

Final Report for Grant Agreement # WRCF-19

**Continued Field Surveys of Aquatic and Terrestrial Plant
Species of Special concern in Eastern Pennsylvania
and PNDI Project Review Assistance**

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Abstract

Aquatic Plant Surveys were carried out at 40 lakes; of those, 10 of the sites had no record of being surveyed previously. Twenty-three sites were new to us, 10 represented follow-up work at lakes we have inventoried over the past three years, and 8 sites were visited to specifically to check for small beggar-ticks (*Bidens discoides*). These surveys resulted in documentation of 41 occurrences of PNDI-listed vascular plants of which 30 were new and 11 were updates. We also gained new understanding of the distribution and occurrence of several native and non-native species.

Field reports have been submitted to the Pennsylvania Natural Heritage Program. Two hundred and eighty-seven herbarium specimens were collected and deposited in the herbarium of the Morris Arboretum of the University of Pennsylvania.

We presented three programs on lake ecology and aquatic plant identification to foster an appreciation of the diversity and ecological importance of aquatic plants. We also met with lake residents at many of the lakes we surveyed.

We conducted additional field surveys in Bucks, Carbon, Delaware, and Chester Counties resulting in 13 additional records of listed species. Five telephone and/or email consultations were held regarding PNDI reviews.

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Objectives

1. Continue the survey of aquatic plants of lakes in northeastern Pennsylvania initiated in 2000.
2. Provide recommendations for appropriate PNDI status of the plants involved.
3. Provide information to lake community residents and lake managers regarding the diversity and ecological role of aquatic plants.
4. Evaluate the potential impact of proposed land development projects on occurrences of PNDI-listed plants as needed.

Justification

Many lakes in northeastern Pennsylvania have not been surveyed for vascular plants recently or at all (Pennsylvania Flora Database, PNHP database). Furthermore, many publicly owned lakes were not included in earlier surveys because it was thought that they did not need protection and therefore were a lower priority for inventorying. Consequently data are not available to accurately assess the true status of many aquatic vascular plants. In addition, several invasive, non-native aquatic plants have been spreading throughout the region and their impact on native lake flora has not been fully evaluated.

Adding to the problem, lake residents and lake managers have little appreciation for the role of aquatic plants in lake ecosystems and little knowledge of the diversity of aquatic vegetation, which is frequently referred to as "seaweed". Demands are frequently made to control aquatic vegetation in privately and publicly owned water bodies to facilitate various recreational and aesthetic uses. The assumption has often been made, in the absence of any inventory data, that the offending vegetation is non-native invasive species such as Eurasian water milfoil.

Materials and Methods

Lake surveys were carried out during July, August, and September 2003 at a total of 40 sites. A rowboat was used to make a circuit of 32 lakes for the purpose of observing and sampling the aquatic flora. A grappling tool constructed from 2 garden rakes bolted together back to back was dragged across the lake bottom at regular intervals to obtain samples from water too deep to reach otherwise. Samples were identified immediately or later in the laboratory, and herbarium specimens prepared for each site. GPS data points were recorded at each site where PNDI-listed plants were found. A depth gauge was used to record water depth at intervals. In addition our intern, Jennifer Petzold made targeted surveys of 8 additional lakes to search for small beggar-ticks (*Bidens discoidea*). A list of all lakes surveyed is provided in Appendix A.

Products Delivered

1. A progress report and this final report were submitted to the Wild Resources Conservation Program on January 5, 2004 and February 13, 2004 respectively.
2. Field reports have been submitted to the Pennsylvania Natural Heritage Program for all PNDI-listed species found.
3. Two hundred and seventy-seven (277) herbarium specimens were deposited in the Morris Arboretum Herbarium (MOAR) permanently documenting findings (see Appendix B for a list).
4. Recommendations for changes in the status of several species are being evaluated for submission to the Rare Plant Forum and the Vascular Plants Technical Committee.

Results and Conclusions

Aquatic Plant Surveys

Records included 30 new PNDI records and 11 updates. Three natural community reports were also submitted. The following collections are of particular interest for reasons discussed below.

Small beggar-ticks (*Bidens discoidea*) - Our intern, Jennifer Petzold, conducted an intensive survey of small beggar-ticks (N/PR) to determine if the recommended status of PR is appropriate. She documented populations at 18 sites in northeastern Pennsylvania, however in no case did the population size exceed a few hundred plants and most were much smaller. Even considering the six additional previously known sites, her conclusion was that PR is the appropriate status for *Bidens discoidea*. As a result of this study we now have much better information to support that decision.

Needle spike-rush (*Eleocharis acicularis*) – We have collected an unusual form of needle spike-rush with tiny tubers on the roots at three lakes, two in Luzerne County and one in Wayne County. Although *Eleocharis acicularis* often grows as a partially or completely emergent plant on lake shores, the tuber-bearing plants are always completely submergent and sterile. The tubers are about 1-1.5 mm long, off-white in color, and are easily seen among the roots. We collected small patches of “turf” of these tuber-bearing plants and grew them in the greenhouse in an emergent condition to obtain fruiting stems in order to confirm the identity.

Water-willow (*Justicia americana*) - In two lakes that we surveyed in 2003, water-willow was the dominant emergent species (Brady’s Lake and Nuangola Lake). These are the only lakes of the 92 that we have surveyed in the past four years where this species is present; however, it is common along the margins of the Susquehanna, Juniata, Allegheny, and Schuylkill Rivers and their tributaries and is becoming more abundant in the Delaware River (PA Flora Database 2004).

Farwell’s water-milfoil (*Myriophyllum farwellii*) – *Myriophyllum* specimens we collected this year at several sites led us to re-examine specimens we have previously identified as Farwell’s water-milfoil. We have confirmed specimens of *M. farwellii* from Lake Greeley in Pike County and Tobyhanna Lake in Monroe County; both sites have

large populations. At Tobyhanna Lake *Myriophyllum humile* and *M. farwellii* are both present, Lake Greeley apparently has only *M. farwellii*.

We do not have *M. farwellii* specimens from the following sites where we have reported it in the past, consequently we recommend that these records be deleted from the PNHP database:

Myriophyllum farwellii, Monroe Co., Lake Naomi, 8/19/1982

Myriophyllum farwellii, Pike Co., Mainses Pond, 8/20/1999

Myriophyllum farwellii, Pike Co., Log Cabin Pond, 8/1/2001

Myriophyllum farwellii, Wayne Co. Miller Pond, 7/10/2001

The best characteristic for distinguishing *M. farwellii* from the very similar *M. humile* is the nature of the surface of the tiny fruits. *Myriophyllum humile* has smooth to somewhat warty fruits; the fruits of *M. farwellii* on the other hand are characterized by more prominent, nearly spine-like projections. Our confusion in the past came from not realizing the full range of surface textures that can be present in *M. humile*.

Long-stem waterwort (*Elatine triandra*) - We have continued to discover additional populations of a species of *Elatine* (waterwort) that we initially identified as American waterwort (*E. americana*). However, in Pennsylvania, American waterwort has traditionally been limited to the intertidal areas of the Delaware River, where it has not been collected for more than 50 years (Rhoads and Klein 1993). After finding this species at several very degraded lakes in southeastern Pennsylvania this year, we checked further into its identification and have concluded that the specimens in question are long-stem waterwort (*Elatine triandra*), a species not previously recorded for Pennsylvania.

Elatine triandra is native to Eurasia and western North America. It has been collected in Maine, where it is considered to be introduced (Haines and Vining 1998; Tucker 1986), and recently at several locations in New York (G. Tucker, personal communication). Taxonomic confusion has further obscured the true identity of the waterworts. American waterwort was considered to be a variety of *E. triandra*; Gleason and Cronquist (1991) list it as *Elatine triandra* Schkuhr var. *americana* (Pursh) Fassett, whereas *E. triandra* is *Elatine triandra* Schkuhr var. *triandra*. Other authors (Tucker 1986; Crow and Hellquist 2000) recognize both American and long-stem waterwort at the species level as *Elatine americana* (Pursh) Arn. and *E. triandra* Schkuhr respectively.

We have concluded that the plant we initially collected as *Elatine americana* at eight lakes in Luzerne, Pike, Susquehanna, and Berks Counties is, in fact, *E. triandra*, and that this species is apparently spreading rapidly within our range. Inspection of herbarium specimens at the Academy of Natural Sciences of Philadelphia indicates that *E. triandra* is also present at one additional lake in Pike County, and that it has been at Twin Lakes in Pike County since at least 1960.

Consequently, the following EOs previously submitted by us should be deleted from the PNHP database:

Elatine americana, Luzerne Co., Lily Lake, 7/27/2001

Elatine americana, Susquehanna Co., Big Elk Lake, 7/28/2002
Elatine americana, Susquehanna Co., Quaker Lake, 7/28/2002
Elatine americana, Pike Co., Twin Lakes, 7/31/2001
Elatine americana, Pike Co., Walker Lake, 7/31/2002
Elatine americana, Pike Co., Twin Lakes - small lake, 8/28/2002

Inflated bladderwort (*Utricularia inflata*) - Inflated bladderwort is another plant that shows very aggressive tendencies. This species was first collected in Pennsylvania at three sites in Sullivan County 1993-1997, but recorded at the time as *U. radiata*, a similar but smaller plant, which had previously been considered a variety of *U. inflata*. However, Peter Taylor in his 1989 monograph on the genus *Utricularia* (Taylor 1989) recognizes both taxa at species rank as do Crow and Hellquist (2000). It has now been found by us at eight lakes in northeastern Pennsylvania and is undoubtedly present at others.

Inflated bladderwort is native to the coastal plain from Delaware to Florida and Texas (Gleason and Cronquist 1991); we probably will never know exactly how it became established in Pennsylvania. Following our recognition of its presence at Pecks Pond and Tobyhanna Lake in 2000, it was added to the PNDI plant list with a TU (tentatively undetermined) classification. However, it appears to be spreading even to lakes that are not visited by boaters such as Beech Lake in State Game Lands 57; waterfowl may be the vector.

Like purple bladderwort, inflated bladderwort can become very abundant locally, causing distress to various recreational users. It is frequently present in vegetative condition only; we have learned to recognize it in the absence of flowering stems based on leaf and stem tip characteristics. *Utricularia inflata* has a G5 (globally secure) rating overall; it is S1 (critically imperiled) in MI, NY, NJ, DE, MD, TN, AL, and OK. It is rated as S2 (imperiled) in VA and NC. It is considered invasive in Washington State, the only western state in which it has been found (NatureServe 2004; Washington State Department of Ecology 2004).

Broad-leaved water-milfoil (*Myriophyllum heterophyllum*) - We have previously (Rhoads and Block 2001) reported on large populations of *Myriophyllum heterophyllum* (broad-leaved water-milfoil) that are present at several eastern Pennsylvania lakes. During our 2003 surveys we documented two additional occurrences of this aggressive species and noted the expansion of one previously recorded occurrence.

At Harris Pond in Luzerne County, a PA Fish and Boat Commission lake, *Myriophyllum heterophyllum* dominated the entire lake. It was rooted throughout, except in the deepest central region; in addition, floating fragments covered the water surface in the vicinity of the dam and extending for about one-third the length of the lake.

We documented an additional population in the inlet at Harvey's Lake, where the presence of this species was first noted by A. E. Schuyler in 1982. Interestingly, we did

not see this species anywhere else in this large lake although it is abundant in the inlet. A revisit to Lily Lake, another PA Fish and Boat Commission site in Luzerne County, revealed a dramatic expansion in the area occupied by *Myriophyllum heterophyllum* compared to our previous visit in 2001.

Myriophyllum heterophyllum is classified as G5 (globally secure); in 6 states or provinces it is classified as S1 (critically imperiled): New Brunswick, IA, OH, PA, MD, DE. It has S2 (imperiled) status in Quebec, NJ, KY, and NC. It is considered secure in Ontario and VA. Vermont, New Hampshire, New York, Rhode Island, and the District of Columbia consider *Myriophyllum heterophyllum* to be exotic (NatureServe 2004; New Hampshire Department of Environmental Services. 1999).

Non-native Invasive Species

We found non-native invasive species in 16 of the lakes we surveyed. In addition to the species discussed below the following were recorded the number of times shown in parentheses: *Acorus calamus* (2), *Iris pseudoacorus* (2), *Solanum dulcamara* (4), *Myosotis scorpioides* (1), *Lythrum salicaria* (1), *Phragmites australis* (3), *Nymphaea* (pink-flowered).

Fanwort (*Cabomba caroliniana*) – Harvey’s Lake contained a large population of fanwort (*Cabomba caroliniana*) in the inlet area, but as far as we could determine it is not present elsewhere in this large lake. This population was first recorded in 1982.

Curly pondweed (*Potamogeton crispus*) – Curly pondweed (*Potamogeton crispus*) was present in seven of the lakes, but in no case was it a dominant plant. This species is easy to miss late in the season as it senesces earlier than many other aquatic species.

Eurasian water-milfoil (*Myriophyllum spicatum*) - Eurasian water milfoil) was present in four lakes; it was the dominant aquatic species in two (Lake Nockamixon and Kaercher's Creek Lake) and abundant, but not dominant, in (Harvey’s Lake).

Hydrilla (*Hydrilla verticillata*) - Hydrilla), a federally designated noxious weed, was found to be widespread in shallow areas of Lake Nockamixon.

Waternymph (*Najas minor*) - Waternymph was found at Hopewell Lake and Kaercher’s Creek Lake, both in Berks County. This Eurasian native was first collected in Pennsylvania in the 1960s and appears to be spreading.

European water-chestnut (*Trapa natans*) - We documented the presence of *Trapa natans* (European water-chestnut) at three lakes in Pike County, all of which are directly connected to each other in the headwaters of the Little Bushkill Creek. European water-chestnut has been present at one of them, Lake Maskenozha, at least since 1982 (A. Rhoads, personal communication), but has not become dominant.

Additional Field Surveys

Additional field surveys were carried out in Bucks, Chester, Delaware, and Carbon Counties. Field reports for the 13 element occurrences documented have been sent to The Pennsylvania Natural Heritage Program. The most notable finds were new occurrences of two state endangered species: swamp lousewort (*Pedicularis lanceolata*) in Bucks County and white twisted stalk (*Streptopus amplexifolius*) in Carbon County.

Aquatic Plant Workshops

We conducted three hands-on workshops in conjunction with the Pike County Conservation District, Delaware Highlands Conservancy, and Lake Paupack Association. The purpose of the workshops was to acquaint Pocono area residents and managers of lakes with the diversity and ecological role of native aquatic vegetation and enlist them in monitoring for non-native invasive species. These meetings also enabled us to make numerous contacts, which have resulted in opportunities to survey additional privately owned lakes. We also met with lake community residents at many of the lakes where we conducted surveys.

Environmental Reviews

At the request of Autumn Sabo, we have consulted on five projects that have come up for environmental review because of potential impacts on PNDI-listed plants.

We also participated in a scouting trip to Little Tinicum Island with Bureau of Forestry personnel on September 15, 2003 to prepare for a Pennsylvania Cleanways trash removal project day scheduled for October.

Discussion of Management Recommendations

An outcome of this year's surveys will be recommendations that the aggressive tendencies of *Myriophyllum heterophyllum* and *Utricularia inflata* be taken into consideration in defining their status.

Our finding of additional large populations of *Utricularia purpurea*, *Potamogeton robbinsii*, *Potamogeton bicupulatus*, *Elatine minima*, *Gentiana linearis*, *Eleocharis olivacea*, and *Najas gracillima* is further evidence that our recommendations in the last three years to drop these species from the PNDI list were correct.

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Appendix A.

Lakes Included in 2003 Survey

Pike County

Forest Lake
Lake Maskenozha
Lake Paupack
Lehman Lake
Minks Pond
Nitche Pond
Pecks Pond
White Deer Lake

Monroe County

Brady's Lake
Pocono Lake

Luzerne County

Beech Lake
Behren Pond
Harris Pond
Harvey's Lake
Lake Silkworth
Lily Lake
Mountain Springs Lake
Nuangola Lake
Panther Lake
Perrins Marsh
Sylvan Lake
The Meadows, SGL 57
unnamed lake 3.5 km ESE of Ochre Mill
Welcome Lake

Wayne County

Cadjaw Pond
Lake Ariel
Tobyhanna Lake

Bucks County

Lake Warren
Nockamixon Lake

Berks County

Hopewell Lake
Scotts Run Lake
Kaercher's Creek Lake

Additional lakes visited by Jen Petzold for *Bidens discoidea* survey

Fariview Lake, Pike Co.

Gouldsboro Lake, Monroe and Wayne Cos.

Lake Minisink, Pike Co.

Promised Land Lake, Pike Co.

Egypt Mills Lake, Pike Co.

Miller Pond, Wayne Co.

Little Mud Pond, Pike Co.

Lower Lake, Pike Co.

Appendix B. Specimens deposited at the Morris Arboretum of the University of Pennsylvania (MOAR).