New England Plant Conservation Program

Stuckenia filiformis (Persoon) Börner subsp. *occidentalis* (J.W. Robbins) R. R. Haynes, Les, and M Král
Slender Pondweed

Conservation and Research Plan for New England

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Approved, Regional Advisory Council, 2001

SUMMARY

Current Species Status

The slender pondweed, *Stuckenia filiformis* subsp. *occidentalis* is a widespread, northern taxon found from Newfoundland west to Alaska, south to northern Maine, central Vermont, central New York, Michigan, Iowa, Colorado, New Mexico, Nevada and Oregon. In New England it is confined to northeastern Aroostook County, Maine and a newly discovered site in Addison County, Vermont. It is listed as S1 in Maine and has not been listed by Vermont. It appears to be particularly vulnerable to competition with other more aggressive species of pondweeds.

Habitat Requirements

Stuckenia filiformis subsp. *occidentalis* is a northern pondweed of cool, slow to fast-flowing alkaline waters, rarely in ponds or lakes. It is confined to alkaline, fresh, brackish, or slightly saline coastal waters throughout its range. Potential threats to the population include runoff from agricultural lands, competition from other aquatic plants, and eutrophication of the waters by agricultural runoff and goose droppings.

Conservation Objectives

1. Determine the taxonomic status of *S. filiformis* subsp. *occidentalis*.
2. Maintain and improve the conditions of the two streams in which it grows.
3. Increase the number of plants in the extant populations.
4. Reduce competition with *Stuckenia pectinata* where applicable.

Conservation Actions Needed

1. Conduct molecular analysis to determine if it is a viable taxon or a hybrid.
2. Inform property owners of species status and gain permission to access sites.
3. Conduct a baseline study to analyze present conditions and possible threats.
4. Perform field surveys on known and potential sites for taxon.
5. Reintroduce plants to the Mars Hill, Maine site.
6. Secure long-term protection for high quality element occurrences.
7. Control undesirable species.

PREFACE

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) 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 individuals and 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.

This document should be cited as follows:

C. B. Hellquist, L. Bush, and K. Parzych. 2002. *Stuckenia filiformis* subsp. *occidentalis* (Slender Pondweed) Conservation and Research Plan for New England. New England Wild Flower Society, Framingham, Massachusetts, USA.

I. BACKGROUND

INTRODUCTION

The slender pondweed, *Stuckenia filiformis* (Persoon) Börner subsp. *occidentalis* (J.W. Robbins) R.R. Haynes, Les, & M. Král (Potamogetonaceae) is a northern and western taxon in North America. Only six occurrences of this pondweed have been reported in New England, with five of these from Aroostook County, Maine. A new population was located in 2000 in New Haven, Addison County, Vermont. The rarity of *S. filiformis* subsp. *occidentalis* in New England and the threats to the Maine populations provide the basis for developing a conservation plan.

Stuckenia filiformis subsp. *occidentalis* is a large, robust subspecies of *S. filiformis*. Throughout its range, it is most often associated with fast-flowing rivers as opposed to *S. filiformis* subsp. *alpina* (Blytt) Haynes, Les and Král that is found in still waters of ponds and lakes. In appearance, *S. filiformis* is distinct from the smaller subspecies by its large size, large inflated basal stipules, and lack of fruit production. Sterility is a characteristic shared by a number of other common aquatic plants in the area (these do not produce fruit or rarely do). The possibility of this taxon being a hybrid could account for the sterility and should be investigated through molecular analysis.

Stuckenia filiformis subsp. *occidentalis* is rare in New England due to the lack of appropriate habitat of cold, alkaline rivers with a combination of fast-flowing and sluggish waters. The global rank for this species is G5T5. In New England, it is regionally rare, and is listed as S1 in Maine. This taxon has not been listed in Vermont because it has just been discovered. The main threats to this taxon in New England from personal observations at the Mars Hill, Maine population over ten years appears to be agricultural pollution and the establishment of other aquatic species in the quieter waters.

DESCRIPTION

Stuckenia filiformis subsp. *occidentalis* is a rhizomatous, perennial herb with tubers absent or present. This slender-leafed pondweed possesses an inflated stipular sheath, particularly in young plants. The sheaths may be lacking in older plants due to deterioration. The leaves are all submersed, filiform to narrowly linear, 5-12 cm long, 0.2-2 mm wide, and 1-5-veined with cross-reticulations. Holub (1997) notes the presence of a channel or groove along the length of the leaf. The leaf tips are blunt, obtuse or notched (rarely apiculate). The stipules are adnate to the base of the leaf blades for 2/3's or more of the stipular length, extending past the adnate portion as a free ligule, 2-20 mm long. It rarely produces fruit, but when it does, the fruit are 2-3 mm wide X 1.5-2.4 mm long and similar to the other subspecies

of *S. filiformis*. The morphologically similar species *Stuckenia vaginata* fruits prolifically and produces an obscure or short ligule to 0.2 mm long. The fruits are larger, 3-3.8 mm long, and 2-2.9 mm wide. It grows in cold, deep, still waters, or more often in strong current (Haynes and Hellquist 2000).

Key to the subgenus* Coleogeton *in eastern North America (Crow and Hellquist 2000, Haynes and Hellquist 2000)

1. Leaves acute, apiculate on young plants; fruit oblanceoloid, distinctly beaked.....***S. pectinata***

1. Leaves blunt, obtuse, notched, or rarely apiculate; fruit roundish-obovate when formed, beakless or minutely beaked.

    2. Free portion of stipule forming a ligule to 20 mm. long; tips of midstem stipular sheaths only slightly inflated and less than twice the width of the stem; fruit, if formed, 2-3 mm long.

        3. Stipules on lower portion of stem tightly clasping or slightly inflated, persisting with age; leaves 0.2-1.0 mm wide; fruit commonly maturing.....***S. filiformis* subsp. *alpina***

        3. Stipules on lower portion of stem loosely clasping, usually inflated, disintegrating with age; leaves 0.2-2.0 mm wide, not producing fruit in New England.....***S. filiformis* subsp. *occidentalis***

    2. Free portion of stipule forming a ligule up to 1 mm long; tips of midstem stipular sheaths sheaths distinctly inflated, twice the diameter of the stem; fruit regularly formed, 3-3.5 mm long.....***S. vaginata***.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

This taxon was originally described by J. W. Robbins in 1871 as *Potamogeton marinus* L. var. *occidentalis* J.W. Robbins. Morong (1893) treated this taxon as *Potamogeton filiformis* var. *occidentalis* (Robbins) Morong and indicated that it was rare in the United States. He noted it from the rapids above Niagara Falls, rapids at Sault St. Marie, Michigan, Hemlock Lake of western New York, and Frankfort, Michigan. He also commented that Macoun indicated that it was more common in Canada. Morong (1893) also discussed *P. interruptus* Kitaibel, a species that had never been observed in fruit in the United States. He apparently had mistakenly believed that *P. interruptus* was the same taxon as *P. filiformis* subsp. *occidentalis*. The populations were from localities in Michigan where *P. filiformis* subsp. *occidentalis* had been known to occur. The rare fruiting or lack of fruiting of *S.*

filiformis subsp. *occidentalis* is a characteristic shared by some other aquatics such as *P. floridanus* Small, *P. robbinsii* Oakes and *Sagittaria graminea* Michx. subsp. *graminea*. Wiegleb and Kaplan (1998) include *P. interruptus* in synonymy with *Stuckenia pectinata* (L.) Börner. Hagström (1916) only notes that Rydberg felt, but without sufficient grounds, that this taxon was a distinct species, *P. interior* Rydb.

Harold St. John brought more confusion to the taxonomy of this taxon by noting that after viewing hundreds of specimens, he could not find any specimens that matched the two originally described from Ruby Lake, Nevada. He believed that it represented a deep-water form of *P. filiformis* (*P. interior*). St. John (1912) went on to describe another new species, *P. moniliformis* St. John, from areas in eastern Canada and northeastern United States, citing specimens that presently Haynes and Hellquist (2000) include under *P. filiformis* subsp. *occidentalis* and others that were classified as *P. vaginatus*. Wiegleb and Kaplan (1998) place *P. moniliformis* in synonymy under *P. vaginatus* Turcz.

In 1996, Les and Haynes renamed the *Coleogeton* subgenus of *Potamogeton; Coleogeton* based on molecular research conducted on the pondweeds. However, this generic name was found to be invalid. Les and Haynes (1996) had chosen *P. pectinatus* as the nomenclatural type for the genus *Coleogeton*, but the name *Stuckenia* had previously been published by Börner in 1912 and is the valid name for the genus. Haynes, Les, and Král (1998) made the change to *S. filiformis* subsp. *occidentalis*.

Cronquist et al. (1977) felt that *P. filiformis* var. *occidentalis* was often mistaken for *P. vaginatus* Turcz in the Intermountain region of western United States. Haynes and Hellquist (2000) noted that in the northeast portion of its range and throughout the Great Lakes region, the name *Stuckenia vaginata* (Turcz.) Holub, has been misapplied to this taxon, which actually is *S. filiformis* subsp *occidentalis*. Volobayev (personal communication) when observing the *S. filiformis* subsp. *occidentalis* from the Massachusetts College of Liberal Arts Herbarium noted that it appeared identical to *S. subretusus* (Hagstr.) Holub in morphology, habitat, and growth habit. Wiegleb and Kaplan (1998) recognize *S. subretusus* as occurring in western North America and being closely related to *S. vaginata.* At present, there has been no work on the taxon to substantiate this.

There is the possibility that *S. filiformis* subsp. *occidentalis* is a hybrid in the northeast given to its sterility. Brayshaw (2000) in British Columbia considers it to be *S.* × *fennica* (Hagstr.) Holub, a hybrid between *S. filiformis* and *S. vaginata*. This may be the situation for many plants in the Pacific Northwest, but this is probably not the case in the northeast. The closest the range of *S. vaginata* gets to New England is central Wisconsin. Another hybrid possibility for New England is *S.* × *suecia* Richter, a hybrid between *S. filiformis* subsp. *alpinus* and *S. pectinata.* These two species are present in the northeast portion of the range of *S. filiformis* subsp. *occidentalis*. Molecular DNA analysis would be extremely helpful in clarifying if it is of hybrid status.

Hollingsworth et al. (1996a) have provided evidence for the hybrid *S.* X *suecia* in Great Britain. They indicate that *S. pectinata* and *S. filiformis* were believed to have hybridized in northern Europe and in Great Britain have crossed where the parental ranges overlap. They observed that the hybrids occurred where the parental species were uncommon. Hollingsworth et al. (1996a) notes that Dandy and Taylor (1946) offer two explanations for this. The first is that *S.* X *suecia* is a relic from post-glacial or inter-glacial times and has been found in areas where at least one of the parents is known from glacial deposits. The second is that *S.* X *suecia* arose north of the present area and was carried by the advancing ice-sheets south. Both of these scenarios show that the populations can exist at an area that may be well removed from the original source. In New England, both parental species of *S.* X *suecia* occur within the region. In Maine, both *S. filiformis* subsp. *alpina* and *S. pectinata* occur within close proximity. In Vermont, the *S. filiformis* subsp. *alpina* populations occur approximately 75 miles to the northeast of the Weybridge population of *S.* X suecia.

In New England, *Stuckenia filiformis* (Persoon) Börner subsp. *alpina* (Blytt) Haynes, Les, and Král is the more common subspecies. It is found in eastern and northern Aroostook County, Maine; one location in Coos County; New Hampshire and presently in northeast Vermont. Historically, this taxon had been found in a few sites in the Champlain Valley.

Synonymy:

Coleogeton filiformis subsp. *occidentalis* (J.W. Robbins) Les and Haynes (Haynes and Hellquist 2000)

Potamogeton filiformis var. *occidentalis* (J.W. Robbins) Morong (Haynes and Hellquist 2000)

Potamogeton interior Rydberg (Hagström 1912)

Potamogeton marianus Linnaeus var. *occidentalis* J.W. Robbins (Hagström 1912)

Stuckenia interior (Rydberg) Holub (Holub 1977).

SPECIES BIOLOGY

The two subspecies of the slender pondweed in New England differ in their reproduction. The more common *S. filiformis* subsp. *alpina* is an extremely fertile taxon propagating by fruit and extensive rhizomes. It mainly depends on water for pollination. This occurs by pollen floating in the water or on bubbles produced by submersed leaves (Wiegleb and Kaplan 1998).

The rare *S. filiformis* subsp. *occidentalis* produces fruit more sporadically. In the eastern part of its range, it rarely (if ever) fruits while the further west and north it grows, the more fertile it becomes. Any possible reasons for this would be strictly conjecture. It might be that the longer day length in the north aids fruiting or that there are more populations, hence better cross-pollination. In New England, it has not been observed in fruit. This is a similar trait to that which occurs with *Sagittaria graminea*. Barre Hellquist has never seen a fertile

population of *S. graminea* in New England and has seen only one herbarium sheet with fertile material. The further south and west the *Sagittaria* is found the more fertile it is. Both *Sagittaria graminea* and *S. filiformis* subsp. *occidentalis* have the formation of rhizomes as the main means of reproduction. Les (1988) notes that water-pollinated vascular aquatic plants show levels of low genetic variability due to the poor pollen transfer in the aquatic environment. Hollingsworth (1966b) notes studies that indicated that genetic diversity is lower in aquatic plants than in terrestrial plants. *Stuckenia filiformis* subsp. *occidentalis* produces large rhizomes and the leaves also develop propagules along the stem as a form of a winter bud that is capable of rooting.

The genus *Stuckenia* is characterized by large stipules, fused for more than half their length; channeled, mostly filiform leaves; and with a high ploidy level. These morphological characteristics are also shared with other species of *Potamogeton*. The inflorescence of the genus *Stuckenia* is lax and floats on the surface and is never erect or submersed as with *Potamogeton*. Wiegleb and Kaplan (1998) do not accept the new genus, while Donald Les (personal communication) and Robert Haynes (personal communication) have indicated that molecular analysis has shown them to be different.

HABITAT/ECOLOGY

Stuckenia filiformis subsp. *occidentalis* typically is found in cool to cold calcareous waters at varying depths. In deep water, it is confined to slow flowing or still water where the plants may obtain lengths up to one meter. It commonly occurs in shallow, fast-moving water where plants can stretch out for lengths up to 0.8 m. In both New England rivers where it occurs shallow water is the most common habitat. Here, it typically roots in the sand and around rocks of the fast-flowing water. A single plant can spread by the extensive rhizomes over a considerable distance.

This pondweed is found in highly alkaline waters throughout its range. Hellquist, in collecting this taxon throughout North American has never observed it in waters of low alkalinity. Data collected by Hellquist in Michigan have shown it to occur in waters with an alkalinity of 86.6 -180.0 mg/L $CaCO_3$ with a mean of 130.5 mg/L $CaCO_3$. Moyle (1945) indicates that *S. vaginata* (which is most likely *P. filifomis* subsp. *occidentalis*) in Wisconsin lakes had an alkalinity range of 107.5-307.7 mg/L $CaCO_3$ with a median value of 145.0 mg/L $CaCO_3$. Hellquist (1975) did not have enough chemical data to carry out any statistical analysis on *S. filiformis* subsp. *occidentalis,* but the Michigan data would include it with *S. pectinata* as indicative of plants in the highest total alkalinity cluster.

THREATS TO TAXON

The populations at Mars Hill, Maine (ME .002) have changed the most over the past ten years. This site has shown a reduction in numbers since the appearance of *Stuckenia pectinata* (L.) Börner, an uncommon species in northern Maine, during the summer of 1995. *Stuckenia pectinata* has almost replaced the entire population of *Stuckenia filiformis* subsp. *occidentalis*. It is unknown how *S. pectinata* got into the stream. The population of *S. filiformis* subsp. *occidentalis* may have suffered a decline, leaving room for the establishment of *S. pectinata*. *Stuckenia pectinata* is known to be a major food source of waterfowl (Martin and Uhler 1939). The large Canada goose population at the pond may have introduced the fruit. Once established, *S. pectinata* plants are abundant fruit producers. The plants also produce large, extensive rhizomes that will provide for further colonization. *Stuckenia pectinata* is also common below the dam in Mars Hill and is starting to appear in the shallow fast-water section of the stream in Blaine. This subspecies is usually found in flowing water, but appears to grow equally well above a dam. This was the case at Mars Hill until the competition with *S. pectinata* became a problem. In Michigan, *S. filiformis* subsp. *occidentalis* does well in deep, slow-flowing or still water.

Mars Hill is in the potato-growing region of northeast Aroostook County. The fields are heavily fertilized, so the chance of eutrophication is great. The McCain Corporation has a potato processing plant at the northern portion of the stream in Easton. The large settling pond that receives the waste from processing the potatoes eventually discharges into the river. Both of these situations could provide excessive nutrient in the form of nitrates and phosphates to the stream. The stream has numerous road crossings north of Mars Hill. Run off from the roads may cause an increase in petro-chemicals and salt.

The Addison, Vermont population (VT Site 1) is large. Upstream, there are many cattle grazing fields and cornfields that are possibly adding nitrates and phosphates to the river. This could present a problem in the future, so monitoring of the area is recommended. In both states, these rivers run through an area vital to the economy of the area.

DISTRIBUTION AND STATUS

General status

Stuckenia filiformis is a common, circumpolar species found throughout the alkaline waters of Canada, northern and western United States, northern Europe and Siberia (Table 1, Figure 1). It is also found in the cooler waters of South America. Three subspecies are recognized by Haynes and Hellquist (2000) in North America: *S. filiformis* subsp. *filiformis* from northern Canada*; S. filiformis* subsp. *alpina* from widespread areas in northern and western North America; and *S. filiformis* subsp. *occidentalis* from northern and western North America.

The following list includes the number of herbarium sheets on file for subsp. *occidentalis* from different sites at various herbaria for the states and provinces (Alaska-28, Colorado-4, Idaho-5, Iowa-1, Michigan-46, Maine-5, Minnesota-9, Montana-11, Nevada-4, New Mexico-1, New York-10, North Dakota-2, Oregon-1, Washington-2, Wisconsin-2, and Wyoming-27). Canada populations found in are Alberta-15, British Columbia-4, Manitoba-27, New Brunswick-3, Newfoundland-7, Northwest Territory-25, Ontario-40, Nova Scotia-2, Prince Edward Island-3, Quebec-16, Saskatchewan-37, and Yukon-5. The above records were gathered for the preparation of the treatment of the Potamogetonaceae for the "Flora of North America" (Haynes and Hellquist 2000). A large collection of specimens from mainly Newfoundland, New England, and Michigan are on file at Massachusetts College of Liberal Arts (NASC).

Status of All New England Occurrences- Current and Historic

Based on literature, herbarium records, and field surveys, *S. filiformis* subsp. *occidentalis* has been identified at six stations in New England. Five of these stations are in Maine, and one in Vermont.

Element occurrence (EO) ranks and Element Occurrence numbers used are those assigned by the Maine Natural Areas Program (the Vermont site has not been entered yet). These ranks are explained in Appendix 5. Rank changes or ranks not assigned are indicated as suggested ranks. Populations not assigned state EO numbers are those not entered into data file by that state and are designated with site numbers. The occurrences reported have been verified by herbarium sheets studied for the "Flora of North America" (Haynes and Hellquist 2000).

Table 1. Occurrence and status of *Stuckenia filiformis* subsp. *occidentalis* in the United States and Canada based on Information from Natural Heritage Programs and verified Herbarium records

OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE REPORTED (MOST VERIFIED FROM HERBARIUM RECORDS)	HISTORIC (LIKELY EXTIRPATED)
Maine: S1, 4 current sites, 5 reported sites, last 2001	Manitoba: S3?, 27 reported sites, last 1980	Alaska: 28 reported sites, last 1989	Colorado: 4 reported sites, last 1938
New York: S1, 10 reported sites. last 1977	Ontario: SU, 40 reported sites, last 1983	Idaho: 5 reported sites, last 1972	Iowa: 1 reported site, 1933

Table 1. Occurrence and status of *Stuckenia filiformis* subsp. *occidentalis* in the United States and Canada based on Information from Natural Heritage Programs and verified Herbarium records

OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE REPORTED (MOST VERIFIED FROM HERBARIUM RECORDS)	HISTORIC (LIKELY EXTIRPATED)
North Dakota: S2S3, 2 current sites, last unknown		Michigan: 46 reported sites, last 2000	New Mexico: 1 reported site, date unknown
New Brunswick: S1, 1 current site, 3 reported sites, last 1990		Minnesota: 9 reported sites, last 1994	Oregon, 1 reported site, last 1920
		Montana: 11 reported sites, last 1985	Nova Scotia: 2 reported sites, last 1953
		Nevada: 4 reported sites, last 1976	Prince Edward Island: 3 reported sites, last 1914
		Washington: 2 reported sites, last 1986	
		Wisconsin: 2 reported sites, last 1975	
		Wyoming: 27 reported sites, last 2001	
		Vermont: 1 reported site, last 2001	
		Alberta: 15 reported sites, last 1983	
		British Columbia: 4 reported sites, last 1974	
		Newfoundland: 7 reported sites, last 1991	
		Northwest Territory: 25 reported sites, last 1986	
		Quebec: 16 reported sites, last 1993	
		Saskatchewan: 37 reported sites, last reported 1987	
		Yukon: 5 reported sites, last reported 1970	

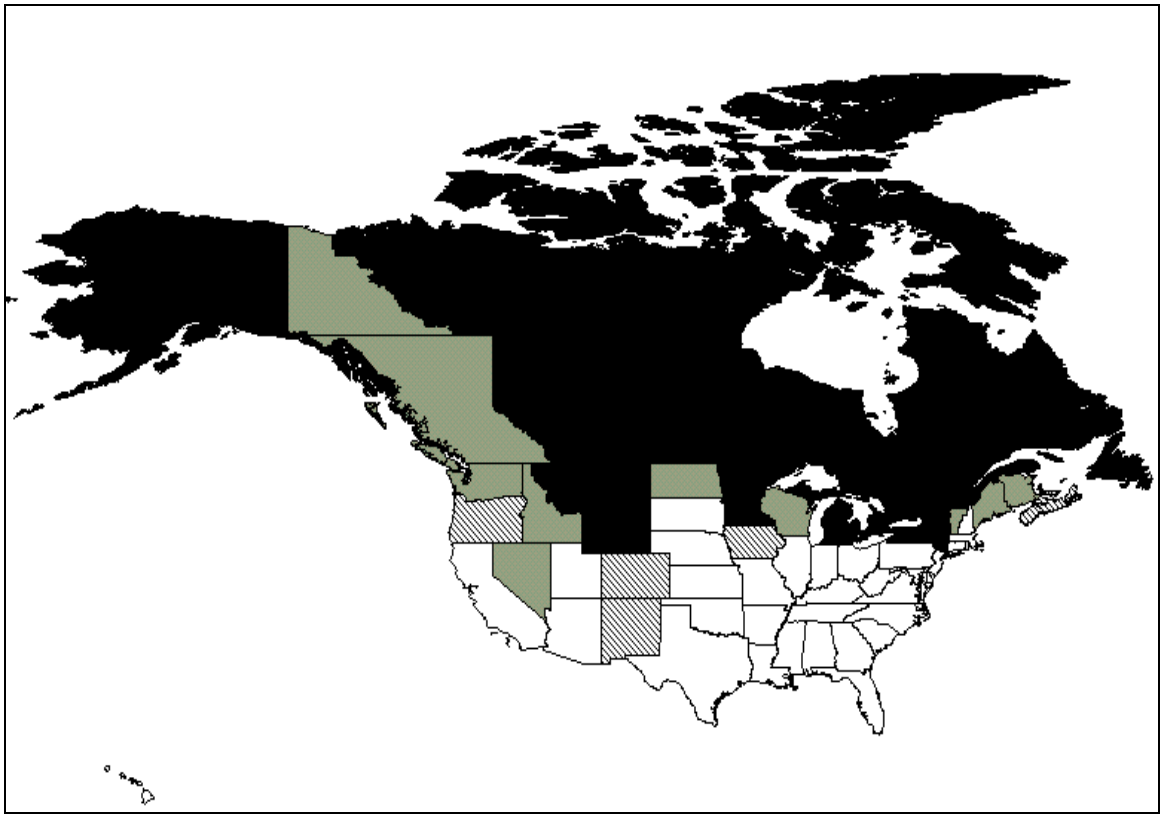

Figure 1. Distribution of *Stuckenia filiformis* subsp. *occidentalis* in North America. States and provinces shaded in gray have 1-5 confirmed, current occurrences of the taxon. Areas shaded in black have more than 5 current occurrences. Diagonal hatching indicates states where the taxon is considered historic or presumed extirpated.

Table 2. New England Occurrence Records for *Stuckenia filiformis* subsp. *occidentalis*. Shaded occurrences are considered extant.

State	EO #.	County	Town
ME	**.001**	**Aroostook**	**Blaine**
ME	**.002**	**Aroostook**	**Mars Hill**
ME	.003	Aroostook	Washburn
ME	**.012**	**Aroostook**	**Blaine**
ME	Site 4	Aroostook	Washburn
VT	**Site 1**	**Addison**	**New Haven, Weybridge**

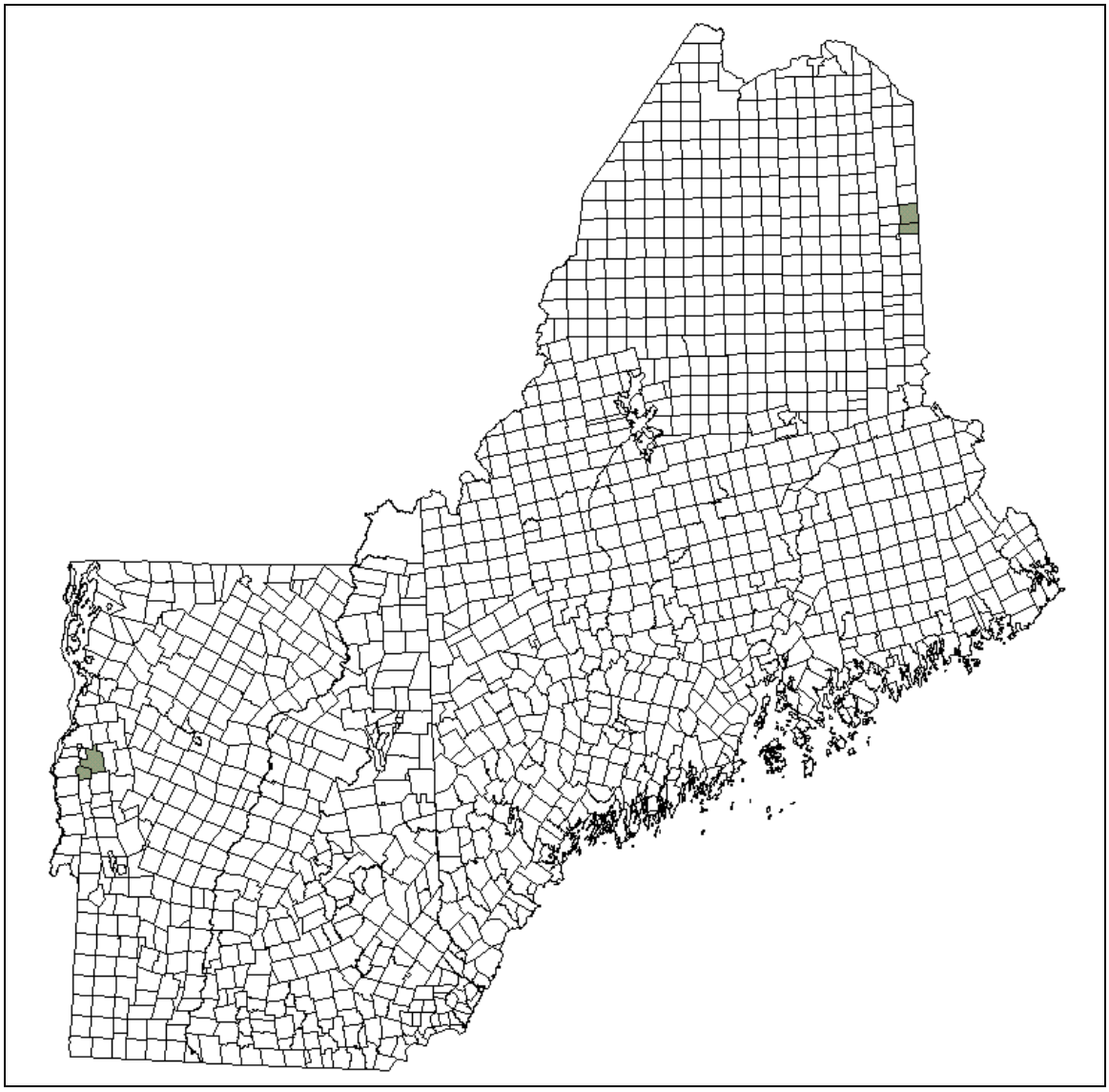

Figure 2. Extant occurrences of *Stuckenia filiformis* subsp. *occidentalis* in New England. Town boundaries for Vermont, New Hampshire, and Maine are shown. Towns shaded in gray have one to five current, confirmed occurrences of the taxon.

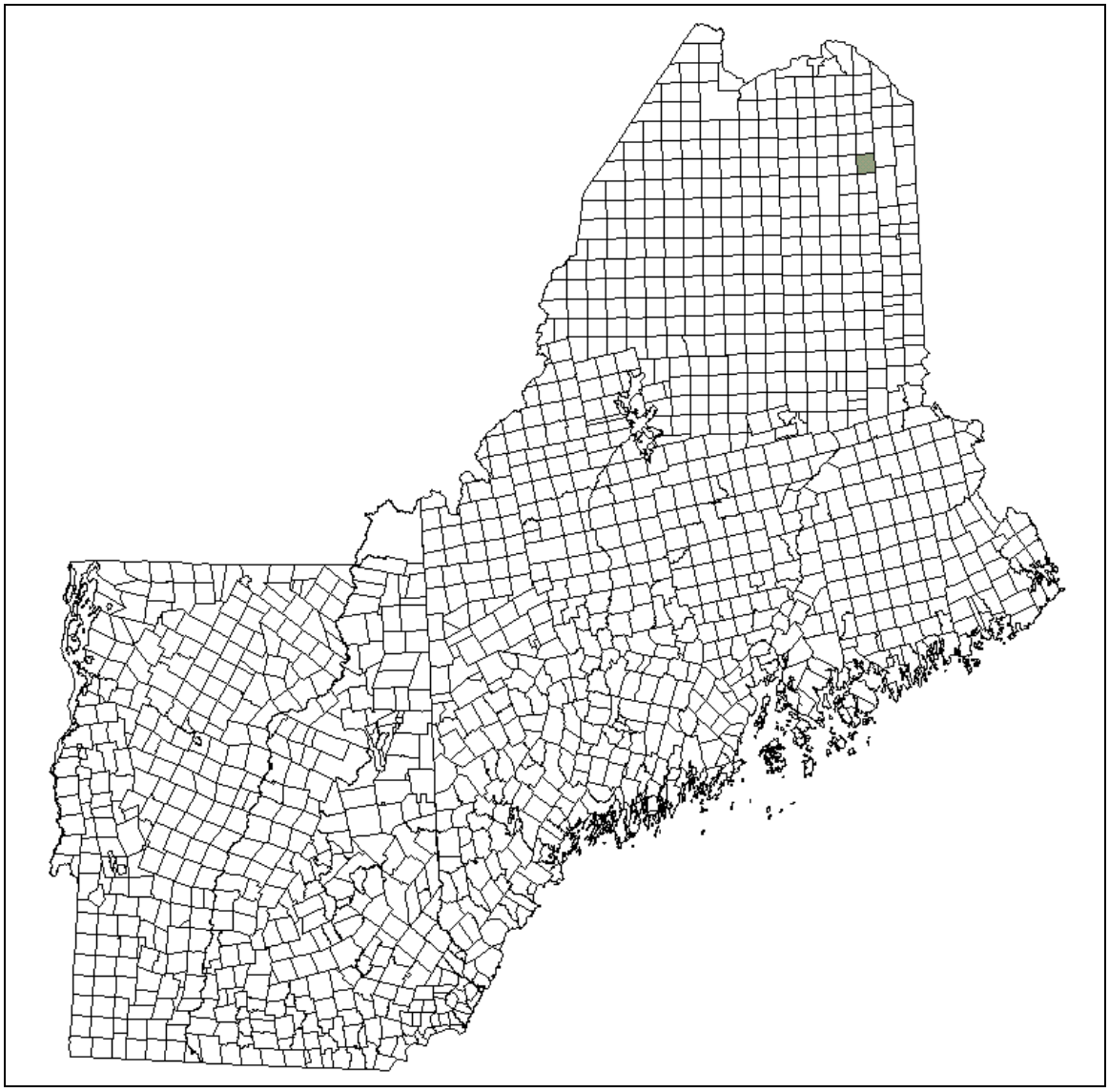

Figure 3. Historic occurrences of *Stuckenia filiformis* subsp. *occidentalis* in New England. The town shaded in gray (Washburn, Maine) has two historic records of the taxon.

CURRENT CONSERVATIONS MEASURES IN NEW ENGLAND

Presently, Maine is not taking any measures to conserve this species other than listing it. A portion of the western shore of the stream encompassing the Maine EOs is owned by the Town of Mars Hill and operates it as a town park. Since 1993, the ME .001 and ME .002 sites have been visited approximately every two years by Barre Hellquist with his class from Humboldt Institute, Steuben, Maine. Each of these times, relative abundance was noted, but no formal population numbers were obtained.

There have been no known attempts to collect any propagules of *S. filiformis* subsp. *occidentalis*. In New England, this taxon has not been observed producing fruit, so the only means of reproduction is by extensive rhizome formation and turions (winter buds) formed along the stems of plants.

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Globally, this taxon is ranked G5T5, which indicates it is demonstrably widespread, abundant, and secure globally (Maine Natural Areas Program 1999). Six stations, (historic and extant) have been documented in New England (ME-5, VT-1). Two of these sites are historic.

The primary goal is to determine the taxonomic status of *S. filiformis* subsp. *occidentalis*. There is the possibility that the taxon in New England is actually a hybrid and is propagating by vegetative means. If it is a hybrid, it is of interest to determine the parentage of it. Is it a cross between two New England native species or is at least one of the parental species from out of the region? These are questions that should be answered. Once its status has been determined, then a conservation strategy can be planned out for the taxon.

The maintenance of the present locations as viable sites is important for preservation of the populations. Streams in Maine and Vermont presently harbor secure populations. Every effort must be made to monitor these sites for the health of the plant populations and any source of river degradation. Efforts should be made to study, protect, and restore populations in danger. Information gathered through both recent and historical investigations will help provide critical information regarding the protection and restoration of *S. filiformis* subsp. *occidentalis*.

Stuckenia filiformis subsp. *occidentalis* is a Maine state-listed species, and is monitored by the Maine Natural Areas Program of the Department of Conservation. Information concerning population size, health, associated species, and threats has been collected for selected sites with repeated observations at some well-known occurrences. Barre Hellquist has monitored the Blaine and Mars Hill, Maine sites approximately every other year since 1992. In 1973, ME .002 had well over 500 plants and by 1994 had started to dwindle, declining to about 100 plants in 2001. This was probably due to the establishment of *S. pectinata* in the pond. This site should be carefully monitored in the future.

The Maine Natural Areas Program lists *S. filiformis* subsp. occidentalis as S1, (critically imperiled in Maine), because of its extreme rarity or vulnerability to extirpation by human activities. The proposed State status based on 1988 data is Endangered (Maine Natural Areas Program 1998). Vermont has not had time to act on this taxon, but a similar ranking would be recommended. A baseline study of both New England waterways would be recommended to provide a basis for later monitoring.

The main threats to the population in Maine are increases in the nutrient loads of the stream from two sources. At the present time, agriculture is a major use for the surrounding

land. Runoff from the fields into the river brings a high nutrient load into the river. A potato processing factory is located at the northern end of the stream in the Town of Easton, and potato waste is deposited into settling ponds that flow into the stream. The threats resulting from this practice are unknown.

III. LITERATURE CITED

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IV. APPENDICES

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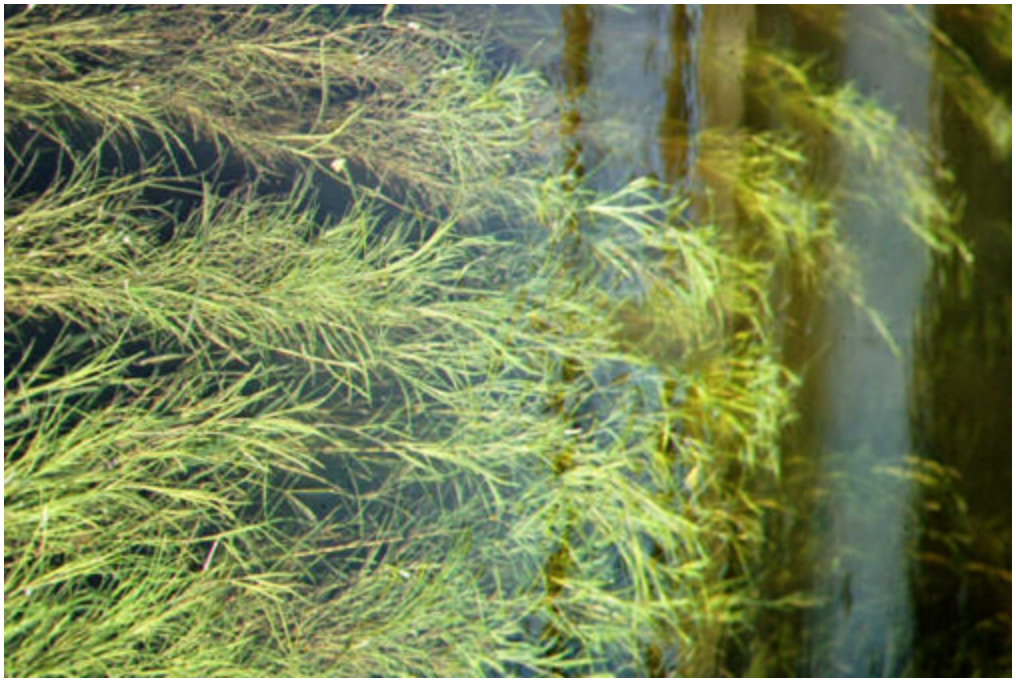
1. *Stuckenia filiformis* subsp. *occidentalis,* Mars Hill, Maine

2. *Stuckenia filiformis* subsp. *occidentalis,* Black River, Cheboygan, Michigan

3 An explanation of conservation ranks used by The Nature Conservancy and Natureserve

1. *Stuckenia filiformis* subsp. *occidentalis,* Mars Hill, Maine.



2. *Stuckenia filiformis* subsp. *occidentalis,* Cheboygan, Michigan

3. 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 groups -- 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 observations have made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EOs have received such ranks in all states, and ranks are not necessarily consistent among states as yet.