

*Conservation Assessment
for
Algal Pondweed (Potamogeton confervoides)*



USDA Forest Service, Eastern Region
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This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information on Potamogeton confervoides. This report provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It is an administrative study only and does not represent a management decision by the U.S. Forest Service. Although the best scientific information available was used and subject experts were consulted in preparation of this document and its review, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if the reader has any information that will assist in conserving this species, please contact the Eastern Region of the Forest Service – Threatened and Endangered Species Program at 310, W. Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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EXECUTIVE SUMMARY

This Conservation Assessment is a review of the distribution, habitat, ecology and population biology of algal pondweed (*Potamogeton confervoides* Reichenbach). This species is listed with a global G4 ranking (Uncommon but not rare; apparently secure) and as Vulnerable (S3) in Michigan. It has Regional Forester Sensitive Species (RFSS) ranking of within the Hiawatha National Forest in Michigan, the Chequamegon-Nicolet National Forest in Wisconsin and the Green Mountain National Forest in Vermont (RFSS 2000). It also occurs on the White Mountain National Forest in New Hampshire, but it is not listed as R9 since it is not state-listed as Threatened or Endangered in New Hampshire (L. Prout pers. comm. 2001).

Since *P. confervoides* favors acidic environments, activities that would encourage eutrophication and enrichment (increased alkalinity), are especially detrimental. General threats to the survival of *Potamogeton confervoides* include development in and around lake, pond and stream habitats where it occurs, including any modification of hydrological regime, or liming of ponds for fishery management.

Opportunities for research and/or monitoring of *Potamogeton confervoides* include life history, habitat requirements and threats to viability. Research and/or monitoring of known populations within National Forest lands are needed to analyze potential impacts from proposed forest management actions.

INTRODUCTION/OBJECTIVES

One of the conservation practices of the USDA Forest Service is designation of Regional Forester Sensitive Species (RFSS). The Eastern Region of the Forest Service (R9) updated its Sensitive Species list on February 29, 2000. Part of that process included identification of priority species for further study by the development of Conservation Assessments and Strategies. *Potamogeton confervoides* (algal pondweed or alga-like pondweed) is one of those priority species.

The objectives of this document are to:

- Provide an overview of the current scientific knowledge
- Provide a summary of the distribution and status range throughout the Eastern Region of the Forest Service
- Provide the available background information needed to prepare a subsequent conservation strategy.

The National Forest Management Act and U.S. Forest Service policy require that Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its range and within a given planning area

(FSM 2670.5.22). *Potamogeton confervoides* is listed as Regional Forester Sensitive in Region 9, the Eastern Region of the U.S. Forest Service.

NOMENCLATURE AND TAXONOMY

Family:	Potamogetonaceae (Pondweed)
Scientific name:	<i>Potamogeton confervoides</i> Reichenbach
Common names:	algal pondweed, alga-like pondweed, algal-leaved pondweed, Tuckerman's pondweed
USDA NRCS plant code:	POCO12
Synonymy:	<i>Potamogeton tuckermanii</i> Robbins

DESCRIPTION OF SPECIES

Potamogeton confervoides is an aquatic perennial. It is a distinctive pondweed characterized by fan shaped branches of extremely delicate, thread-like leaves and a solitary, long, peduncle (Voss 1972). Peduncle length can vary considerably with conditions; in Michigan peduncle length was reported by Voss as between 3-14 cm, in the Northeastern states peduncle lengths ranged between 15-24 cm (Crow and Hellquist 2000). Plants have slender, creeping rhizomes and develop submerged tread-like leaves. When not in flower, this species can be difficult to distinguish, appearing somewhat like filamentous algae (Chadde 1998) as this species often become entangled among other submerged plants (Hellquist and Crow 1980 in USDA Forest Service 1999). Some botanists find *P. confervoides* easier to identify in spring through early summer when it is in flower (Sorrie 1993); others prefer to use the fruits to verify identification (Voss, pers. comm. 2003).

Similar Species

In New England, *P. confervoides* grows with other submergent thread-like foliage such as *Eleocharis acicularis* (spike-rush), *Eleocharis robbinsii* (spike-rush) and *Scirpus subterminalis* (bulrush) (Hellquist and Crow 1980). The spike-rushes and *S. subterminalis* have only a basal tuft of leaves; while in *P. confervoides* the leaves are alternate on an elongated, branched stem (Voss pers. comm. 2003).

Technical Description:

Material from Chadde 1998, Fernald 1987, Flora of North America 2000, Gleason and Cronquist 1991, and Radford et al. 1968

Rootstock: Filiform, extensively creeping, bearing small fusiform tubers (winter buds) late in the season.

Stem: Filiform, flaccid, multi-branched (forked), 1-8 dm long.

- Leaves:** Filiform and flaccid with numerous, alternate, submersed leaves of bright green to purplish color; 5 cm long, 0.2-0.3 mm wide, linear-setaceous, tapered to hairlike tips.
- Stipules:** Delicate, inconspicuous, and pale green; 3-10 mm long.
- Peduncle:** Slender, erect, and bearing a single, dense, globular cluster of fruits at tip of main stem; (3)5-20 cm long.
- Fruiting spike:** Terminal, thick cylindrical or subglobose, capitate; 5-10 mm long, 5-6 mm broad.
- Fruits:** Round-obovoid, small achenes, light green with a dorsal ridge and short, blunt beak; 2.2-3.5 mm long; June-August.
- Flowers:** Perfect, protogynous. Flower June through August for northern areas and April through September in the south.

HABITAT/ECOLOGY

Potamogeton confervoides characteristically occurs in acid or soft-water bogs and lakes (Voss 1972). It also occurs in slow-flowing streams associated with acid lakes (Roland and Smith 1969 in The Nature Conservancy 1993; Fernald 1932). Preferred habitat in the Great Lakes region is shallow water of lakes, kettle hole ponds, and peatlands (Chadde 1998). Substrate varies from sand to peat (Radford *et al.* 1968, The Nature Conservancy 1993). In New England according to Hellquist (1980), this species shows the greatest preference for acidity of all North American *Potamogeton* species; it is the only pondweed found in *Sphagnum* bog ponds (Hellquist and Crow 1999). Fernald (1932) termed this species as an oxylophyte (i.e. one for which the acidity of the substrate or water medium is a more important environmental criterion than climate or elevation). It has been suggested that *P. confervoides* success in acidic water is due to the species ability to take up CO₂ (Hutchinson 1975). Also, the high surface to volume ratio of some dominant plants in acidic lakes favors the uptake of nutrients (Roberts *et al.* 1985). There are no specific depth preferences cited for *P. confervoides*; however, it is not free floating and like other pondweeds requires substrate to root (Hellquist and Crow 1999).

Habitat and ecology specific to certain states/regions follows:

Canada

In Newfoundland, Fernald (1932) described this species as being characteristic of shallow depressions in peat. It is also found with other subarctic associates *Sparganium hyperboreum* (bur-reed), *Lycopodium inundatum* (bog clubmoss), *Schizaea pusilla* (curly-grass fern), and *Bartonia paniculata* (twisted stem) (The Nature Conservancy 1993). Fernald (1932) considered this pondweed common in all depths of water in the acid region of southwestern Nova Scotia and

Newfoundland. In Ontario, *P. confervoides* occurs in acidic waters of bogs, lakes, and slow-moving streams (Hellquist 1987).

Great Lakes States

For locations in Michigan's Upper Peninsula, common habitat is acid or soft-water bogs and lakes (MNFI 1993; Voss 1972). Substrate is typically a sandy-mucky bottom; the species has also been observed in loose peat along bog mat edges. The pH generally ranges from about 4 to 5.5 (The Nature Conservancy 1993). At Cusino Lake in Schoolcraft County in 1942, the lake was "slightly acid and extremely soft" (pH 6.8 and methyl orange alkalinity of 2.0 to 4.0 ppm.). In 1949, a lower pH was reported (5.2 to 5.4). Over 40% of Cusino Lake was less than 5 feet deep; water temperature at 5 feet was 72°. The dominant bottom type in shallow water is mostly sand, except for fibrous peat in protected bays; at about 11 feet the bottom changes from sand to pulpy peat (Voss 1965). At Little Dollar Lake (pH 4.5) in west-central Mackinac County, Michigan the submerged aquatic flora consisted of *P. confervoides* found with *Isoetes echinospora* (quillwort), and bladderwort *Utricularia geminiscapa* (Hellquist and Crow 1999). At Cusino Lake in Schoolcraft County, Michigan *P. confervoides* was found growing with *P. oakesianus* (Oakes' pondweed) and several bladderwort species, *Utricularia cornuta* being the most conspicuous (Voss pers. comm. 2003). Other plants found at that site include *Juncus pelocarpus* (rush), *Eriocaulon septangulare* (pipewort), *Isoetes macrospora* (quillwort), *Littorella americana* (water plantain), and *Lobelia dortmanna* (water lobelia) (USDA Forest Service 1999).

In Wisconsin, *Potamogeton confervoides* occurs in the shallow water of inland lakes, especially slightly acid to soft-water seepage lakes, typically surrounded by bog or swamp forest (Wisconsin DNR 1993). The water is usually of a low transparency (light brown in one occurrence) and the substrate is mucky or muddy (The Nature Conservancy 1993). Associates in Wisconsin, at a soft-water bog lake included *Eriocaulon septangulare* (pipewort), *Isoetes echinospora* (quillwort), *Najas flexilis* (naiad), and *Sagittaria latifolia* (arrowhead) (USDA Forest Service 1993).

New England

P. confervoides is commonly associated with soft waters in high elevation ponds and lakes. It occurs in waters with an average pH of 6.3 but can reside in water with a pH as low as 5.3 or as high as 6.8. Alkalinity averages 3.6 mg/liter CaCO₃ (Hellquist and Crow 1980 in The Nature Conservancy 1993). This species grows with other submergent thread-like foliage such as *Eleocharis acicularis* (spike-rush), *Eleocharis robbinsii* (spike-rush) and *Scirpus subterminalis* (bulrush) (Hellquist and Crow 1980).

In Vermont, *P. confervoides* occurs in extremely soft-water ponds with alkalinities generally less than 8.5 mg/liter. Common pond associates found in the Green Mountain National Forest include *Brasenia schreberi* (water shield), *Eriocaulon septangulare* (pipewort), *Equisetum fluviatile* (water horsetail), *Potamogeton oakesianus* (Oakes' pondweed) and *P. epiphydrus* (pondweed). Another pond was dominated by *Brasenia schreberi* and *Scirpus subterminalis* (water bulrush). Other aquatic plants included *Utricularia vulgaris* (bladderwort), *Nuphar variegata* (yellow pond lily), and *Eriocaulon aquaticum* (pipewort) (Vermont Heritage Program 2001).

In the Adirondack lakes of New York, *P. confervoides* was found to occur only in lakes with a pH below 5.1 along with *Utricularia geminiscapa* (bladderwort), and several *Sphagnum* species. These species are typical of oligotrophic systems and similar to those found in lake surveys in Scandinavia and eastern Canada. An increase in aluminum concentration was also observed in these lakes (Roberts *et al.* 1985).

DISTRIBUTION AND ABUNDANCE

Potamogeton confervoides occurs primarily in eastern North America along the Atlantic Coast ranging from Newfoundland to New York, Pennsylvania, New Jersey, North Carolina, South Carolina, extending west to outlier localities in eastern Wisconsin and the Upper Peninsula of Michigan (The Nature Conservancy 1993). In the eastern portion of its range, both in the United States and Canada, *P. confervoides* often occurs at higher elevations, up to 1500 m (FNA 2000). In the Great Lakes states it occurs in colder micro-climates within the Upper Peninsula of Michigan and northern Wisconsin.

Canada

It is found in New Brunswick, Newfoundland, Labrador, Nova Scotia, Ontario, and Quebec (FNA 2000). It is locally common in Nova Scotia and Newfoundland (The Nature Conservancy 1998). It is rare and only known from only a few occurrences in New Brunswick, Ontario, and Quebec (The Nature Conservancy 1999). Hellquist (1987) states that *P. confervoides* is rare in Quebec and New Brunswick.

Eastern United States

Known number of occurrences:

Michigan:	17 sites (Voss pers. comm. 2003)
New York:	22 sites (50 occurrences in Adirondack Mt. lakes)
North Carolina:	16 (extensive survey in 1994)
South Carolina:	1 (The Nature Conservancy 1998)
Vermont:	11; 7 in ponds within Green Mt National Forest (2001)
Wisconsin:	7 sites in 5 lakes; primarily from old records (Nichols and Martin 1990)

Other sources: Heritage Programs 2001; The Nature Conservancy 1993

Great Lakes States

For Michigan, *P. confervoides* is found within the Upper Peninsula counties of Alger, Chippewa, Luce, Mackinac, and Schoolcraft (MNFI 1999). On the Hiawatha National Forest, *P. confervoides* was discovered at the edge of Paquette Lake in Alger County during a year (1988) when the lake was 4 to 5 feet below normal water level (MNFI 1999). It is also known (1981) from Walker Lake in Chippewa County, which is a small soft-water lake with a sand bottom and bog shrubs on the margin. There is a campground on the north end. Walker Lake receives little use except for fishing (MNFI 1999). Whitmarsh Lake, also in Chippewa County is another

Hiawatha National Forest location (MNFI 1985). Lake Superior State Forest has bogs and lakes with several occurrences. Habitat within Lake Superior State Forest is described as soupy peat in shallow water for Luce County and as bog ponds in Chippewa and Mackinac Counties (MNFI 2001). *P. confervoides* is locally common in Cusino Lake in Schoolcraft County where it has been known (B.M. Robertson 916) since 1942 (Voss 1965). Other locations lie in the Tahquamenon Falls State Park and The Nature Conservancy's MacMahon Lake Preserve (The Nature Conservancy 1998).

Wisconsin's Chequamegon-Nicolet National Forest in Bayfield County has one occurrence that has been known since 1980 (Ree Lake). Ree Lake is a landlocked acid bog lake of 25 acres with a maximum depth of 14 feet. The substrate consists of 3 to 6 inches of soft muck over sand. Unrooted, floating plants of *Potamogeton confervoides* were ubiquitous throughout the lake. Rooted plants formed dense mats in littoral areas at water depths of 3 to 6 feet, primarily in a zone within 30 feet of the shoreline. *Potamogeton confervoides* prefers a substrate of firmer, more stable muck. Colonization was estimated to be about 30% of the littoral zone (Meyer and Dobberpuhl 1992). Other documented Wisconsin sites include Greater Bass Lake in Langlade County and Bass Lake in Lincoln County (Voss 1965).

In the Great Lakes Region, *P. confervoides* is not found as far west as Minnesota (NatureServe 2002).

New England

In New England, including New York and Pennsylvania, *P. confervoides* is found in ponds and lakes among granitic or schist mountains, mostly at altitudes between 610m (2000 ft.) to 915m (3000 ft.). The eastern Pennsylvania populations are now all believed to be extirpated (Steve Grund pers. comm. 2001). In New Jersey *P. confervoides* is restricted to ponds and streams in the Pine Barrens (Fernald 1932).

This species is mostly restricted to higher elevations either in the Green Mountains or the northeast region of Vermont. Within the Green Mountain National Forest, *P. confervoides* was reported from a 15 acre high elevation (2600 ft.) soft-water pond in 1989. Pipewort (*Eriocaulon septangulare*) was the only common aquatic plant at this site. *P. confervoides* was not observed in a 1992 survey of the same lake (Diane Burbank pers. comm. 2001). Eight ponds were listed by the Vermont Nongame and Natural Heritage Program based on surveys done by Dr. Barre Hellquist between 1994 and 1996. Pond elevations were listed from 500 to 2600 feet. The most vigorous sites were between 2100 and 2600 feet. One site was listed as having over 1000 stems with over 50% in fruit. Site pH was between 4.6 and 6.5 and conductivity ranged from 0-10 (Vermont Heritage 2001).

Distribution in New York is principally in the Adirondack Mountains at medium to high elevations and in soft-water lakes and ponds (including beaver ponds) and inlet streams. Several of the lakes occur at high elevations dominated by spruce and fir forests.

In North Carolina, there are 16 occurrences, 10 of which were found since 1992. Habitat is listed as beaver impoundment on creeks with mucky peat substrate, coastal plain man-made

impoundments, and eastern or southern shorelines of lakes in water up to 1.5 meters deep (MNFI 2001). Associates at the coastal plain impoundment include *Brasenia schreberi*, *Sparganium americanum*, *Mayaca fluviatilis*, and *Sagittaria latifolia*. Associates at a lake of 0.3 to 0.8m depth include *Juncus repens*, *Eriocaulon compressum*, and *Juncus abortivus* (MNFI 2001). In South Carolina, the single tracked population occurs in a beaver pond within a State Forest, where it was observed in full sun in 72cm of water (The Nature Conservancy 1993).

STATUS/PROTECTION

Current Global, Federal, State, and agency conservation status is given by rank. Rank definition for *Potamogeton confervoides* is as follows:

U.S. Fish and Wildlife Service: None (Not listed)

U.S. Forest Service: Region 9 Sensitive on Hiawatha (MI), Chequamegon-Nicolet (WI), and Green Mountain (VT) National Forests.

The Regional Forester has identified it as a species for which viability is a concern on Hiawatha National Forest as evidenced by: a) significant current or predicted downward trends in population numbers or density; and/or b) significant current or predicted downward trends in habitat capability that would reduce its existing distribution (FSM 2670.5.19).

Global Conservation Status Rank: G4

This status rank was chosen because “[*P. confervoides*] is a fairly frequent and abundant species with a large range but somewhat scattered distribution. It is reasonably secure at present because it occurs in remote locations; however, it is highly vulnerable to changes in water chemistry and to other alterations in aquatic habitats” (NatureServe 2002).

National Conservation Status Rank: United States: N3-N4 Canada: N3-N4

United States: (NatureServe 2002, Heritage programs 2001)

Connecticut	SH (possibly extirpated)
Maine	S3 (vulnerable)
Michigan	S3 (vulnerable)
Minnesota	Does not occur
New Hampshire	S2S4 (Imperiled/apparently secure)
New Jersey	S3 (vulnerable)
New York	S3 (vulnerable)
North Carolina	S1, now S2 (from critically imperiled to imperiled) 16 occurrences
Pennsylvania	S2 (imperiled) 8 extant in eastern PA
Rhode Island	SH (possibly extirpated)
South Carolina	S1 (critically imperiled) 1 site in northern county
Vermont	S2 (imperiled)
Wisconsin	S2 (imperiled)

Canadian Provinces: (NatureServe 2002)

Ontario	S2 (imperiled)
Quebec	S? (unranked)
New Brunswick	S2 (imperiled)
Newfoundland Labrador	S1? (critically imperiled/not enough information)
Newfound. Is.	S3? (vulnerable/not enough information)
Nova Scotia	S3 (vulnerable)

Potamogeton confervoides status is somewhat uncertain. It is considered rare in several areas of its relatively restricted range, which includes the Canadian provinces of Ontario, Quebec and New Brunswick. (Hellquist 1987). However, *Potamogeton confervoides* can be considered common in central New Hampshire, eastern Massachusetts, and eastern Newfoundland. The species occurs as a rare disjunct in such areas as Wisconsin, Michigan and North Carolina (The Nature Conservancy 1993).

LIFE HISTORY

“In some *Potamogeton* species, an aquatic system of pollination has evolved, where microspores float to the stigmas on the water surface” (Sculthorpe 1967 cited in Sorrie 1993). *Potamogeton confervoides* is, however, exceedingly limp, and the plant is supported simply by its buoyancy in the water so it is less likely either wind or water assist with transfer of pollen (Voss pers. comm. 2003). *P. confervoides* often does fruit and produce abundant seed (The Nature Conservancy 1993). “Reproduction also takes place by vegetative propagation, through production of over wintering buds (turions) that develop late in the season from old leaf axils and on tips of disintegrating branches” (Fernald 1932).

“Flowers are hermaphroditic (bisexual), regular, and inconspicuous, with four petal-like scales, four stamens and a superior ovary” (Sorrie 1993). “Aerial flowers of *Potamogeton spirillus* appear to be facultatively autogamous” (Philbrick 1984). When 30 aerial inflorescences were bagged, all 30 exhibited 100% fruit production, illustrating an autogamous nature. Pollen was found to be compatible with the stigma of the same flower. “In the protogynous aerial flowers the stigma expands and becomes receptive before the anthers dehisce, although receptivity lasts until after anther dehiscence” (Philbrick 1984). Self-fertilization can occur only if outcrossing has not already occurred.

POPULATION BIOLOGY AND VIABILITY

Potamogeton confervoides is a perennial with perfect protogynous flowers. Its long terminal peduncles may raise the flowering spikes to the tops of pools in late spring or early summer. *P. confervoides* is a very fertile species (Fernald 1932). *Potamogeton* species often are found to have persistent seed banks (Baskin and Baskin 1998). In *P. confervoides* propagating buds are developed on the branches very late in the season after fruiting is over and stems are disintegrating (Fernald 1932).

Flowering and fruiting occur from June through August in the north (Fernald 1950) and April through September in the south (Radford *et al.* 1968), although peak flowering/fruiting in the Carolinas is April to June. Winter buds are produced in the fall. Fernald (1932) observed winter buds in Nova Scotia in September, several weeks after most fruits had dropped. Fernald (1932) theorized that propagation by winter buds is adapted to many highly fertile species of *Potamogeton* when the vegetation season extends far beyond the fruiting season (The Nature Conservancy 1993).

In a detailed study of seed germination in *Potamogeton*, Muenscher (1936) found that dried seed (fruits) germinated poorly if at all, but that for most pondweeds germination was enhanced by storage in cold water. Muenscher also cites another study in which pondweed seeds obtained from the stomachs of wild ducks germinated in a short time (*P. confervoides* not studied). Muenscher (1936) observed a germination rate of more than 80% for *Potamogeton confervoides*. A high germination rate suggests that sexual reproduction is an important form of propagation for this pondweed.

Only a few populations have been followed to determine viability. However, at Little Dollar Lake in Mackinac County, Michigan *P. confervoides* was especially abundant and fruited copiously in the summer of 1994; it seemed less abundant in 1995 and was not fruiting as prolifically as in 1994. By 1996 the population continued to recede, with the majority of the population scattered along the lake margin of the eastern and southern mats. Previously, it had been found around the entire circumference of the lake (Hellquist and Crow 1999).

Several Michigan sites have been rated by the Michigan Chapter of The Nature Conservancy. The Tahquamenon Falls State Park site was given an A rank since it had a large (over 1000) population that was undisturbed. Sleeper Lake on the Lake Superior Forest was given a B rank; the population was locally abundant but contained in a small pond (The Nature Conservancy 1998).

POTENTIAL THREATS

Threats to the species include loss or change of habitat (The Nature Conservancy 1993, The Nature Conservancy 1999), liming of ponds for fisheries management (J. Schultz pers. comm. 2001, USDA Forest Service 1993), and changes in water chemistry (NatureServe 2002, The Nature Conservancy 1999). Other threats include peat mining, high nutrient inputs, herbicides, grazing by waterfowl and activities that encourage eutrophication and enrichment of lakes (The Nature Conservancy 1993). Aquatic and hydrological regimes including water chemistry must remain unaltered (USDA Forest Service 1993) by artificial disturbances such as pollution, dredging, and aquatic herbicide application. An additional threat is intensive timber harvesting and mining activities (i.e. peat) in watersheds thereby increasing runoff and affecting the trophic status of lakes (The Nature Conservancy 1999).

The algal pondweed Element Stewardship Abstract (The Nature Conservancy 1993) identifies the following threats for specific areas:

- In New York, beaver activity and the destruction of beaver dams are threats.
- In Michigan, lakes where this species occurs have few homes or cottages along the shoreline; many sites are within State-owned forests. However, Paquette Lake in Alger County may be seriously impacted by development (Voss pers. comm. 2003).
- In Wisconsin, timber harvesting in watersheds could increase runoff and affect the trophic status of lakes and other water bodies. One documented population occurs within a recently proposed zinc mining project area and may be threatened by future activities in this site.

Restoration/Recovery Potential

Restoration potential has yet to be studied although high seed germination rate observed for this species, as indicated by Muenscher (1936), suggests that there is potential for propagation and reintroduction into suitable sites (The Nature Conservancy 1993).

RESEARCH AND MONITORING

There are no known monitoring programs for this species. Long-term monitoring may be required to determine population trends, reproduction and the response to hydrological changes and habitat disturbance. Long-term monitoring is inherently difficult due to its aquatic lifestyle. Estimates of population/colony sizes within areas of a lake would be helpful, including evidence of sexual reproduction. Because this species requires acidic waters, monitoring should include water quality measurements, including analysis of alkalinity, pH, color and any other relevant parameters (The Nature Conservancy 1993).

Examination of available element occurrence records and last observed dates indicate that the species appears to be stable in status and distribution. However, in Wisconsin many occurrences are based on old records. In Wisconsin, a systematic inventory is needed with an emphasis on trying to locate older records (USDA Forest Service 1999).

Monitoring on Forest Service land as well as other locations is needed in order to analyze effects associated with management actions and answer management questions. Results of monitoring and research may provide managers with data to develop a Conservation Approach. This effort could include developing goals for maintaining viability of the species, writing management prescriptions for known sites, and public outreach in efforts to protect this aquatic plant populations and its habitat.

SUMMARY

Potamogeton confervoides is primarily a species of the eastern United States and Canada that inhabits soft water lakes and slow-moving streams throughout its range. According to Hellquist (1987), of all the species of *Potamogeton* in North America, *P. confervoides*, prefers the most acidic waters. Changes in water quality, constitute the principal threat to this species. Additional threats include intensive timber harvesting in watersheds that would increase runoff and affect the trophic status of lakes; and liming of fisheries. This species of pondweed is found in lakes or bogs with the greatest acidity; therefore, anything that would raise the pH of a lake is a threat (Voss pers. comm. 2003). The biology, ecology, and specific management requirements are poorly known. At present, this species is probably best managed by protecting its aquatic habitat from degradation, including pollution, eutrophication and modifications of hydrological regime.

REFERENCE

- Baskin, C. and Baskin J. 1998. Seeds—Ecology, Biogeography, and Evolution of Dormancy and Germination. San Diego: Academic Press.
- Chadde, S. 1998. A Great Lakes Wetland Flora. Calumet, Michigan: Pocketflora Press..p. 512-513.
- Crow, G.E. and C. B. Hellquist. 2000. Aquatic and Wetland Plants of Northeastern North America. Volume 2. The University of Wisconsin Press. p. 39, 44-48.
- Fernald, M.L. 1932. The Linear-Leaved North American Species of *Potamogeton*, Section Axillares. Memoirs of the Gray Herbarium of Harvard University. Pp. 1-36.
- Fernald, M.L.. 1950. Gray's Manual of Botany. Dioscorides Press. Portland, Oregon. p. 71.
- Gleason H. A. and Cronquist, A. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition. New York: New York Botanical Garden. p. 642.
- Hellquist, C.B. 1987. *Potamogeton confervoides* In: G.W. Argus and D.J. White (eds). Atlas of the Rare Vascular Plants of Ontario. National Museum of Natural Sciences, Ottawa.
- Hellquist, C.E. and Crow, G.E. 1999. The distribution of the bryophytes and vascular plants within Little Dollar Lake peatland, Mackinac County, Michigan. Rhodora Vol. 101, No. 905, pp. 46-86.
- Meyer, T. and Dobberpuhl, J. 1992. Survey Report for *Potamogeton confervoides* in the Chequamegon National Forest.
- Michigan Natural Features Inventory (MNFI). 2001. Element Occurrence Records database. February 2001
- Michigan Natural Features Inventory (MNFI). 1999. County Record Occurrences. September 1999

- Michigan Natural Features Inventory (MNFI). 1985. An Overview of Endangered and Threatened Species in the Hiawatha National Forest, Michigan. P. 145-146.
- NatureServe. 2002. *Potamogeton confervoides*. <http://www.natureserve.org/explorer>
- Nichols, S. and Martin R. 1990. Wisconsin Plant Database. Wisconsin Geological and Natural History Survey. Information Circular 69.
- North American Flora Committee (FNA). 2000. Flora of North America. Vol. 22. Oxford University Press. p. 56.
- Philbrick, C.T. 1984. Aspects of floral biology in three species of *Potamogeton* (Pondweeds). The Michigan Botanist. 23: 35-38.
- Radford, A.E., H.E. Ahles, C. R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press. Chapel Hill. p. 46.
- Roberts, D.A., R. Singer, and C.W. Boylen. 1985. The submersed macrophyte communities of Adirondack Lakes (New York, U.S.A.) of varying degrees of acidity. Aquatic Botany 21: 219-235.
- Sorrie B.A. 1993. *Potamogeton confervoides* Element Stewardship Abstract. (Focused on North and South Carolina) pp. 97-101.
- The Nature Conservancy. (Not Dated). Conservation Status Rank. pp. 1 – 8.
- The Nature Conservancy (TNC). 1993. Element Stewardship Abstract for *Potamogeton confervoides*. (Michael Penskar, MNFI, Lansing, MI) pp. 1-3.
- The Nature Conservancy. 1998. *Potamogeton confervoides* in Great Lakes Program Notebook. Pp. 1-4.
- The Nature Conservancy. 1999. Species Data Search
http://biosource.heritage.The_Nature_Conservancy.org/cgi-bin/biosource/species-query.cgi
- USDA Forest Service (FS). 2000. Regional Forester Sensitive Species (RFSS). Eastern Region (R9). Hiawatha National Forest. 10-23-00 pp. 3.
- USDA Forest Service. 1999. Species Data Collection Form. *Potamogeton confervoides* (P. Beyer). pp. 1-15.
- USDA Forest Service. 1993. Chequamegon National Forest Sensitive Plant Species Guide. Pp. 1-13.
- USDA NRCS Plant Database. *Potamogeton confervoides*.

<http://plants.usda.gov>

Vermont Natural Heritage Program. 2001. Significant Biological Features of the Green Mountain National Forest. pp. 20.

Voss, E.G. 1965. Some rare and interesting aquatic vascular plants of northern Michigan, with special reference to Cusino Lake (Schoolcraft County). *The Michigan Botanist*. Vol. 4(1) pp. 11-19.

Voss, E.G. 1972. Michigan Flora. Part 1. Gymnosperms and monocots. Cranbrook Institute of Science and University Michigan Herbarium. Ann Arbor. p. 91.

Wisconsin DNR. 1993. Guide to Wisconsin's endangered and threatened plants. Bureau of Endangered Resources. PUBL-ER-067

Cited in Other References:

Hellquist, C.B. and G.E. Crow. 1980. Aquatic vascular plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae. New Hampshire Agricultural Experiment Station. Station Bulletin 515. University of New Hampshire, Durham. 68 pp.

Hutchinson, G.E. 1975. A Treatise on Limnology, Vol. 3. Limnological Botany. Wiley, New York. 660 pp.

Muenschler, W.C. 1936. The germination of seeds of Potamogeton. *Ann. Bot.* 50:805-821.

Roland, A.E. and E.C. Smith. 1969. The flora of Nova Scotia. The Nova Scotia Museum, Halifax.

Sculthorpe, C.D. 1967. Biology of Aquatic Vascular Plants. Reprinted in 1985 by Koeltz Scientific Books, Koenigstein, West Germany.

Sugden, L.G. 1973. Feeding ecology of pintail, gadwall, American widgeon and lesser scaup ducklings in Southern Alberta. Canadian Wildlife Service Report Series No. 24.

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