

New England Plant Conservation Program

*Nymphaea leibergii* Morong  
Pygmy Water-lily

Conservation and Research Plan  
for New England

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## SUMMARY

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*Nymphaea leibergii* Morong (Nymphaeaceae), the pygmy water-lily, is an uncommon species with 21 historic sites in New England, of which 18 are extant (17 in Maine, 1 in Vermont). The species is listed as G5 globally, and S1 by the states of Maine and Vermont. Five other states and provinces also list it as S1 or S2, and one as Endangered. *Nymphaea leibergii* is most abundant in Ontario. *Nymphaea leibergii* is found in neutral to acid ponds, lakes, and slow-flowing streams. Throughout its range, most of the sites are in undeveloped waters with minimal threats.

### **Conservation Objectives**

1. Maintain approximately 20-25 populations with 50-100 plants at each site.

### **Conservation Actions Needed**

1. Attempt to locate *N. leibergii* from the site (ME .006 [Oxbow]) that has not been verified as *N. leibergii*.
2. Attempt to relocate populations from historical records or from the site above if the identity is verified and conduct *de novo* searches.
3. Closely monitor known populations for increases or long-term decreases in numbers.
4. Monitor sites at least every two years for signs of eutrophication and invasive species or every five years for stable populations.
5. Conduct water chemical analyses at each extant site of *N. leibergii* to determine the habitat parameters of the species.
6. Educate fishermen and boaters concerning the impacts to public waterways when invasive species are introduced.

## PREFACE

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This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Full plans with complete and sensitive information are made available to conservation organizations, government agencies, and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

The New England Plant Conservation Program (NEPCoP) of the New England Wild Flower Society is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published “*Flora Conservanda: New England.*” which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of *Flora Conservanda* species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP’s Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection.

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# I. BACKGROUND

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## INTRODUCTION

The pygmy water-lily, *Nymphaea leibergii* Morong (Nymphaeaceae), is the eastern North American representative of the diminutive water-lilies. It is widely distributed in northern North America, with the greatest concentration in Ontario, Canada. In northeastern North America, the greatest concentration is in northern Maine. In New England there are 21 historical sites of which 18 are extant: 17 in Maine, one in Vermont. *Nymphaea leibergii* is typically found in cool, neutral to acidic, pristine waters. Presently in New England, only the Vermont location is tending toward eutrophic conditions.

This Conservation and Research Plan evaluates the status of *Nymphaea leibergii* in New England and provides recommendations essential to the recovery and long-term preservation of the taxon. The conservation objective for the taxon in New England is to maintain approximately 20-25 populations with 50-100 plants at each site. This will be accomplished through regular monitoring of existing sites, research to determine the habitat parameters of the species, education and other actions to prevent competition from invasive species, and research and verification of additional sites from which the taxon has been recorded.

## DESCRIPTION

*Nymphaea leibergii* is an aquatic perennial that grows from vertical, unbranched rhizomes. Leaves are ovate to elliptic, 3-9 x 2-15 cm, green above, deep purple below, glabrous on the lower surface with 7-13 major veins. Flowers are floating, 3-7.5 cm in diameter. The sepals and outermost petals form distinct whorls of 4. Petals are 8-15, white, with stamens 20-40, yellow, filaments slightly dilated, longer than the anthers. The pistils are 5-12-locular with tapered or slightly cymbiform appendages 0.6-1.5 x 0.8-1.4 mm. Seeds are ovoid, 2-3 X 1.5-2 mm (Wiersema 1997). The flowers open approximately at noon and close by 6 pm for four to six days. Flowers have a slight scent (Hellquist, personal observation).

The key below (Crow and Hellquist 2000, Wiersema 1997) is for the species of *Nymphaea* in New England. The related *Nymphaea tetragona*, from northwestern North America is included to indicate the distinction between it and the native *N. leibergii*. Photographs in the Appendix illustrate the differences between the two taxa.

1. Flowers 6-19 cm wide; petals 17-43; filaments widest below the middle; leaves 5-40 cm wide, ovate; rhizome horizontal.
  2. Petioles green or purple, not striped, rounded at the junction with the leaf; leaves red to purple (rarely green) on lower surface; branches of rhizomes not constricted and not detaching easily; seeds 1.5-2.3 mm long .....  
.....*N. odorata* subsp. *odorata*
  2. Petioles green with brown stripes, slightly flattened at junction with leaf; leaves green to slightly reddish on lower surface; branches of rhizome constricted and easily detaching; seeds 2.8-4.4 mm long.....  
.....*N. odorata* subsp. *tuberosa*
1. Flowers 3-7.5 cm wide; petals 8-17; filaments widest above the middle; leaves 2-15 cm wide, obovate to elliptic; rhizome vertical.
  3. Stigmatic disc yellow; carpellary appendages up to 1.5 mm long; receptacle on bud and open flower, rounded or slightly 4-angled .....*N. leibergii*
  3. Stigmatic disc reddish-purple; carpellary appendages mostly 3 mm or more long; receptacle on bud and open flower distinctly 4-angled .....*N. tetragona*

**TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY**

*Nymphaea leibergii* was first described in 1888 by Thomas Morong (as *Castalia leibergii* Morong) from collections made by Leiberg from northern Idaho. The site of the type locality (lectotype at New York Botanical Garden) was described by Morong as “small pond in northern Idaho near Granite station, on North Pacific Railway,” June, 1887. Hellquist attempted to relocate this site in 2001, in Kootenai County, without any success. Morong differentiated *N. leibergii* from the Asian *N. pygmaea* Salisb. based upon its larger flowers with more obtuse sepals, petals, and leaf lobes (Wiersema 1996). Conard (1905) reduced *N. leibergii* and *N. pygmaea* to synonymy under an older name *N. tetragona* Georgi. Cockerell (1908) followed the suggestion of Conard and accepted *N. tetragona* Georgi var. *leibergii* (Morong) J. Schust. (Wiersema 1996). Porsild (1939) assigned all the North American pygmy water-lilies to *N. tetragona* subsp. *leibergii*, with *N. tetragona* subsp. *tetragona* assigned to the Old World. Wiersema (1996, 1997) has split the taxa, recognizing both *N. leibergii* (Appendix 2) and *N. tetragona* (Appendix 2) in North America.

Wiersema (1996) noted that every author studying the two small water-lilies, *N. leibergii* and *N. tetragona*, from North America considered them together as one taxon, causing much confusion in the description of the two species. All manuals of northeastern North America recognized *N. tetragona*, which, in fact was *N. leibergii*. The eastern-most site for *N. tetragona* is southeastern Manitoba (Wiersema 1996).

*Nymphaea leibergii* is in the hardy (non-tropical) subgenus *Nymphaea*, section *Chamaenymphaea*.

**Synonymy** (Wiersema 1996)

- *Castalia leibergii* Morong, 1888, *Botanical Gazette*, 13: 124.
- *Castalia tetragona* var. *leibergii* (Morong) J. Schust., 1907, *Bulletin des L'Herbier Boissier ser. 2*, 7: 856.
- *Nymphaea tetragona* Georgi subsp. *leibergii* (Morong) A. E. Prosild, 1939, *Canadian Field-Naturalist* 53: 50.

**SPECIES BIOLOGY**

*Nymphaea leibergii* is an insect-pollinated perennial, propagating exclusively from seed. Flowers are diurnal, opening in the early afternoon and closing around 6:00 pm. Flowers bloom for five to seven consecutive days. When the first day flowers open, the stigma is covered with nectar and is receptive for pollination. By day three, the stamens are producing pollen (Hellquist, personal observation). These observations are consistent with that reported for the European *Nymphaea* by Hutchinson (1975). Sculthorpe (1967) notes that all the Nymphaeaceae are protogynous and nectarless. They are pollinated by beetles, small flies, and sweat-bees that crawl over the surface of the flower. It is believed that the attraction for these pollinating agents is most likely the odor and warmth of the opening flower along with the food value of the stamens. Sculthorpe (1967) indicates that some north-temperate Nymphaeaceae such as *N. alba* and *N. tetragona* have a faint odor and may have abandoned cross-pollination. Hill viewed pollination at the ME .002 (T14 R4 WELS) population in 1988. He reported the fly (Diptera) *Notiphila* cf. *shewelli* of the family Ephyridae apparently pollinating the plants. There is no evidence that autogamy, which occurs in some species of *Nymphaea*, contributes to seed production, as flowering plants in cultivation fail to set seed when pollinators of other flowers are not present (Wiersema 1988).

Following pollination, the peduncle bends just below the flower and the lower portion twists into a spiral, eventually pulling the developing fruit below the surface. The fruit matures in three to four weeks. Upon ripening, the fruit ruptures and the seeds with the surrounding aril float on the surface of the water. The seeds fall to the substrate as the aril deteriorates (Hellquist, personal observation). The fruit is technically a berry with a firm outer wall with inner tissues becoming soft and mealy. The ovary cells are filled with hard, ovoid cells embedded in mucilage and surrounded with an aril (Conard 1905).

*Nymphaea leibergii* is dependent on seed for propagation. Flowers of *Nymphaea leibergii* produce large seeds that fall to the substrate near the parent plants. Seedlings are rarely observed at any distance from the parent plant. Sown seeds tend to stay on the same side of the river where the parent plants are. The seed usually needs a period of

dormancy and will readily germinate in the spring or after a cold treatment. Young seedlings produce thin membranous leaves (Hellquist, personal observation).

*Nymphaea leibergii* produces vertical tubers that rarely produce offshoots. This is in contrast to *N. odorata* which occasionally produces seeds, but readily produces offshoot tubers from the main horizontal tuber. Leaf characteristics vary among populations. In New England, the floating leaves typically have a wide sinus.

Leaf characteristics vary among populations. In New England, the leaves typically have a wide sinus. Leaves in Minnesota, Manitoba, and Saskatchewan often have overlapping leaf bases. Newly-formed leaves occasionally have slight mottling. This contrasts with the newly emergent leaves of *N. tetragona*, which are often strongly mottled. Leaves have been observed in populations of *N. leibergii* in Minnesota and Manitoba that are much larger than any found in New England. These are at the upper range of leaf measurements given in the description (Hellquist, personal observation).

Hybridization has been observed among the various northern species and subspecies in the United States and Canada. Hellquist has observed natural hybrids between *N. odorata* Aiton subsp. *odorata* × *N. odorata* Aiton subsp. *tuberosa* (Paine) Wiersema & Hellquist in Vermont. Sterile hybrids of *Nymphaea odorata* subsp. *tuberosa* × *N. tetragona* and *N. leibergii* × *N. tetragona* have been documented in Manitoba by Hellquist and Wiersema (personal observations). In New England, the sterile hybrid between *N. odorata* subsp. *odorata* and *N. leibergii* has been found at two locations, ME Site 3 (Holeb) and VT .001 (Derby). A fertile population of *N. odorata* × *N. leibergii* is also known from a Manitoba site where only *N. leibergii* occurs. The subspecies of parental *N. odorata* involved in this hybrid is presently not known, but is most likely subsp. *tuberosa* because it is the closest in proximity to the population (Hellquist and Wiersema, personal observations).

## **HABITAT/ECOLOGY**

*Nymphaea leibergii* occurs in many habitats, but appears to be rare throughout most of its range (Wiersema 1997). It has been observed growing along undeveloped, shallow shores of lakes and ponds in sand and mud. It is most often found in slow-flowing streams in northern cool, clear waters, mainly at inlets where rivers and streams enter major lakes. It typically grows in water from two to seven feet (0.5-2.5 m) in depth that is protected from destructive wave action. In New England, most of the sites are rivers and streams near their entry into lakes and ponds or in lakes and ponds near inlets. They rarely are found any distance from an inlet (Hellquist, personal observation). Not much is known of the water chemistry from sites for *N. leibergii*. Associated plants indicate it occurs in neutral to acid waters (Moyle 1945, Hellquist 1975). Hellquist (unpublished data from three sites), has found it in waters with an average pH of 7.1 and total alkalinity of 20 mg/l CaCO<sub>3</sub>.

The areas where the species has been found in New England are in regions of neutral to acid waters with the exception of the VT .001 (Derby) site. While no data are available on the pH or alkalinity of this site, associated plants at the site indicate a higher pH or more alkaline situation (Hellquist, personal observation). In Manitoba and Saskatchewan, it has been found in waters both off and on the granitic Canadian Shield (Hellquist, personal observation). Populations observed in Minnesota, Manitoba, and Saskatchewan occur in similar habitats to that of New England. Plants typically occurring with *N. leibergii* in New England are: *Potamogeton natans* L., *P. epihydrus* Raf., *P. richardsonii* (Ar. Benn) Rydb., *Nuphar variegata* Engelm., *Sagittaria cuneata* Sheldon, and *Myriophyllum verticillatum* L.

## **THREATS TO TAXON**

*Nymphaea leibergii* is found mostly in remote, pristine areas of northern New England. The VT .001 (Derby) site is the only site that has any invasive species, *Myriophyllum spicatum* L. and *Potamogeton crispus* L., growing in the nearby vicinity. The same site has a large population of the native *Myriophyllum verticillatum*, which at the moment appears not to be imperiling the *N. leibergii*. Eutrophication is not currently a problem at any of the areas.

Hybridization has been documented at ME Site 3 (Holeb) and VT .001 (Derby) with *N. odorata*. *Nymphaea leibergii* and *N. odorata* both exist at ME .003 (Portage Lake) but no hybridization has been observed at this location. The hybrids are far less abundant than the parent species at the two sites. Hybridization probably does not present any major threats to *N. leibergii*.

The ME .002 (Sinclair/T14R4 WELS) site has been observed at least six times since it was originally discovered in 1972. A beaver dam has been constructed since then and the population has been reduced. Whether the beavers are eating the tubers of *N. leibergii* or not is pure speculation. The increase in water depth may or may not be contributing to the decline. Plants are found above and below the dam.

## **DISTRIBUTION AND STATUS**

### ***General Status***

*Nymphaea leibergii* occurs across North America from southern Quebec west to Ontario, Manitoba, Saskatchewan, Alberta, and eastern British Columbia, south to northern Maine, northern Vermont, Isle Royale, Michigan, northern Minnesota, western Montana, and northern Idaho (Figure 1, Table 1). It is rare throughout its range, with the greatest number of populations in northern Ontario (Wiersema 1996). In the eastern portion of its range, it is not known from New Brunswick, even though there are sites in northern Maine less than ten miles from the border. In Quebec, there are approximately 20 sites (M. Blondeau, freelance botanist, personal communication), with a few near the

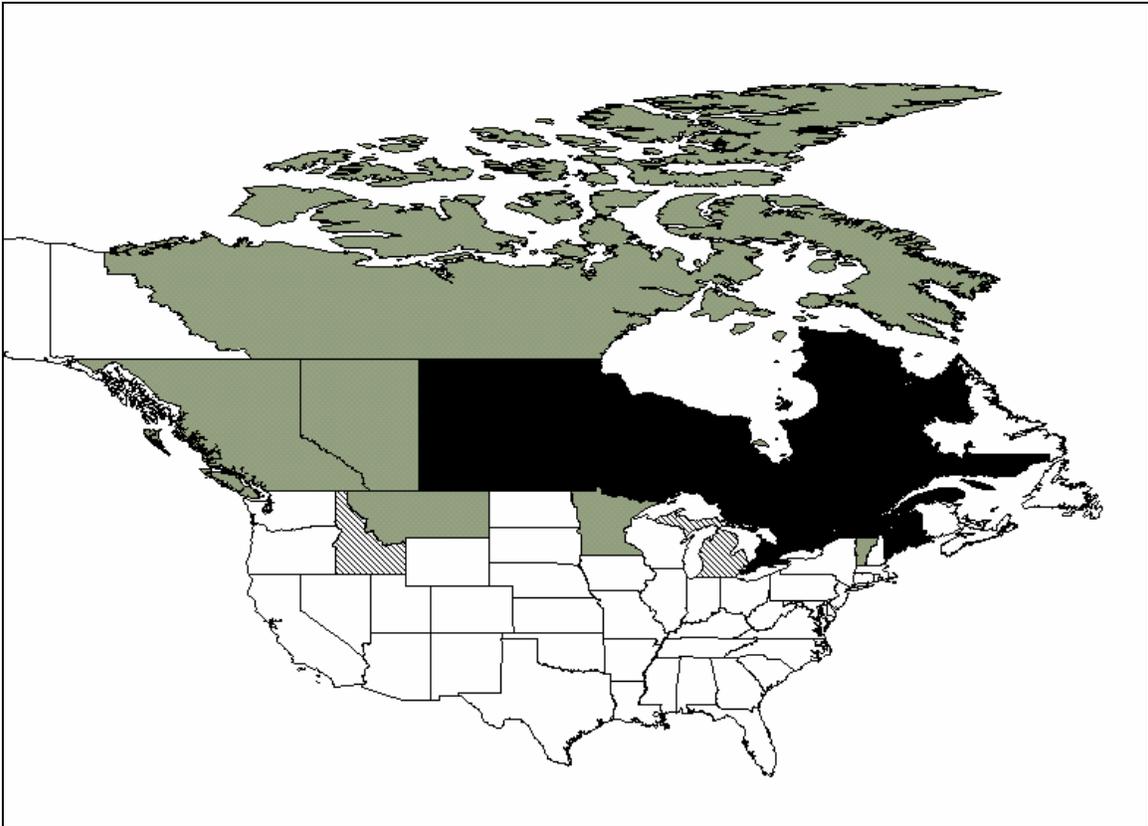
United States border. One Quebec site is near the VT .001 (Derby) site. The Maine populations appear to have the greatest concentration of plants in the eastern United States and also have the populations at the closest proximity to each other in eastern North America. The next greatest concentration of populations in the United States appears to be in northern Minnesota (Hellquist, personal observation), where the plant is listed as Threatened. The Isle Royale, Michigan site was last collected in 1963 (Voss 1985). In western North America, a few populations still exist in northwestern Montana, Alberta, and British Columbia, but none are currently known from Idaho, where the species was originally discovered. Records of *N. leibergii* from Alaska are in error. The records are based on *N. tetragona*, not *N. leibergii* (Wiersema 1996, 1997).

### ***Status of all New England Occurrences — Current and Historical***

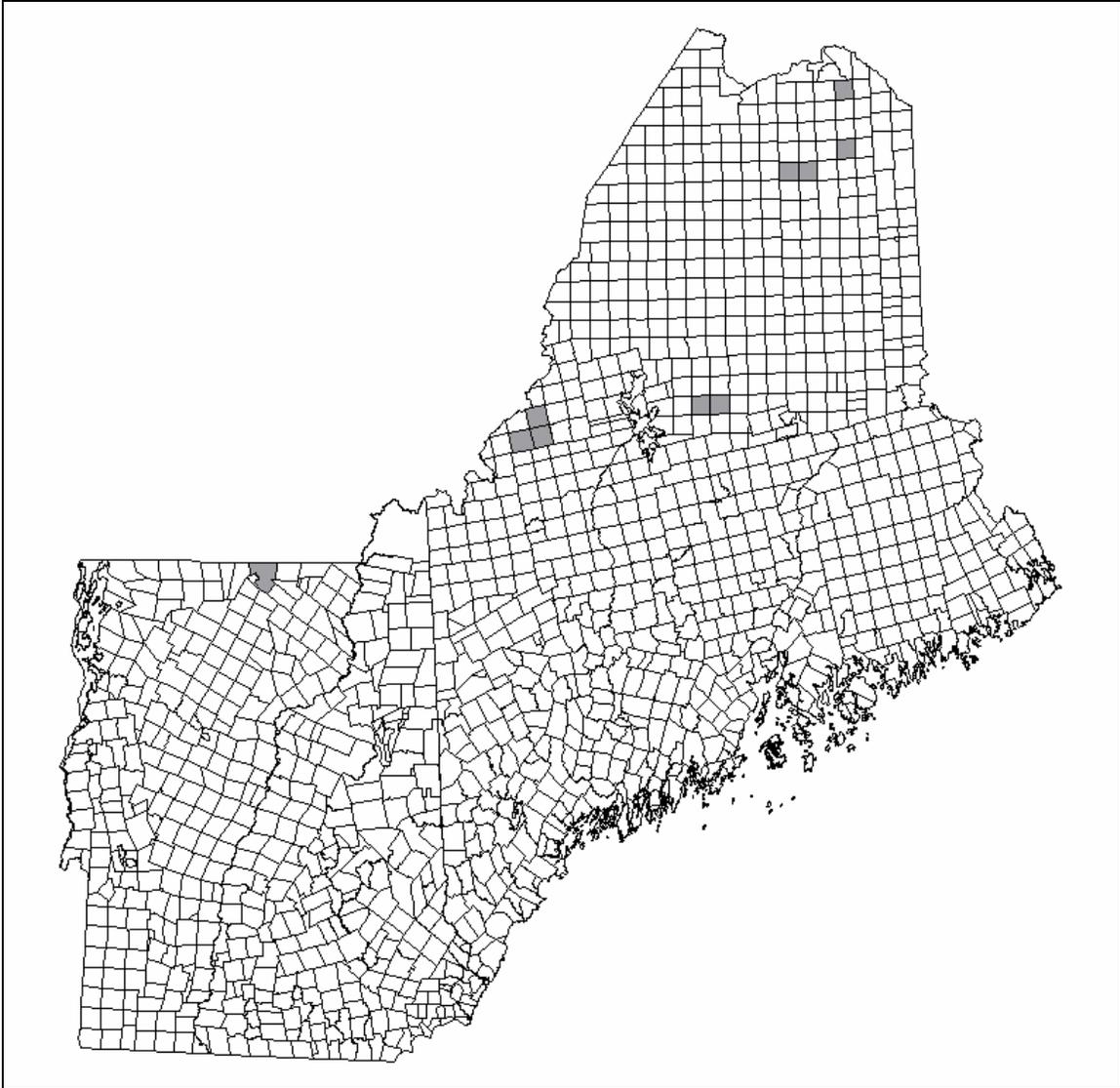
Based on herbarium records, literature (Gawler 1981), records of Maine Natural Areas Program, and fieldwork of C. B. Hellquist and Sally Rooney, 20 locations, of which 17 are extant, occur in Maine, and one extant site occurs in Vermont (Table 2, Figure 2, Figure 3). Element Occurrences (EO) ranks and Element Occurrence numbers used are those assigned by the Maine Natural Areas Program and the Vermont Natural Heritage Program. Those sites not entered in the states data files are designated as site numbers.

A population is designated as a separate location when in the same body of water. This is indicated by separating ME .004 (Attean) and ME Site 1(Attean) populations. The ME .004 (Attean) site is on one side of the river and the ME Site 1(Attean) is a series of coves on the other side of the river. These populations have been kept separate because the chance of the seed being easily dispersed from one site to the other is remote. Since the seed is large and generally germinates around the parent plant, these populations are treated as distinct. This would hold true for populations in the same drainage such as the ME .005 (T1, R12, WELS) and ME Sites 7- 10 (T1 R11 WELS). It is highly unlikely that the seed has moved that easily through the system.

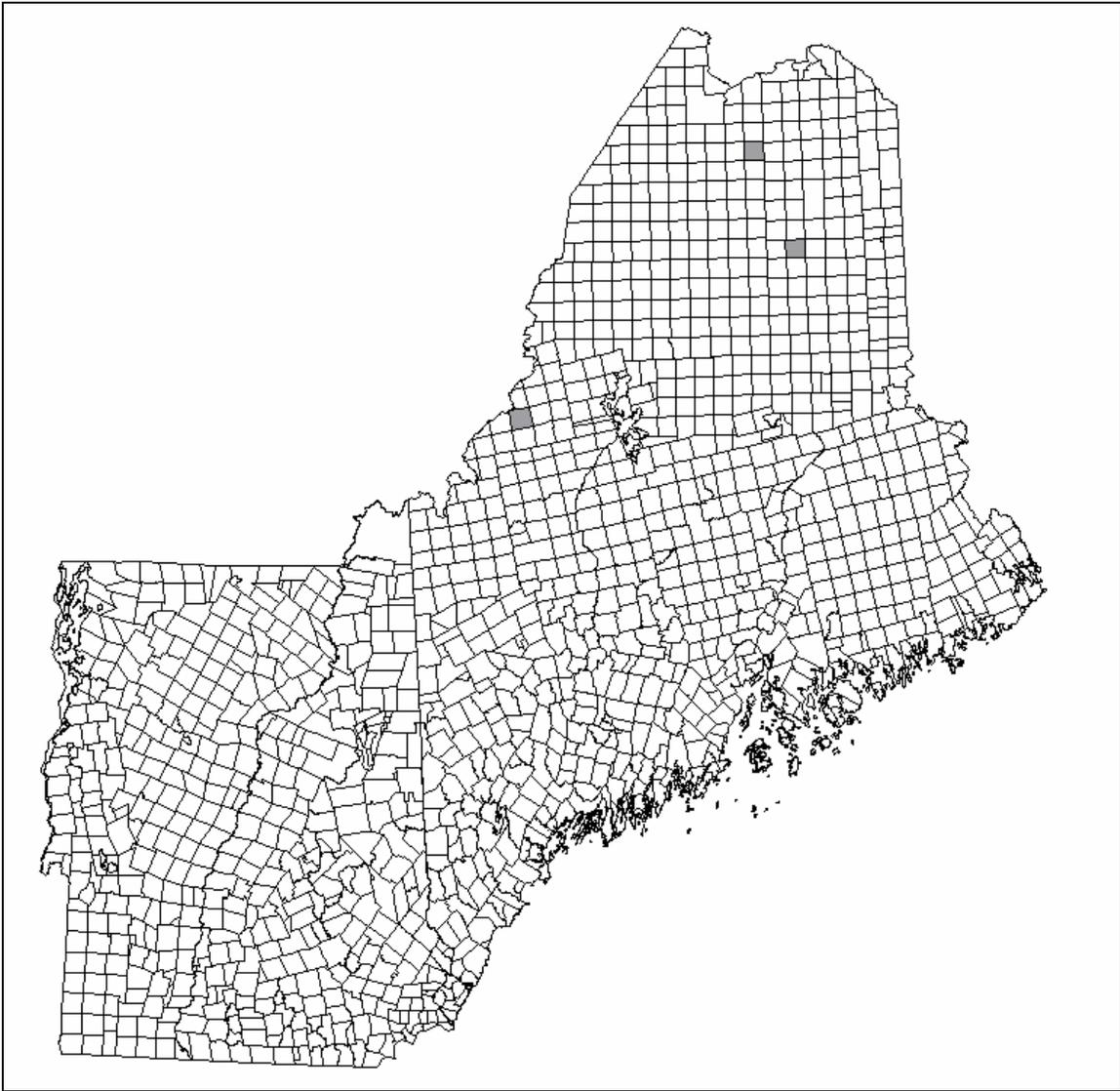
<b>Table 1. Occurrence and status of <i>Nymphaea leibergii</i> in the United States and Canada based on data from Natural Heritage Programs and NatureServe records unless otherwise specified</b>			
<b>OCCURS &amp; LISTED (AS S1, S2, OR T &amp; E)</b>	<b>OCCURS &amp; NOT LISTED (AS S1, S2, OR T &amp; E)</b>	<b>OCCURRENCE VERIFIED FROM HERBARIUM RECORDS OR WRITTEN RECORDS</b>	<b>HISTORIC (LIKELY EXTIRPATED)</b>
Maine (S1), Endangered, 20 sites, 17 current (Cameron, Maine Natural Areas Program, personal communication).	Michigan (S1), Endangered site, but should be considered historical (Voss 1985)	Northwest Territories, 1 site, (Cody 1979, McJannet et al. 1983). (Most likely these reports are <i>N. tetragona</i> which has been confirmed for the Province; Wiersema personal communication).	Idaho, (SH)1 site historical (Wiersema 1996)
Vermont, (S1), proposed as Endangered 2003, 1 site, 1 current, (Popp, Vermont Nongame and Natural Heritage Program, personal communication)	Ontario (S4) ca. 13 sites (Wiersema 1996). Wiersema notes at least 22 distinct dots on the population map published therein (Wiersema, USDA, personal communication). Not listed.		
Minnesota, (S2), Threatened ca. 6 sites) at least 3 current (Wiersema, 1996, Hellquist personal data)	Manitoba (S4) ca. 10 sites (White and Johnson 1980, Wiersema 1996, Hellquist unpublished data). Not listed.		
Montana (S1), Species of Concern, 3 sites (Schuyler 1983)			
Quebec ca. 20 sites, 16 sites current, (Wiersema, 1996, M. Blondeau personal communication), rank unknown			
Saskatchewan (S2) 10 sites (S. Porter, Sask. Environment, personal communication), rank unknown			
Alberta (S1)1 site (Argus & White 1978, Wiersema 1996) 2 additional sites located in 2000, Wiersema and Hellquist personal observations), rank unknown			
British Columbia (S2S3), Special Concern 3 sites (Brayshaw 1989, Staley et al. 1985, Wiersema 1996)			



**Figure 1. Occurrences of *Nymphaea leibergii* in North America.** States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. Area shaded in black have more than five confirmed occurrences. States with diagonal hatching are considered "historic," where the taxon no longer occurs. See Appendix for explanation of state ranks.



**Figure 2. Extant occurrences of *Nymphaea leibergii* in New England.** Town boundaries for northern New England states are shown. Towns shaded in gray have one to five extant occurrences of the taxon.



**Figure 2. Historic occurrences of *Nymphaea leibergii* in New England.** Towns shaded in gray have one to five extant occurrences of the taxon.

**Table 2: New England Occurrence Records for *Nymphaea leibergii*. Shaded Occurrences are Considered Extant.**

State	EO #	County	Town
ME	.001	Aroostook	Perham
ME	.002	Aroostook	T17 R4 WELS/ Sinclair
ME	.003	Aroostook	Portage Lake
ME	.004	Somerset	Attean
ME	.005	Piscataquis	T1 R12 WELS
ME	.006	Aroostook	Oxbow
ME	.007	Aroostook	T13 R7 WELS
ME	.008	Somerset	Holeb
ME	.009	Somerset	Dennistown
ME	.010	Aroostook	T14 R8 WELS
ME	Site 1	Somerset	Attean
ME	Site 2	Somerset	Holeb
ME	Site 3	Somerset	Holeb
ME	Site 4	Somerset	Dennistown
ME	Site 5	Aroostook	T17 R4 WELS, Sinclair
ME	Site 6	Aroostook	T17 R4 WELS, Sinclair
ME	Site 7	Piscataquis	T1 R11 WELS
ME	Site 8	Piscataquis	T1 R11 WELS
ME	Site 9	Piscataquis	T1 R11 WELS
ME	Site 10	Piscataquis	T1 R11 WELS
VT	.001	Orleans	Derby

## II. CONSERVATION

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### CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

The primary goal for *N. leibergii* is to regularly monitor the populations at the 18 extant sites and, in the future, to add new sites for a total of at least 20-25 viable sites in northern New England. It is hoped that these sites will support a minimum average of 50-100 plants, each reflecting numbers at many of the long-lived sites in New England. It is important to record the change in population densities over a number of years to determine how *N. leibergii* is growing and to see if there is any correlation of population growth with factors that might affect growing conditions. Presently, the most secure sites in New England are ME .004 (Attean) and ME .003 (Portage Lake), with ME .005 (T1, R12, WELS), and VT .001 (Derby) also secure. These and all sites should be monitored regularly every five years.

The sites where *N. leibergii* occurs should be carefully monitored for any signs of eutrophication. Presently, all the sites except for VT .001 (Derby) are in northern pristine water bodies with minimal development. The chances for imminent eutrophication occurring at the Maine sites are remote. The most likely place where eutrophication and invasive weeds could become a problem would be at the VT .001 (Derby) site. Invasive aquatic species are presently unknown at all sites except VT .001 (Derby), where a small number of *Myriophyllum spicatum* and *Potamogeton crispus* plants are found. Presently, they are not interfering with the *N. leibergii*. Public education is recommended to prevent eutrophication and introduction of invasive species into waters where *N. leibergii* occurs.

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## APPENDICES

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### **1. Photographs of *Nymphaea leibergii***

***a. Nymphaea leibergii*: Snow Lake, Manitoba**

***b. (top) Nymphaea tetragona*, fruits L-R: immature to mature fruit**

***b. (bottom) Nymphaea leibergii*, fruits L-R: immature to late fruit**

### **2. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe**

1. Photographs of *Nymphaea leibergii*



*Nymphaea leibergii*: ME .002 (T14 R4 WELS) Aroostook County, Maine



Top row: *Nymphaea tetragona*, fruits: L, mature fruit, M. early fruit, R. developing fruit  
Bottom row: *Nymphaea leibergii*, fruits: L, mature fruit, M. early fruit. R. developing fruit

## 2. An Explanation of Conservation Ranks Used by the Nature Conservancy and NatureServe

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

- 1 = critically imperiled
- 2 = imperiled
- 3 = vulnerable to extirpation or extinction
- 4 = apparently secure
- 5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis—that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction—i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks. (The lower the number, the “higher” the rank, and therefore the conservation priority.) On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element group—thus G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observation have been made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EO's have received such ranks in all states, and ranks are not necessarily consistent among states as yet.