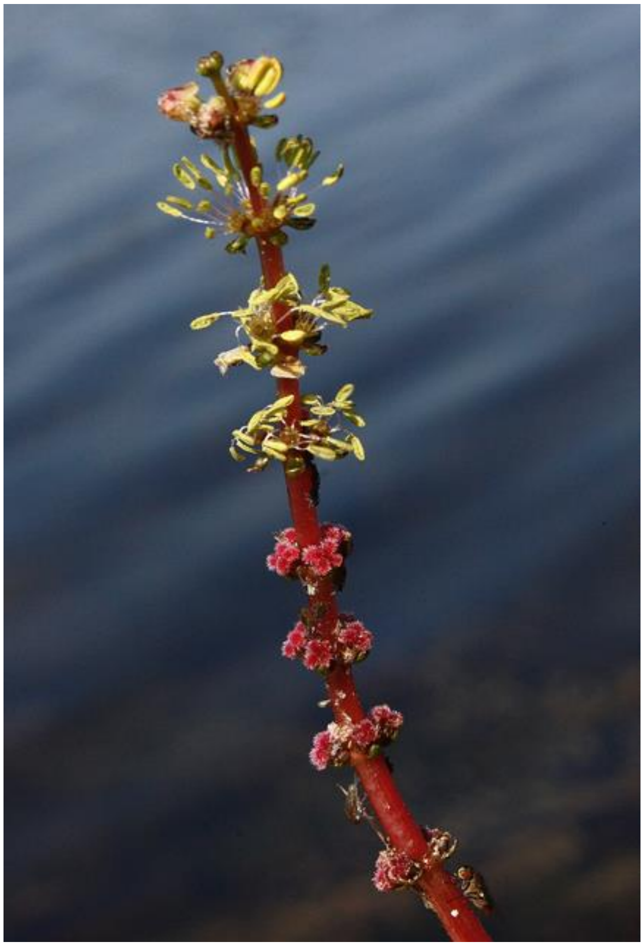
Myriophyllum sibiricum

Common Water-milfoil

Haloragaceae



Myriophyllum sibiricum courtesy R. W. Smith, Lady Bird Johnson Wildflower Center

Myriophyllum sibiricum Rare Plant Profile

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
State Forest Fire Service & Forestry
Office of Natural Lands Management
New Jersey Natural Heritage Program

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Life History

Myriophyllum sibiricum (Common Water-milfoil) is a rooted perennial aquatic plant in the Haloragaceae. The smooth submerged stems are seldom branched but can achieve lengths of up to 6 meters. *M. sibiricum* stems are pinkish or purplish in living plants but often turn white upon drying. The leaves are 1.2–3 cm long and develop in whorls of 3–4 along the stem. Each leaf is partitioned in a pectinate (comblike) arrangement with fewer than 12 segments on each side of the midrib. The linear segments may be straight or curve slightly forward but their bases are set at an angle of 45–90^{o} relative to the midrib. The flowering stems project above the surface of the water and may be up to 16 cm long. *Myriophyllum sibiricum* produces separate male and female flowers on the same plant. The lowest flowers on a stem are pistillate while those near the top are staminate; occasionally some near the middle have both pistils and stamens. Small bracts are present at the base of the flower clusters. *M. sibiricum* flowers have tiny sepals (less than 0.4 mm long) and small cream, green, red or purple petals. The male flowers have eight stamens and the petals may be up to 2.5 mm long but they are quickly discarded. Petals on the female flowers are shorter (less than 0.5 mm) but often persist. The fruits are spherical and they split into four parts (mericarps) which are rounded on the back but can be smooth or rough. (See Fernald 1919 and 1950, Gleason and Cronquist 1991, Scribailo and Alix 2022).

Peter Zika, 2021.

Courtesy James L. Reveal, Lady Bird Johnson Wildflower Center.

Jose Hernandez, courtesy USDA NRCS.

Myriophyllum sibiricum may flower from May to October (Scribailo and Alix 2022, Weakley et al. 2022). During the autumn months the plants store carbohydrate reserves in specialized structures called turions that can persist through the winter months and also serve as dispersal units. Turions consist of numerous tiny leaves that are densely packed together around stem tips or on short lateral branches. *M. sibiricum* turions are long, narrow, and dark green. In the spring, the internodes elongate and the leaves expand but some of the small, dark, reduced leaves may still be visible at the base of the plants well into the summer (Aiken 1981, Knight 2014, Scribailo and Alix 2022). New *M. sibiricum* plants can also arise vegetatively from adventitious roots at the nodes of stems or stem fragments (Les 2017, Scribailo and Alix 2022).

Myriophyllum sibiricum is morphologically similar to the invasive Eurasian milfoil, *M. spicatum*, and the two have often been confused in North America (See Synonyms and Taxonomy section). *Myriophyllum spicatum* has stems that are thicker below the inflorescence while those of *M. sibiricum* are uniform (Block and Rhoads 2011). Aiken (1981) pointed out that the vegetative tips of *M. spicatum* stems are tassel-like and *M. sibiricum* has knob-shaped tips. *Myriophyllum spicatum* leaves have more than 12 segments per side which frequently form angles of less than 45^{o} with the midribs, and the species does not develop turions (Scribailo and Alix 2022).

Identification of *Myriophyllum sibiricum* can be especially challenging because the species hybridizes with *M. spicatum*, producing plants with intermediate characteristics. Experimental work reported by Aiken (1981) resulted in hybrid plants, suggesting a close relationship between the two species. Spontaneous hybridization has subsequently been documented all across North America (Moody and Les 2007) and also in parts of China where both species are native (Wu et al. 2015). Although the two species can usually be distinguished when growing on their own, the proliferation of hybrids has blurred their boundaries to a point where molecular analysis may be required in order to make a positive determination (Grafe et al. 2015, Patterson et al. 2017, Scribailo and Alix 2022). Hybrids between *Myriophyllum sibiricum* and *M. spicatum* can reproduce both sexually and vegetatively (Moody and Les 2002, LaRue et al. 2013) which allows them to spread aggressively. Recent evidence indicates that the hybrids are highly invasive and more likely to become dominant in aquatic settings than either of the parent species (Wu et al. 2015, Glisson and Larkin 2021).

Pollinator Dynamics

Myriophyllum species with emergent flowering stems are generally pollinated by wind (Patten 1956, Cook 1988, Haynes 1988). A number of the floral characteristics of *M. sibiricum* make it particularly well-adapted to wind-pollination, including the reduced perianths, deciduous petals on staminate flowers, and long anthers (Cook 1988). Both self-pollination and the production of cleistogamous flowers (those that self-fertilize without opening) are common in *Myriophyllum* (Philbrick and Les 1996, Les 2017), although neither has been specifically reported in *M. sibiricum*. Although self-fertilization is likely to be deterred by separation of the male and female flowers on a single stem, flowers may receive pollen from related plants on nearby stems because of the high rate of clonal reproduction (Patten 1956).

Seed Dispersal

Each pistillate flower of *Myriophyllum sibiricum* can produce four one-seeded mericarps (Gleason and Cronquist 1991, Scribailo and Alix 2022). Studies of other *Myriophyllum* species found that seeds began to drop from the plants in the fall, with those in aquatic settings sinking to the bottom near the parent plants where they could become part of the seed bank (Brock 1991, Wani and Arshid 2013). Observations of an *M. spicatum* population in New Jersey indicated that some of the achenes remained attached through the early part of the winter, often becoming embedded a layer of ice (Patten 1956). Long-distance dispersal is probably dependent on birds (Les 2017). Waterfowl often consume *Myriophyllum* seeds, although they do not seem to be a preferred food source, and some may be inadvertently ingested by ducks as they root in the mud for invertebrates (McAtee 1918, Fassett 1957, Dirschl 1969, Drobney and Fredrickson 1979). *Myriophyllum* seeds are occasionally eaten by fish (Patten 1956) which might also result in dispersal (Silveira et al. 2019).

Myriophyllum seeds have a hard endocarp that prevents rapid germination, so they remain dormant until the seed coat has broken down as a result of age, exposure, drying and rewetting, freezing, scarification, or other processes (Patten 1956, Brock 1991, Wani and Arshid 2013). *M. sibiricum* seeds require a cold period in order to break dormancy (Aiken 1981, Maki and Galatowitsch 2008). Passage through the digestive tracts of birds or fish may also help to weaken the seed coats in preparation for germination (Wongsriphuek et al. 2008).

Vegetative propagules play an important role in the dispersal of most *Myriophyllum* species, including *M. sibiricum*. As plant stems decay at the end of the growing season, turions become detached and fall into the water where they may sink or float to a new location (Knight 2014, Les 2017). The majority of water-milfoils regularly reproduce from stem fragments, which can remain afloat and be dispersed by water movements (Les and Mehrhoff 1999). *Myriophyllum sibiricum* has been noted for its rapid formation of adventitious roots from pieces of stem (Valley and Newman 1998, Les 2017) and the species was easily propagated from stems segments in a laboratory setting (Roshon et al. 1996). *Myriophyllum* species are sometimes dispersed by people unintentionally when their long stems get tangled in boat motors and trailers and the fragments are subsequently carried to new locations (Philbrick and Les 1996). The movement of stem sections with attached fruits could also result in the dispersal of sexual propagules.

Habitat

Myriophyllum sibiricum occurs at elevations ranging between 0–3300 meters above sea level (Scribailo and Alix 2022). Many aquatic species of *Myriophyllum* occasionally develop on mudflats but terrestrial plants are rare in *M. sibiricum* (Aiken 1981). Common Water-milfoil generally occurs in quiet waters of lakes, ponds, marshes, rivers, or streams over substrates of clay, gravel, marl, muck, mud, organic matter, sand or silt (Rhoads and Block 2007, Les 2017, Weakley et al. 2022). Because the species requires adequate light penetration it is intolerant of turbidity and is usually found in clear water (Les 2017), where it is likely to be located at depths of less than a meter (Rhoads and Block 2007). *M. sibiricum* often grows in fresh water but it can also occur in brackish water (Tiner 2009). The waters are usually alkaline or circumneutral—pH levels from 5.5–9.8 have been reported (Les 2017, Weakley et al. 2022). When growing in hard water the plants may accumulate lime, becoming encrusted and brittle (Gutzmer and Kaul 2001). Nutrient availability in *M. sibiricum* habitats can vary from low to high (Scribailo and Alix 2022).

Wetland Indicator Status

Myriophyllum sibiricum is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2023)

MYSI

Coefficient of Conservatism (Walz et al. 2018)

CoC = 8. Criteria for a value of 6 to 8: Native with a narrow range of ecological tolerances and typically associated with a stable community (Faber-Langendoen 2018).

Distribution and Range

The global range of *Myriophyllum sibiricum* extends throughout much of the northern hemisphere (POWO 2023). The species is well-adapted to northern climates and is most abundant in places with where January temperatures average 0^{o}C or lower (Aiken 1981). The map in Figure 1 depicts the extent of *M. sibiricum* in North America.

The USDA PLANTS Database (2023) shows records of *Myriophyllum sibiricum* in eight New Jersey counties: Cape May, Hunterdon, Mercer, Middlesex, Monmouth, Passaic, Warren, and Sussex (Figure 2). The data are based on historic reports and do not reflect the current distribution of the species. Some of the old records may be based on misidentifications or hybrid plants (see Synonyms and Taxonomy section).

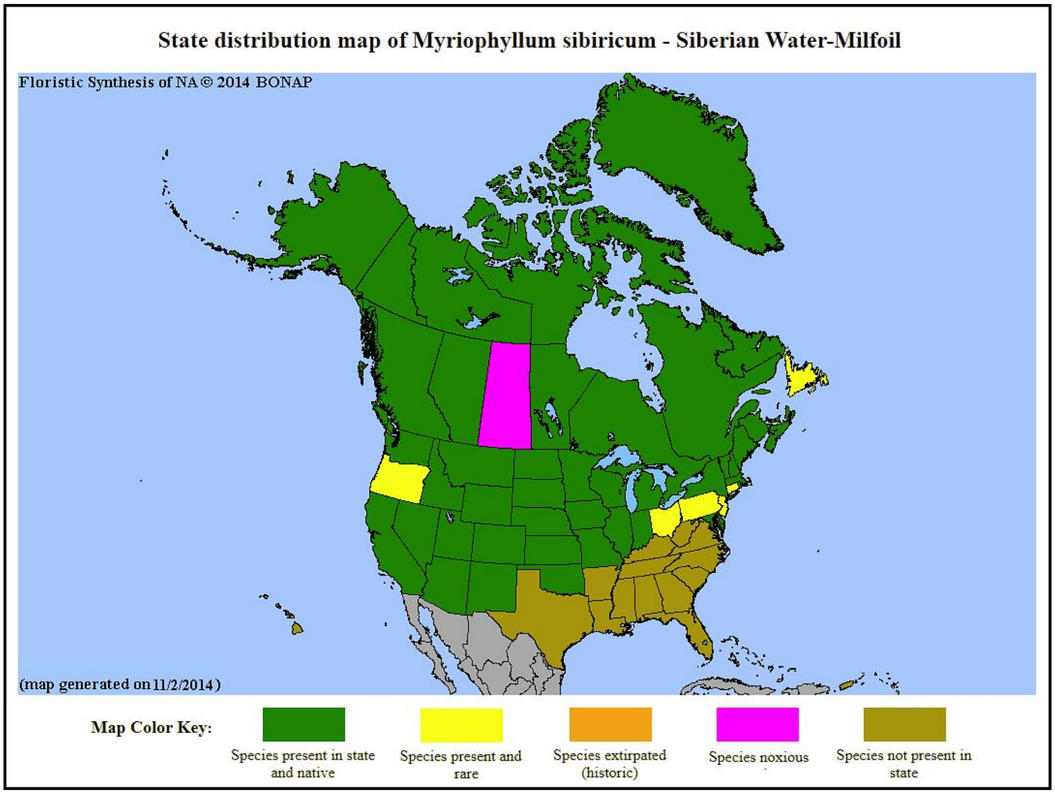

Figure 1. Distribution of M. sibiricum in North America, adapted from BONAP (Kartesz 2015).

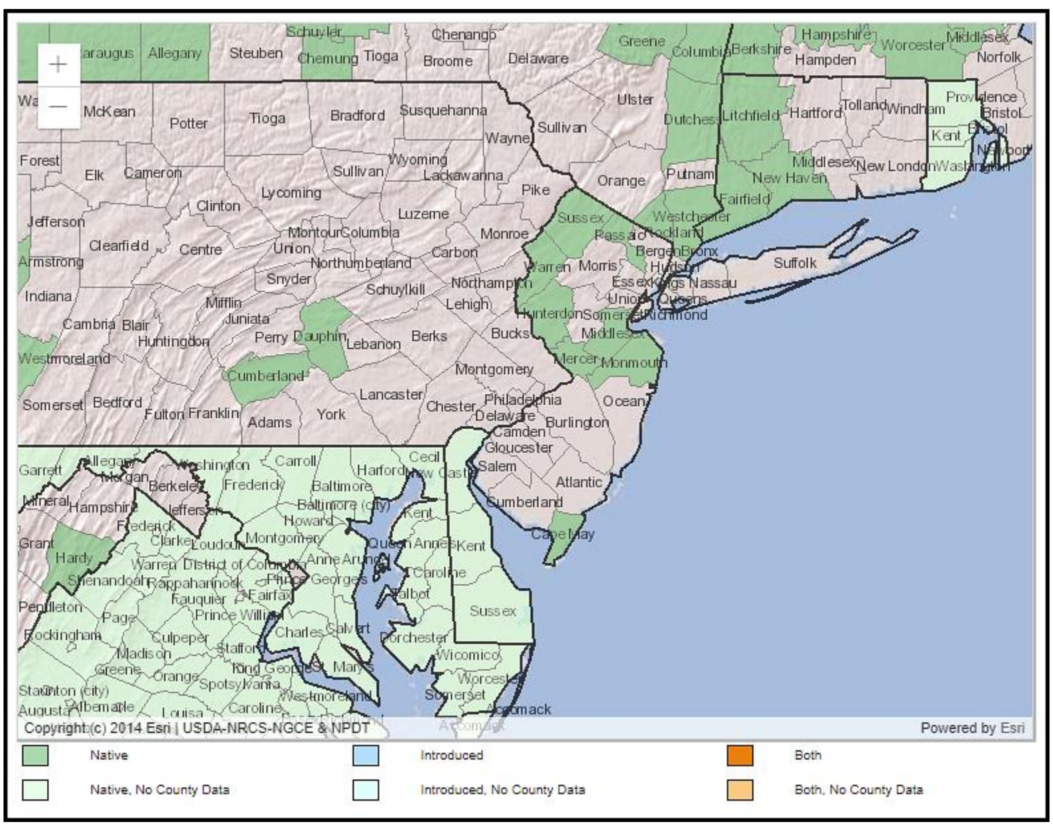

Figure 2. County records of M. sibiricum in New Jersey and vicinity (USDA NRCS 2023).

Conservation Status

Myriophyllum sibiricum is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2023). The map below (Figure 3) illustrates the conservation status of *M. sibiricum* throughout its range. The species is critically imperiled (very high risk of extinction) in five states, imperiled (high risk of extinction) in two states and one province, and vulnerable (moderate risk of extinction) in two states. *M. sibiricum* is secure or apparently so throughout most of Canada, and it is present but unranked in many U. S. states.

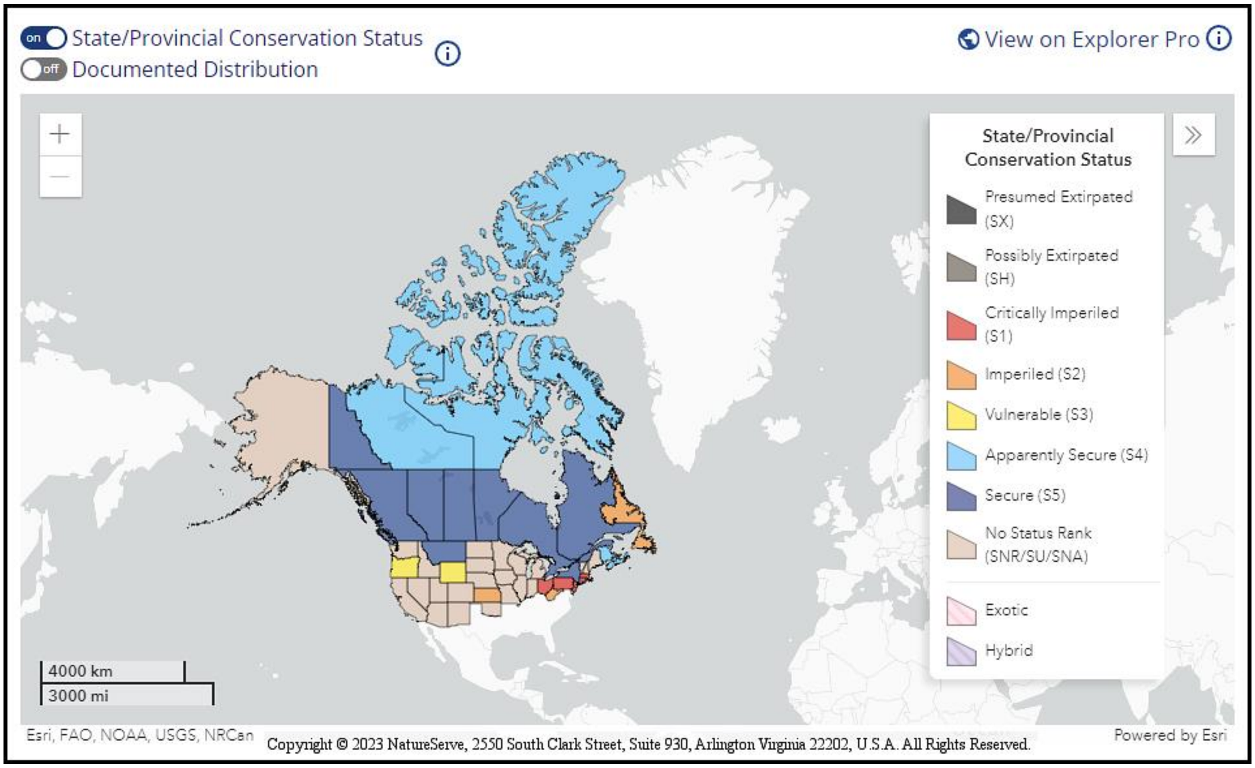

Figure 3. Conservation status of M. sibiricum in North America (NatureServe 2023).

Myriophyllum sibiricum is critically imperiled (S1) in New Jersey (NJNHP 2022). The rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *M. sibiricum* is also listed as an endangered species (E) in New Jersey, meaning that without intervention it has a high likelihood of extinction in the state. Although the presence of endangered flora may restrict development in certain communities such as wetlands or coastal habitats, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to *M. sibiricum* signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Most of the early reports of *Myriophyllum sibiricum* in New Jersey remain unsubstantiated, with the exception of one Sussex County population that was documented with a specimen in 1920

(NJNHP 2022). The occurrence could not be relocated during the latter part of the 1900s and the species was ranked as historical in the state (NJ ONLM 1992). Snyder (2000) documented a new population in 1996, and that is presently the only occurrence known to be extant in New Jersey (NJNHP 2022).

Threats

In New Jersey, *Myriophyllum sibiricum* is presently known from a single site where the population is relatively small. No immediate threats to the occurrence have been identified (NJNHP 2022) but a number of potential risks could rapidly generate new concerns.

Some invertebrate herbivory has been documented on *Myriophyllum sibiricum* but it is unlikely to pose any significant threat to healthy populations, particularly since most of the insects that feed on submerged aquatic plants are not host-specific. Reported herbivores include the larvae of midges (*Harnischia abortiva*, *H. tenuiscaudata*), caddisflies (*Atripsodes* sp., *Leptocella* spp., *L. exquisita*, *Mystacides longicornis*) and a moth (*Paraponyx badiusalis*). Damage is mainly limited to the plants' leaves and stems, although *Leptocella* spp. occasionally consume young buds (McGaha 1952, Harms and Grodowitz 2009).

Myriophyllum sibiricum is particularly vulnerable to a number of pollutants that are often inadvertently introduced into aquatic habitats through surface runoff. Research on the impacts of low doses of some herbicides which were frequently employed in agriculture (Forsythe et al. 1997) and forestry operations (Roshon et al. 1999) demonstrated that they were harmful to *M. sibiricum*, and the latter study found that Common Water-milfoil was equally or more sensitive to contaminants than most other aquatic flora and some aquatic fauna. Similar research examined the effects of various pharmaceutical compounds that often enter surface waters via agricultural runoff or sewage effluent (Brain et al. 2004, 2005). The results showed that the compounds could harm aquatic plants, including *M. sibiricum*, even when present at low levels but they were especially damaging at high concentrations. One antibiotic mixture in particular significantly reduced the amount of light penetrating the water column (Brain et al. 2005).

Myriophyllum spicatum appears to present a two-pronged threat to *Myriophyllum sibiricum*: One due to direct competition and another as a result of hybridization. An investigation of competition between the two species found that *Myriophyllum sibiricum* had an initial advantage due to its rapid establishment and the species could hold its own in clear water. However, the researchers surmised that once *M. spicatum* was able to form a dense canopy it would reduce the amount of light available to *M. sibiricum*, eventually displacing it (Valley and Newman 1998). Marko et al. (2008) examined variations in the phytochemical composition of the two species when they were exposed to different growing conditions. Their results showed that *M. spicatum* had a superior ability to concentrate compounds that could serve as protection against damage from ultraviolet light, phytoplankton competitors, and generalist herbivores, which was likely to contribute to its long-term competitive advantage over *M. sibiricum*. In New Jersey, the invasive *M. spicatum* appears to have replaced *M. sibiricum* (and several other rare native aquatic species) in the lake where Common Water-Milfoil was originally documented (Snyder 2000).

Myriophyllum sibiricum may also be outcompeted by plants that develop from its hybridization with *M. spicatum* (Scribailo and Alix 2022). Wu et al. (2015) observed that the hybrids of *M. sibiricum* × *M. spicatum* were more fit than the parental species. The close resemblance of the hybrid to *M. sibiricum* might cause it to be overlooked when it establishes at new locations, preventing a timely response (Grafe et al. 2015). Over time, repeated hybridization and subsequent backcrossing could result in the genetic dilution of *Myriophyllum sibiricum*. When viewed through a North American lens, hybridization with Eurasian Water-milfoil looks like a threat to the integrity of the native *M. sibiricum*. However, in regions where both water-milfoils are indigenous the establishment of hybrid offspring that can outcompete the parent species might alternately be interpreted as a normal part of the evolutionary process (Wu et al. 2015).

The tenuous existence of *Myriophyllum sibiricum* in New Jersey is likely to become even more precarious as a result of climate change. Common Water-milfoil is well adapted to cold climates and is thought to require low winter temperatures to break dormancy in its seeds (Aiken 1981, Maki and Galatowitsch 2008). Populations that are situated near the southern edge of the species' range are likely to experience shorter, warmer winters and hotter summers—particularly in New Jersey where temperatures are rising faster than they are in other parts of the northeast (Hill et al. 2020). The warming climate might also increase the competitive advantage of *M. spicatum*: While *M. sibiricum* is restricted to the northern hemisphere the native range of *M. spicatum* spans the globe from northern Russia to South Africa (POWO 2023), indicating that the latter species can thrive in a wide variety of climactic conditions.

Management Summary and Recommendations

In the long run there is probably little that can be done to maintain *Myriophyllum sibiricum* in New Jersey, particularly as the local climate is becoming increasingly unsuitable. *Myriophyllum spicatum* has been ranked as highly invasive in the state, meaning that it is widespread and poses a significant threat to native communities (Van Clef 2009, FoHVOS 2022). Even if recreational usage of the pond inhabited by *M. sibiricum* was restricted it would be nearly impossible to prevent the entrance of the more competitive *M. spicatum* (or a *M. sibiricum* × *M. spicatum* hybrid) into the habitat since plant fragments could be casually introduced on the feet of a visiting duck. Like other *Myriophyllum* species, Eurasian Water-milfoil can quickly proliferate vegetatively and once the plant becomes established it is extremely difficult to eradicate. Mechanical, chemical, and biological methods applied for control of *M. spicatum* in other locations have only been moderately effective and many of the techniques have proven equally likely to damage co-occurring native plants, with some treatments even resulting in more harm than no action at all (Kaufman and Kaufman 2007, Marko and White 2018, MAISRC 2023). The most realistic way to have a positive impact on the extant population of *Myriophyllum sibiricum* may be to focus on water quality and prevent the introduction of pollutants into the aquatic environment.

Synonyms and Taxonomy

The accepted botanical name of the species is *Myriophyllum sibiricum* Kom. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, POWO 2023, USDA NRCS 2023). *Myriophyllum sibiricum* plants in North American were initially mistaken for the Eurasian Water-milfoil (*M. spicatum*). Fernald (1919) noted differences and described the North American plants as a new taxon (*M. exalbescens*), although once it became known that the species was also present in Asia and had previously been identified as *M. sibiricum* the earlier name was applied (Scribailo and Alix 2022). Confusion between *M. sibiricum* and *M. spicatum* was exacerbated by their ability to hybridize. Observations of *Myriophyllum* plants in New Jersey led Patten (1954) to conclude that characteristics of the two species overlapped and they should be regarded as varieties within a broader complex, although it now seems likely that some of his specimens were hybrids (Aiken 1981, Moody and Les 2002). The non-native *Myriophyllum spicatum* was first documented in the eastern United States in 1942 (Les and Mehrhoff 1999) although it may have been present earlier and overlooked: Many botanists were slow to recognize *M. sibiricum* and *M. spicatum* as distinct species (Löve 1961).

Botanical Synonyms	**Common Names**
Myriophyllum exalbescens Fernald	Common Water-milfoil
Myriophyllum exalbescens var. *magdalenense* (Fernald) Á. Löve	Northern Watermilfoil
Myriophyllum magdalenense Fernald	Shortspike Watermilfoil
Myriophyllum spicatum var. *capillaceum* Lange	Siberian Water-milfoil
Myriophyllum spicatum ssp. *exalbescens* (Fernald) Hultén	American Watermilfoil
Myriophyllum spicatum var. *exalbescens* (Fernald) Jeps.	
Myriophyllum *spicatum* var. *muricatum* Maxim.	
Myriophyllum spicatum ssp. *squamosum* Laest. ex Hartm.	
Myriophyllum spicatum var. *squamosum* (Laest. ex Hartm.) Hartm.	

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