Centre | 21 | E | 1995 | 1995 | depression swamp | 1995: 3 collections, fruits, from depression swamp | U | State (DCNR) | |
| PA | Centre | 22 | E | 1995 | 1995 | vernal wetlands | 1995: 1 collection, fruits, from vernal wetlands. | U | State (DCNR) | |
| PA | Centre | 23 | E | 2008 | 2008 | vernal wetlands | 2008: CD rank recommended. 1995: 1 collection, fruiting | S | State (DCNR) | |
| PA | Centre | 25 | E | 2008 | 2008 | Swampy depression | 2008: C rank recommended. 1995: 1 collection, fruiting | S | State (DCNR) | |
| PA | Centre | 26 | E | 1995 | 1995 | Swampy depression | 1995: 1 collection, fruiting | U | State (DCNR) | |
| PA | Centre | 27 | A | 2000 | 2000 | vernal pond | 2000: observed, fruit specimen collected | U | Private | buffers: 50' no disturbance, 100' limited activity |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|--------|--------|----------------|----------|-------------|---|--|-------------|--------------|----------|
| PA | Centre | 539 | E | 2002 | 2002 | None | None | U | Unknown | |
| PA | Centre | 543 | A | 2008 | 2008 | Sphagnum vernal pool in wooded area near pipeline ROW. Area dominated by forest but there are some large open areas immediately adjacent to the site. | 2008: BC rank recommended. 2002: ~3000 stems, habitat and buffer intact. 1999: somewhat small population in good health; observed 101-1000 plants of normal vigor covering 10-100 sq yds. Plants in leaf and immature fruit. | D | State (DCNR) | |
| PA | Centre | 544 | E | 2008 | 2008 | Vernal pool surrounded by forest; ~30 m radius. Dirt roads leading to gas wells are in the surrounding area. Plants growing in a flat area, elevation of about 1850 m, in open light, saturated (wet mesic) soil. Less than 1 acre of potential habitat for EO. | 2008: BC rank recommended. 2002: estimated 9500 vigorous culms, all in leaf, very few in flower, occupying a circular patch of about 255 sq. meters. ~37 culms per sq. m. This was the dominant vegetation in this vernal pool. Vegetative reproduction likely due to large area of population. | S | State (PGC) | |
| PA | Centre | 545 | E | 2008 | 2008 | Vernal pool surrounded by forest in the broad headwaters plateau. Much of the area is undergoing gas well development. | 2008: D rank recommended. 2002: 1 plant cluster of several culms observed in a 1 sq.yd. area in vernal pool; normal vigor, mature fruit. Growing on a flat area with partial light and in saturated (wet mesic) habitat with sandy mineral soil and some organic accumulations. Multiple culms may indicate vegetative spread has occurred | S | State (DCNR) | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|---------|--------|----------------|----------|-------------|--|--|-------------|--------------|--|
| PA | Clinton | 1 | C | 1995 | 1995 | Gentle depression at source of small drainage; top of broad high plateau, anticlinal, greatly dissected W & E. Area largely forested: acid, oak. Bog-marsh habitat originally with large floating sphagnum-cranberry mat, but recently has been disrupted by beaver flooding and degraded in part. Dead tree ring surrounds. | 1995: 4 separate clumps, 3 clumps at wetland margin; 1 clump 50-75 yds into wetland. Clumps have grown since summer of 1994, each almost doubling in size (each approx. 2x1 meters in size. 1994: 4 separate clumps. | U | State (DCNR) | natural area should be expanded to include all of upper watershed of bog |
| PA | Clinton | 5 | C | 2008 | 2008 | wetland - contained little water on 7/6/95 | 2008: site surveyed; retain C rank. 1995: population appears to be doing well. 1992: small EO in partially disturbed wetland. | S | State (DCNR) | revise management plan for commercial forest |
| PA | Clinton | 6 | C | 2006 | 2006 | Natural pool; dry-mesic hardwood forest; no standing water in wetland on 7/11/95. Habitat: flat (0-3% slope), open light at crest, inundated, potential habitat about 1/8 acre. | 2006: D rank recommended. 99% decline in population area since 1995 survey (now covers 2 sq m area). 1995: large stand in 10.5 x 13 m area. Population appears unchanged form 1994. 1994: Population appears to be doing fine. Plants in seed and species is dominant vegetation in the wetland, occupying approx. 10 x 10 m area. 1992: estimated 51-100 ramets, several Scirpus species intermixed. Normal vigor, possible insect damage to inflorescences, prolific sprouting from stems. | D | Private | work with owner to protect wetland hydrology and general disturbance |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|---------|--------|----------------|----------|-------------|---|--|-------------|--------------|---|
| PA | Clinton | 7 | B | 2006 | 2006 | 1995: Wetland dry except for 2 bear wallows on 7/17; contained 10-20 cm water on 7/20 after heavy rain. Natural pond within dry-mesic hardwood forest. | 2006: D rank recommended. 98% decline in population area since 1995 survey (now covers 6 sq m). 1995: Plants in center of wetland in floating mat of organic matter in 11.5 X 8.5 m area. 1994: EO dominates wetland, occupies center of wetland in area approx. 7 X 10 m; most plants in flower with some immature seeds. 1992: est. 101-1000 ramets over 5-10 sq. yds (small pool), 50% in fruit; vigorous vigor, possible insect damage of inflorescence; profuse sprouting. Potential habitat 0.25 acre. | D | State (DCNR) | assess commercial forest management regarding protection of EO and wetlands hydrology |
| PA | Clinton | 8 | C | 2006 | 2006 | Swampy headwaters area with numerous pools scattered along low gradient drainage. Partial canopy in most spots; 2 well established pools with sedges and grasses. | 2006: D rank recommended. 93% decline in population area since 1995 survey. 1995: pop unchanged from 1994. 1994: site dominated by EO; occupies approx 10 x 8 m area. 1992: 11-50 ramets over 1-5 sq yds. | D | State (DCNR) | revise management plan for commercial forest |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|----------|--------|----------------|----------|-------------|--|---|-------------|--------------|---|
| PA | Clinton | 9 | C | 2006 | 2006 | emergent marsh (in dry-mesic central forest); no standing water in wetland on 8/1/95 | 2006: CD rank recommended. 95% decline in population area since 1995 survey. 1995: Two areas (21 X 13 m and 4.5 X 8 m). Pop is half the size of 1994 pop., possibly from aphid infestation seen in 1994. 1994: EO is dominant, occupies 13 X 17 M area; flowering and non-flowering plants, seeds appeared mature but not dispersing. 1992: ~101-1000 ramets (1-10 genets) over 1-5 sq yds in mature fruit and seed dispersing, vigorous vigor, with culms separate from main colony; plants appear to be using most of available habitat. Potential habitat 0.25 acre. | D | State (DCNR) | revise commercial forest and road maintenance plans to protect EO |
| PA | Clinton | 18 | E | 2008 | 2008 | wetland | 2008: D rank recommended. 1995: Pop. occupies almost the entire 22 X 13M wetland; one of the most vigorous wetlands observed. Appears unchanged from previous year; flowering and asexual production heavy. No standing water on 6/19. | D | State (DCNR) | |
| PA | Columbia | 537 | BC | 2003 | 2003 | Small woodland pond on mid-slope with SE aspect; pond shallow with mucky/organic base; probably a fluctuating water level; dominated by graminoid vegetation; perimeter of shrubs and small trees; open light. | 2003: about 60 fruiting stems in 2 main patches; additional vegetative stems probably present but are tough to identify with certainty. Phenology: In leaf, flower and immature and mature fruit. Vigor: Normal. | U | Private | no threats evident |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|------------|--------|----------------|----------|-------------|---|--|-------------|--------------|---|
| PA | Cumberland | 513 | B | 2008 | 2008 | Small vernal pond (1000 sq meters) with surrounding shrub swamp or forest. Some disturbance (weeds) on edge. Site on lower NW-facing slope of mountain. | 1990: specimen collected. 1992: 2600 mature ramets with vigorous growth; found in inundated-saturated, organic/very stone loam soil in open light. 1997: 1000-10,000 mature culms in leaf; growing exceptionally vigorously over 1000 sq m. 2008: BC rank recommended. | D | State (DCNR) | threats: deer browsing, trampling, tree falls |
| PA | Cumberland | 514 | BC | 1997 | 1997 | Small woodland pond (100 x 30 yards), surrounded by oak-heath forest except at northern end where woods thin out and house is situated. Located on lower north slope of mountain. | 1992: 150 fruiting culms and 500 vegetative culms, all mature with normal vigor; on flat, open lighted area in inundated, organic soil. 1997: 100 clumps with 10% having mature fruit; growing vigorously on 60 sq m in fluctuating vernal pond. | U | Private | |
| PA | Cumberland | 519 | C | 1992 | 1992 | Natural, shallow woodland pond on lower slope of mountain; pond has herbaceous and woody vegetation and a few very small pockets of standing water. | 1992: ~1000-1500 culms; plants in flower and immature fruit; normal growth; soil inundated-saturated; water level about 6"; full sun. | U | Unknown | |
| PA | Dauphin | 510 | CD | 2008 | 2008 | Site is one of a series of small, shallow vernal pools on the flat summit of mountain. Surrounding land is oak-heath forest. Pool has graminoid vegetation and no standing water at present, but basin is damp and spongy despite the extremely dry summer. | 2008: D rank recommended. 1991: over 15 mature and fruit dispersing plants of normal vigor in small woodland pool; site receives a lot of sun; soil has very thick clay layer and is probably poorly drained. | D | State (PGC) | Some evidence of previous logging in vicinity. Possible threats: deer browse, man-made changes in water regime. |

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|-------|----------|--------|----------------|----------|-------------|--|--|-------------|--------------|---|
| PA | Dauphin | 517 | B | 2008 | 2008 | Shallow woodland ponds on summit of mountain | 2008: A rank recommended. 1992: several thousand culms; plants in fruit; asexual reproduction evident; site in full sun and inundated organic soil; water level currently one foot but probably fluctuates. 1997: original pop. appears unchanged; 4 separate subpopulations were discovered in nearby ponds, which are smaller with less suitable habitat. One pond is in a disturbed area. | I | State (PGC) | |
| PA | Dauphin | 524 | B | 1994 | 1994 | Large wetland at N-facing base of mountain. A variety of plant communities are present, including wet woods, herbaceous-dominant openings, and small sphagnum areas. | 1994: over 1000 mature, fruiting culms with normal vigor; found inundated in open-partial light in mixed herb/shrub/tree wetland. | U | Unknown | potential threats: beaver activity |
| PA | Franklin | 511 | CD | 2008 | 2008 | Numerous ephemeral-fluctuating pools located on gentle W-facing low slope; surrounding well-drained, sandy, acid woods; 2 ponds with <i>S. ancistrochaetus</i> . | 2008: site surveyed; retain CD rank. 1992: 300 ramets (including ~60 fruiting culms) possibly representing a single genet; normal vigor; found in inundated-saturated soil; open-partial light; extremely stony, sandy loam. 1996: ~150 fertile & 150 vegetative culms of normal vigor in leaf, bud, flower and immature fruit. Found in small additional pond S of previous pop; similar flora as other pond. | S | State (DCNR) | 1992: occurrence has been degraded by clearcutting in the surrounding area. |

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|-------|----------|--------|----------------|----------|-------------|---|---|-------------|--------------|--|
| PA | Franklin | 512 | AB | 1992 | 1992 | 5 vernal ponds (ombrotrophic basin marshes/shrub swamps) located on lower W slope of mountain in headwaters; surrounded by oak-heath woodland. | 1992: approx. 4000 culms in 2 ponds (mostly pond #1); growth vigorous; plants in flower and mature fruit; sexual and asexual reproduction present; found in chiefly full sun; soil inundated/saturated, organic/sandy loam. | U | Private | 1992: Threats: jeep lanes, deer paths, selective cutting, bulldozing brush by owners near pond; increasing residences in forest. |
| PA | Franklin | 518 | D | 1992 | 1992 | Site includes 4 ponds with EO. Site is an archipelago of 34 ombrotrophic basin wetlands in dry-mesic acidic central forest. | 1992: 135 culms in 4 ponds; generally in full sun; inundated/saturated organic and gravelly loam soil. | U | Private | 1992: ponds formerly surrounded by forest, but clearcutting has occurred recently and may be damaging to the EO in the future. |
| PA | Franklin | 533 | BC | 2006 | 2006 | Two woodland openings of a vernal pond-type habitat located in headwaters; large opening had some standing water; small opening had none. Beds of both ponds are organic material and dried sphagnum. | 2006: B rank recommended. 1997: 1200 mature culms of normal vigor in leaf, flower and with immature fruit; habitat is hydric; open light. | I | State (DCNR) | signs of deer browsing |
| PA | Franklin | 534 | BC | 2008 | 2008 | Vernal pond complex (9 ponds) along waterway. Ponds lack a dense woody perimeter. | 2008: CD rank recommended. 2000: ~215 fertile stem clumps & ~80 vegetative clumps; appears to be thriving and reproducing; shedding fruits; found in the wettest part of the pond. | D | State (PGC) | No obvious threats |

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|-------|------------|--------|----------------|----------|-------------|--|---|-------------|-------------------------|---|
| PA | Fulton | 550 | E | 2008 | 2008 | Vernal pool in mountain gap, surrounded by clearcut; surrounding forest regenerating | 2008: C rank recommended. 2004: 20 plants growing in mucky silt substrate; in flower and fruit | S | State (PGC) | |
| PA | Huntingdon | 3 | A | 2006 | 2006 | Graminoid march; all vegetation in pond herbaceous; one side logged to within 20 m of pond edge; gypsy moth mortality in area 40%. 1995 - wetlands dry during visits. EO occurs in 2 wetlands. | 2006: one population has increased by 71% since 1995 survey. 1995: Pop #1 appears to be doing fine with abundant flowers and asexual bulblets. Pop #2 - no <i>S. ancistrochaetus</i> found. | I | State (PGC) and Private | threats: jeep road a N end of natural community |
| PA | Huntingdon | 4 | B | 1994 | 1992 | Ombrotrophic basin marsh/shrub swamp | 1994: small population; 30 ramets; small percentage of plants in flower; normal vigor; in 10-100 sq yd area. | U | Private | threats: maintenance or expansion of powerline clearing and jeep trails; trampling and browsing by deer. Need to protect hydrology of pools |
| PA | Huntingdon | 24 | E | 2008 | 2008 | Vernal wetland | 2008: C rank recommended. 1995: one collection from vernal wetland | S | State (DCNR) | |
| PA | Lackawanna | 501 | X? | 1946 | 1993 | Seepage swamp with a floating peat mat in the middle. Some clearing of woods has occurred. | 1993: plants not found but marginal habitat still present. 1986: plants not found. 1963: plants not found. 1946: specimen collected from clump in mud hole on margin of wet woods east of lake. | X | Unknown | |

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|-------|------------|--------|----------------|----------|-------------|--|--|-------------|------------|----------|
| PA | Lackawanna | 502 | F | 1897 | 1993 | UNKNOWN | 1993: plants not found; original collection site unknown. 1897: specimen collected. | F | County | |
| PA | Lackawanna | 503 | C | 1996 | 1996 | Open grassland with shrubs and large area of exposed bedrock. Mixed oak with thick ericaceous layer. E-facing slope of ridgetop dwarf-tree forest below vertical outcrop. | 1996: 200-300 mature, flowering ramets with immature fruit and normal vigor; found in saturated soil; partially lighted. Collected from 1940 sphagnous bog between sandstone ridges. Bogs rechecked in 1986 and additional plants not found. Mountain top burned in 1988. Plant of 1985 not found in 1988, 1989, 1991. | U | Unknown | |
| PA | Lackawanna | 529 | C | 1996 | 1996 | Wooded area around pond is boggy-swampy w/ sphagnous openings. At edge of woods is a low, wet active cattle pasture. | 1996: several hundred ramets with normal vigor. 1995: 101-1000 vigorous, mature ramets with mature fruit; found in low end of moist, open pasture adjacent to wet hummocky woods. | U | Unknown | |
| PA | Lehigh | 504 | C | 1993 | 1993 | 150' x 100' woodland shrub thicket or vernal pond; outlet at E end; currently no standing water; pond bed is saturated muck and organic material. Pond surrounded by 100' fringe of woods. | 1993: 30 mature, fruiting ramets and hundreds of small seedlings; normal growth; sexual and asexual reproduction. Growing in ephemeral fluctuating vernal pool / shrub thicket. | U | unknown | |
| PA | Lehigh | 505 | F | 1921 | 1993 | Mud-hole or depression, sometimes dry, sometimes marshy; numerous vernal pools in the area. | 1921: specimen collected from mud hole or depression. 1989: extensive searches of vernal pools in area; failed to locate plants. 1993: no plants or suitable habitat found. | F | Private | |

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|-------|-----------------|--------|----------------|----------|-------------|--|---|-------------|--------------|----------|
| PA | Lehigh | 506 | H | 1926 | | | | H | unknown | |
| PA | Lehigh | 536 | AB | 2008 | 2008 | Graminoid-dominated vernal pond (200 x 150 feet) on ridge summit; surrounding young hardwood forest; water level probably fluctuates considerably. | 2008: retention of AB rank recommended. 2002: more than 1000 fertile stems; dominates wetter portions of vernal pond. In leaf, flower and fruit with normal vigor. Bed of pond with thin sphagnous layer and spongy organic substrate. | S | State (PGC) | |
| PA | Lycoming, Union | 515 | BC | 2006 | 2006 | Collection of 28 vernal ponds occurring along a mixed oak N-facing ridge. From E to W site covers a 1.2 mile narrow band. Surrounding land logged in early 1900's. | 2006: C rank recommended. 4 ponds with this species surveyed; population in these ponds has declined by 89, 100, 17 and 96% respectively since the 1995 survey; flowering only observed in 1 pond. 1997: plants observed flowering in 4 ponds. 1995: plants observed flowering in 4 ponds. 1992: 500-700 mature flowering culms of normal vigor; found in partial light in saturated silt loam. | D | State (DCNR) | |

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|-------|---------|--------|----------------|----------|-------------|--|--|-------------|--------------|--------------------|
| PA | Mifflin | 525 | BC | 2007 | 2007 | Group of 5 woodland ponds on saddle between two ridges - 3 ponds drain to W, 2 to E. Surrounding woods are upland hardwood. Dominated by graminoid vegetation. | 2007: EO consists of dense clumps in center of vernal pool, roughly 10 x 3 m in area. Majority appear to be reproductive. EO is now located in 2 of 10 ponds. Largest population remains in essentially the same location (pond #4); densely covering an 8 x 15 m patch. EO was not located in pond #1 but was evenly scattered in an additional pond in two clusters each 1 x 5 m, roughly 42 flowering spikes. 1995: several hundred mature fertile culms of normal vigor in leaf, flower, and with immature fruit. Inundated-saturated in ephemeral/fluctuating pool in open light. | S | State (DCNR) | no threats evident |
| PA | Mifflin | 530 | BC | 2006 | 2006 | Group of 4 shallow woodland ponds on watershed divide between 2 ridges. Surrounding woodland - well-drained mixed hardwood/pine/heath woods. | 2006: About 200 stems in 2-3 ponds. Pond C: no plants observed; silt-laden water. Pond D: 53 flowering clumps, 50 non-flowering observed on NW side of pond. Pond A: Most sedges in vegetative state; 5 in flower in first area and 9 in second. Not observed in Pond B. 1996: About 500 fertile stems found in 4 ponds; normal vigor; in leaf, flower and immature fruit; plants mostly vegetative. | D | State (DCNR) | no threats evident |

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|-------|-------------|--------|----------------|----------|-------------|---|---|-------------|--------------|----------------|
| PA | Mifflin | 535 | C | 2006 | 2006 | Woodland opening with saturated, thin sphagnum substrate, occasional pockets of standing water; lots of sun; differs from many <i>S. ancistrochaetus</i> ponds in lacking a well-defined sloping bed and tree/shrub perimeter zone. | 2006: 49 flowering clumps observed in NW corner of pond, as described in 2000, but no plants found in the two bear wallow areas 2000: ~110 clumps; 72 with fertile stems. Found in wettest part of pond along sides; appears healthy and is reproducing; may be occupying all available habitat. | D | State (DCNR) | |
| PA | Mifflin | 551 | E | 2006 | 2006 | Vernal pool complex surrounded by forest | 2006: several vernal ponds searched, but EO only found in 1 pond. Plants scattered in an 8 x 8 meter area. | S | State (DCNR) | Nearby ATV use |
| PA | Monroe | 508 | X | 1936 | 1985 | Swampy area in woods | 1985: area searched; unable to find good habitat or the plant | X | Unknown | |
| PA | Monroe | 509 | C | 1993 | 1993 | Shallow, elongated, vegetation-choked kettle lake with mucky bottom underlain by unconsolidated sand and gravels. Lake has no outlet but is fed by groundwater. | 1993: 5 fertile culms. Plants in 6" to 1' of water, in slightly shaded part of lake. Extensive production of bulblets in leaf axils; nearly every clump shows this asexual reproduction. Most clumps also producing seed. 1991: several sprouts found from vegetative reproduction; water level very low. | U | Private | |
| PA | Northampton | 507 | X? | 1940 | 1993 | UNKNOWN | 1993: plants searched for but not found; more searching needed. 1976: A.E. Schuyler unable to relocate. | X | Unknown | |

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|-------|--------|--------|----------------|----------|-------------|---|---|-------------|--------------|--------------------|
| PA | Perry | 521 | B | 1994 | 1994 | Site is a group of at least 4 woodland ponds in upland area between two ridges. All ponds have a buffer of woods. One house about 200 yards from one pond. | 1000'S of fertile culms; fruits and asexual nodal shoots; forms a dense patch of 100 x 25' in pond A. Found in open ephemeral/fluctuating pond in well-drained oak-heath woods. | U | Private | |
| PA | Perry | 522 | BC | 1994 | 1994 | Group of at least 12 vernal ponds on level or gently sloping terrain on lower ridge at base of mountain. Surrounding woods well-drained, acidic, oak-hickory-pine-heath. Ponds currently lack standing water. | 1994: 75-100 mature, fruiting culms with normal vigor. Inundated-saturated in open, vernal pond | U | Unknown | |
| PA | Perry | 523 | CD | 2008 | 2008 | Woodland/vernal pond type habitat surrounded by woods; nearby dirt road. Ponds may not be natural. Additional ponds to W have marginal habitat but have been disturbed by logging and dumping of slash; adjacent woods show signs of mining and other disturbances. | 2008: D rank recommended. 1994: 11-50 mature ramets with normal vigor; 6 fruiting culms & approx 24 vegetative culms; found in ephemeral/fluctuating pond in partial-filtered light. 1997: Pop. increased to 28 fruiting and approx. 70 sterile culms. New subpop. found in corner of larger pond; 6 fruiting and 30 sterile culms found. | D | State (PGC) | |
| PA | Perry | 531 | D | 2008 | 2008 | Group of woodland ponds located on watershed divide. 4 ponds surveyed | 2008: CD rank recommended. 1996: 2 mature genets w/normal vigor in leaf, flower and immature fruit; found in ephemeral-fluctuating natural pool located at crest in open light. 1997: 9 genets in flower at end of pond; plants appear to have spread since first survey. 2003: 7 flowering genets | S | State (DCNR) | No obvious threats |

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|-------|--------|--------|----------------|----------|-------------|--|---|-------------|--------------|--|
| PA | Perry | 532 | B | 2008 | 2008 | Shallow high elevation basin at divide between 2 watersheds. Community consists of series of wet depressions; some forested, some open. Larger open ponds are graminoid dominated. Smaller ponds are partially forested. | 2008: D rank recommended. 1997: thousands of culms; about 1/3 in fruit and 2/3 sterile; some plants had wilted/wrinkled stems. | D | State (DCNR) | logging and throwing slash in the pond are potential threats; road nearby could affect drainage |
| PA | Snyder | 527 | A | 2008 | 2008 | 17 variously-sized woodland ponds/wetlands scattered in mixed hardwood-white pine-hemlock forest on watershed divide/saddle between 2 mountains | 2008: C rank recommended. 1995: 10,000+ fertile stems; in leaf, flower and immature fruit; found inundated-saturated in open-partially shaded ephemeral/fluctuating pools at crest of drainage. | D | State (DCNR) | |
| PA | Snyder | 552 | E | 2006 | 2006 | 3 herbaceous vernal ponds within forested setting | 2006: EO found in 2 ponds. 1 clump with 5 fertile culms plus about 15 vegetative rosettes covering 1 square meter, in flower. | S | unknown | |
| PA | Tioga | 538 | B | 2008 | 2008 | High elevation, open, bog-like wetland with graminoid and fern vegetation on pipeline right-of-way. Surrounding land use is wooded. | 2008: BC rank recommended. 2002: Occurrence is 100 x 120 ft patch. No estimate given as to the number of stems. Found in leaf, flower and immature fruit with normal vigor. Found in open light and saturated moisture. | D | State (DCNR) | Threats: possibly pipeline maintenance. Disturbances - previous pipeline maintenance though this may have been beneficial. |

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|-------|--------|--------|----------------|----------|-------------|--|--|-------------|--------------|--------------------|
| PA | Tioga | 540 | B | 2008 | 2008 | Vernal pond surrounded by forest, shrubs around the edges. <i>Scirpus ancistrochaetus</i> is the dominant vegetation in the pond. The pond is open and exposed to light. | 2008: C rank recommended. 2004: 100's of mature plants in vernal pool; sides and outer edges of pool dominated by <i>Scirpus ancistrochaetus</i> . Found in mature fruit with normal vigor. Element found in open to shaded light and saturated moisture. | D | State (DCNR) | No obvious threats |
| PA | Tioga | 541 | B | 2008 | 2008 | Vernal pond about 30 sq meters in size and surrounded by forest, but open, with lots of light penetrating to the water. | 2008: AB rank recommended. 2004: <i>Scirpus ancistrochaetus</i> formed dense cover in the vernal pond, which was about 30 sq meters in size. 100's of stems filled the pond; plants were absent from a ring around the edge of the pond, about 2 feet wide. Found in mature fruit with normal vigor. Plants found in open to partial light and saturated moisture. | I | State (DCNR) | No obvious threats |

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|-------|--------|--------|----------------|----------|-------------|---|--|-------------|--------------|--|
| PA | Tioga | 547 | E | 2008 | 2008 | Two ponds: Pond #1 is a small circular pond in forest that has been recently logged. Horse/logging trail skirts edge of pond, degraded context. Pond #2 is larger and more diverse. | 2008: B rank recommended. 2005: Pond # 1: Plants have only 11 flowering culms; plants found in feeble vigor in a small, shallow pond in recently thinned forest. Pond # 2 had 500-1000 flowering culms; plants in normal vigor with mature fruit. Plants found in a deep water channel of a larger pond in forested context. | S | State (DCNR) | Disturbances to pond # 1: logging road, horse trail skirts edge of pond, area around pond has been logged. Disturbance to pond #2: recent logging near boundary. Threats to both ponds: logging of pond margins; changes to wetland hydrology. |
| PA | Tioga | 548 | E | 2004 | 2004 | Vernal pond surrounded by forest | 2004: pond dominated by <i>S. ancistrochaetus</i> . More than 1000 fruiting culms within a 60 x 50 foot area of pond. | S | State (DCNR) | |
| PA | Tioga | 549 | E | 2004 | 2004 | Large grouping of vernal ponds scattered in otherwise well drained upland woods | 2004: Several 1000s of fertile and vegetative culms found in at least 7 vernal ponds. | I | State (DCNR) | |

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|-------|-----------|--------|----------------|----------|-------------|--|--|-------------|--------------|----------|
| PA | Union | 516 | C | 2006 | 2006 | Small (less than 0.25 acre) woodland pond in headwaters of a run. | 2006: CD rank recommended. 95% decline in population area since 1995 survey; no flowering. 1995: population covers 41 sq m and is flowering. 1992: several hundred culms; plants of normal growth in flower and immature fruit. Found in nearly full sun in inundated/saturated soil, over sandstone-shale bedrock. 1995: Pop. about half the size of previous year. Decline may be partially due to a bear wallow found in 1994. 1996: Pop. has declined from 1995. 2000: ~ 50 fertile stems and a few vegetative clumps found, a lot fewer than in 1992. | D | State (DCNR) | |
| PA | Union | 520 | D | 1992 | 1992 | Cluster of 15-20 natural, seasonal, woodland ponds. | 2 ramets; both culms fallen over and producing asexual shoots; substrate muddy/organic; currently no standing water; filtered light; mature fruit present. | U | Unknown | |
| VA | Alleghany | 4 | A? | 1987 | 1987 | Basin marsh; water about 30 cm deep; probably rarely, if ever, goes dry. | 1990: 3 clumps with 10, 20 & 100 fruiting culms respectively. 1989: 44 fertile culms counted; about half of pond edge individuals vegetative; other half produced fertile culms. Toward pond center, 4 aggregated clumps produced 17 fertile culms. | U | Federal | |

| STATE | COUNTY | EO NUM | EO RANK (2007) | LAST OBS | LAST SURVEY | GENERAL DESCRIPTION | EO DATA | POP. STATUS | LAND OWNER | COMMENTS |
|-------|------------|--------|----------------|----------|-------------|--|--|-------------|------------|----------|
| VA | Alleghany | 8 | A | 1994 | 1994 | Population occupies most of the area of about a 15,000 sq foot peat-filled mountain pond situated on a mountainside bench. Appears to be natural, situated over devonian-silurian boundary formations. | 1994: 1000+ culms, many fruiting, occupying about 15,000 sq ft area. Growing on saturated peat in oligotrophic semi-permanently flooded wetland. | U | Federal | |
| VA | Augusta | 5 | B? | 1990 | 1990 | Mountain pond with open water, emergent vegetation and shrub border. | 1987: appears to be doing well at all life stages. 1985: scatted in zone of emergent vegetation, particularly at one end. | U | Private | |
| VA | Augusta | 6 | B | 2005 | 2005 | Natural pond, edged by swamp forest. | 2005: Plants in deeply flooded portion of pond. 1990/1989: relatively small population; about 10 clumps, 26 fertile culms counted. | S | Private | |
| VA | Augusta | 7 | E | 1991 | 1996 | Plants in deepest section of pond. | 1996: not found. 1991: 1 vegetative plan observed; not 100% sure of ID | U | Unknown | |
| VA | Bath | 3 | A? | 1988 | 1988 | Open mountain pond with much aquatic vegetation and no shrub border. | 1988: thousands of plants producing seeds and vigorously growing; scattered in zone along edge of pond. | U | Private | |
| VA | Rockingham | 1 | H | 1970 | 1970 | Tiny ridgetop pond on sandstone, in shallow water. | 1970: plants found on tiny ridgetop pond on sandstone, in shallow water. | H | Federal | |

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|-------|------------|--------|----------------|----------|-------------|---|--|-------------|-----------------------|----------|
| VA | Rockingham | 2 | A? | 1994 | 1994 | Two sinkhole shallow depressions close to each other; large one with standing water, other much shallower without standing water. | 1994: several hundred clumps dominating smaller pond; vigorous population. 1987: most abundant in smaller, dried pond. >100 clumps over 100 sq yd area producing seed. | U | Private | |
| VT | Windham | 1 | C | 1999 | 2005 | Emergent marsh in backwater of Conn.River. Water level fluctuates due to beaver activity | 2005: No plants. 1999: single clump w/ 34 fruiting culms. 1994: 22 clumps w/ 110 fruiting culms. | D | Private with easement | |
| VT | Windham | 2 | C | 2001 | 2001 | Series of emergent marshes along a stream. Water level fluctuates due to beaver activity | 2001: 3 clumps w/ 4 fruiting culms at 1 pond. 1994: 12 clumps w/ 29 fruiting culms at 3 ponds. | D | Private | |
| VT | Windham | 3 | C | 1994 | 2003 | Emergent marsh associated with a pond. Water level fluctuates due to beaver activity | 1994: 10 clumps w/ 150 fruiting culms | D | Private | |
| VT | Windham | 4 | C | 2002 | 2002 | Large wetland complex along a stream. Water level fluctuates due to beaver activity | 2002: 6 clumps w/ 36 fruiting culms. 1998: 8 clumps w/ 52 fruiting culms. 1994: 4 clumps w/ 19 fruiting culms | S | Private | |
| VT | Windham | 5 | B | 2001 | 2001 | Series of emergent marshes along a stream. Water level fluctuates due to beaver activity | 2001: 26 clumps w/ 75 fruiting culms in 2 ponds. 1997: 30 clumps w/ 190 fruiting culms in 3 ponds. 1994: over 1,500 fruiting culms. | D | Private | |

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|-------|---------|--------|----------------|----------|-------------|--|---|-------------|------------|----------|
| VT | Windham | 6 | C | 2005 | 2005 | Series of emergent marshes along a stream. Water level fluctuates due to beaver activity | 2005: 5 clumps w/ 15 fruiting culms. 2001: 95 clumps w/ 285 fruiting culms. 1995: 5 clumps w/ 34 fruiting culms | D | Private | |
| VT | Windham | 7 | C | 2004 | 2004 | Pond and associated wetlands with beaver activity | 2004: 30 clumps w/ 210 fruiting culms. 1998: 40 clumps w/ 110 fruiting culms | S | Private | |
| VT | Windham | 8 | B | 2004 | 2004 | Pond and associated wetlands with beaver activity | 2004: 60 clumps w/ 1000+ fruiting culms. 2000: 215 clumps w/ 1000+ fruiting culms | S | Federal | |
| VT | Windham | 9 | C | 1998 | 2002 | Emergent marsh with previous beaver activity | 1998: 13 clumps w/ 76 fruiting culms. 1996: 14 clumps w/ 195 fruiting culms | D | Private | |
| VT | Windham | 10 | B | 2004 | 2004 | Pond and associated wetlands with beaver activity | 2004: Main population only few clumps, but new subpopulation has 75 clumps w/500 fruiting culms. 1997: Main pop'l 100+clumps w/ 1,000+ fruiting culms | D | Private | |
| VT | Windham | 11 | C | 2004 | 2004 | Small quaking bog | 2004: 10 clumps w/ 23 fruiting culms. 1998: 1 clump w/ 9 fruiting culms | I | Private | |
| VT | Windham | 12 | C | 1999 | 2003 | Emergent marsh with previous beaver activity | 1999: 40 clumps w/140 fruiting culms | D | Private | |
| VT | Windham | 13 | C | 2004 | 2004 | Pond and associated wetlands with beaver activity | 2004: 20 clumps w/ 80 fruiting culms. 1999: 30 clumps w/ 90 fruiting culms | S | Private | |
| VT | Windham | 16 | B | 2004 | 2004 | Artificial pond | 2004: about 200 clumps. 2000: 250 clumps w/ 1,500 fruiting culms | S | Private | |

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|-------|---------|--------|----------------|----------|-------------|---|---|-------------|------------|----------|
| VT | Windham | 18 | B/C | 2005 | 2005 | 2 Subpops: N is shrub swamp; S is hemlock/hardwood swamp; neither has beaver activity | 2005: N population has fewer fruiting culms; S pop. has 5 w/ 7 fruiting culms. 2004: N pop has 53 clumps w/ 360 fruiting culms. S pop. has 7 clumps w/ 11 fruiting culms. | D? | Private | |
| VT | Windham | 19 | C | 2005 | 2005 | Buttonbush basin swamp w/ no beaver activity | 2005: 20 clumps w/ 60 fruiting culms. 2004: ? clumps w/ 45 fruiting culms | S? | Private | |
| VT | Windham | 20 | B/C | 2005 | 2005 | Shrub swamp associated w/ hardwood swamp. No beaver activity | 2005: unknown # of clumps w/ 500+ fruiting culms. 2004: unknown # of clumps w/ 150 fruiting culms | I? | Private | |
| VT | Windham | 21 | C | 2005 | 2005 | A narrow shrub/ emergent swamp assoc. w/ a small stream, surrounded by hemlock woods | 2005: 2 clumps w/ 11 fruiting culms | U | Private | |
| VT | Windham | 22 | C | 2005 | 2005 | Series of emergent marshes along a stream. Water level fluctuates due to beaver activity | 2005: 21 clumps w/ 87 fruiting culms | U | Private | |
| VT | Windsor | 14 | C | 2005 | 2005 | Small perched hemlock-hardwood swamp in a shallow basin with no indication of beaver activity nor any clear inlet or outlet. Water level likely fluctuates on a seasonal basis. | 2005: 5 clumps w/ 26 fruiting culms. 1999: 15 clumps w/ 50 fruiting culms | D | Private | |

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|-------|----------|--------|----------------|----------|-------------|---|--|-------------|------------|---|
| VT | Windsor | 15 | C | 2002 | 2002 | Small perched hemlock-hardwood swamp in a shallow basin with no recent beaver activity Water level likely fluctuates on a seasonal basis. | 2002: 26 clumps w/ 90 fruiting culms. 1999: 1 ind w/ 1 fruiting culm | I | Municipal | |
| VT | Windsor | 17 | B | 2003 | 2003 | Pond and associated wetlands with beaver activity | 2003: 105 clumps w/ 900 fruiting culms in 3 locations. | U | Private | |
| WV | Berkeley | 1 | B | 2005 | 2005 | Several well-developed sinkhole ponds atop a low, flat sandstone ridge. Adjacent woods are dry deciduous forest, selectively cutover about mid-1970s. | 2005: 2 erect inflorescences observed; evidence of advanced vegetative reproduction throughout one pond; EO is dominant in this pond, but overall, vegetative cover is declining; at time of monitoring, no standing water in pond; organic substrate moist. | D | Private | No human induced disturbance is apparent. Shade created by overhanging trees may be causing a decline in pop. |

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|-------|----------|--------|----------------|----------|-------------|--|---|-------------|------------|----------|
| WV | Berkeley | 2 | B | 2005 | 2005 | 4 well-developed sinkhole ponds in poor second-growth deciduous forest atop a low, flat limestone ridge. | 2005: large blowdown in 2002 opened canopy on W side of pond 1, allowing drier conditions and encroachment by terrestrial vegetation. Pond 1: EO in section A appears to have increased density within historic distribution; section B is a nearly pure stand of EO - water depth and sunlight are greatest here. Section C remains stable. EO patches in sections D, E, and F developed following a number of trees falling on or near edge of pond. Pond 2: in east section, EO remains dominant plant; appeared denser in 2005 than 2004 or 2003, and distribution has shifted more to E half in response to encroaching buttonbush and possibly increased light. % cover of EO is only 30% compared to 90% and 80% in 1998-2001. | S? | Private | |

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|-------|--------|--------|----------------|----------|-------------|---------------------|---|-------------|----------------|--|
| WV | HARDY | 3 | D | 2005 | 2005 | Small seasonal pond | 2005: pond often dry at time of monitoring. Pop has remained stable and with same distribution since 2000; vegetation in pond appears to be changing from aquatic emergent plants to more woody wetland/riparian vegetation; surrounding forest canopy continues encroaching along pond edge; expanding woody vegetation affecting light and space requirements in sections C,D and E. EO remains dominant in section D but declining; overhanging elm appears to be causing the pop. to disperse around edge of deepest section of pond. | S | Federal (USFS) | deer and horse tracks seen within pond |

Population Status: D=declining; F= failed; H= historic; I=increasing; S=stable; U=unknown; X= extirpated

Data in Appendix 2 were summarized from information obtained from:

- Cairns, Sara. 2006. New Hampshire Heritage Bureau, Division of Forests & Lands. *in litt.*
- Cipollini, Kendra. 2008. Wilmington College, *in litt.*
- Cipollini, Kendra. 2006. Wilmington College, *in litt.*
- Frye, Chris. 2006. Maryland Department of Natural Resources. *in litt.*
- Grund, Steve. 2006. Western Pennsylvania Conservancy – Pittsburgh Office. *in litt.*
- Harmon, Paul. J. 2006. Natural Heritage Program, Division of Natural Resources. *in litt.*
- Popp, Bob. 2006. Non-game and Natural Heritage Program, Vermont Fish and Wildlife Department. *in litt.*
- Somers, Paul. 2006. Natural Heritage & Endangered Species Program, Massachusetts Division of Fisheries & Wildlife. *in litt.*
- Townsend, John. 2006. Department of Conservation of Natural Heritage Recreation, Division of Natural Heritage. *in litt.*

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