

Brittle Waternymph (*Najas minor*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2012
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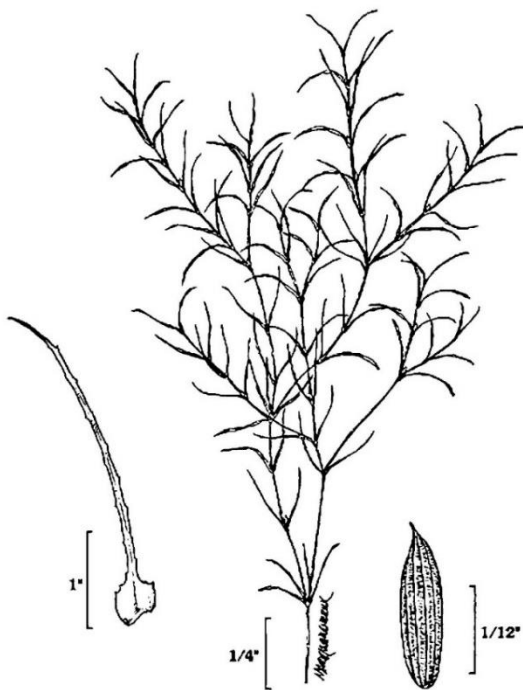


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1 Native Range and Status in the United States

Native Range

From Pfingsten et al. (2018):

“*Najas minor* is native to Europe, western Asia, and northern Africa (Meriläinen 1968; Triest 1988).”

From GISD (2018):

“*Najas minor* is a submerged aquatic herb native to Europe and Asia [...]”

From Lansdown (2014):

“Native: Afghanistan; Algeria; Austria; Belgium; Bulgaria; Canada; China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Shaanxi, Shandong, Sichuan, Xinjiang, Yunnan, Zhejiang); Czech Republic; Egypt; France (France (mainland)); Germany; Hong Kong; Hungary; India (Assam); Iran, Islamic Republic of; Iraq; Italy; Japan (Nansei-shoto); Kazakhstan; Korea, Democratic People's Republic of; Lebanon; Libya; Liechtenstein; Luxembourg; Nepal; Netherlands; Pakistan; Palestinian Territory, Occupied; Poland; Portugal; Romania; Russian Federation (Amur, Buryatiya, Khabarovsk, Primoryi); Saint Pierre and Miquelon; Spain; Sri Lanka; Switzerland; Syrian Arab Republic; Taiwan, Province of China; Tajikistan; Thailand; Tunisia; Turkey; Uzbekistan; Viet Nam”

Status in the United States

Pfingsten et al. (2018) list 36 states within the contiguous United States where *N. minor* is established: Alabama, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin.

From Pfingsten et al. (2018):

“*Najas minor* is prohibited in Minnesota, Wisconsin, and Illinois (GLPANS 2008). In Minnesota it is illegal to possess, import, purchase, sell, propagate, transport, or introduce *N. minor* or any related varieties or hybrids (Invasive Species Program 2011). The New York Invasive Species Council ranks this species moderate ecological risk and recommends that the species be regulated (New York Invasive [Species Council] 2010).”

From GISD (2018):

“[...] has established in eastern United States and Ontario. Initially recorded in the 1930s, it has established populations in 26 states in the US.”

Means of Introductions in the United States

From Pfingsten et al. (2018):

“The vector of introduction of *N. minor* to North America is not clear. It could have been accidentally introduced with more commonly cultivated species, such as rice (McIntyre and Barrett 1985; Les and Mehrhoff 1999). Alternatively, it could have been introduced to the Great Lakes, the Hudson River, or upper Chesapeake Bay by shipping (Mills et al. 1993; Mills et al. 1997).”

From GISD (2018):

“*Najas minor* may be introduced through disposal of aquarium species (DNR, 2007). *Najas minor* or its seeds may cling to boat hulls or boat trailers in inconspicuous places and be transported to other locations where they can establish (Capers et al, 2005).”

Remarks

From Pfingsten et al. (2018):

“Seven other species of *Najas* are reported by Haynes (1979) as occurring in the United States. Because several of the species are morphologically similar, identification of the various species can sometimes be difficult. *Najas minor* is easily confused with the other *Najas* species, slender water nymph (*N. flexilis*), common water nymph (*N. guadalupensis*) and northern naiad (*N. gracillima*). These species can be differentiated from *N. minor* by looking at the leaf bases and seeds.”

“Other naiads (*Najas* spp.). *Najas minor*, with its mature leaves recurved, and its seed pits (areolae) arranged in longitudinal rows like the rungs of a ladder, is one of the more distinctive species of *Najas* (Meriläinen 1968). Proper identification without reproductive structures requires genetic testing due to morphological similarities to *N. gracillima* and *N. marina* (Les et al. 2015).”

From Wang et al. (2017):

“For *N. minor*, we found that the distribution of high climatic suitability did not match the invasive ranges based on the native model. Furthermore, we could not use the invasive model to predict distributions of suitable climatic habitats in native ranges, further indicating large climatic niche shifts between native and invasive ranges [...]”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

“Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Lilianae
Order Alismatales
Family Hydrocharitaceae
Genus *Najas*”

Species *Najas minor* All. – brittle waternymph”

“Current Status: accepted”

Size, Weight, and Age Range

From GISD (2018):

“The stems may reach up to 2.5 m long and are profusely branched near their apex. Leaves are opposite or subopposite, about 1 mm wide and 0.5 to 3.5 cm long, becoming stiff and recurved with age. Leaves have 7 to 15 small, but conspicuous teeth along each side of the leaf.”

From Pfingsten et al. (2018):

“Size: up to 1.2 m in length (Haynes 1979)”

Environment

From GISD (2018):

“*Najas minor* prefers calm waters such as ponds, lakes, and reservoirs but may grow in streams and rivers as well. It prefers alkaline environments and is known to inhabit pH levels of 6.0-9.3 with an optimum range of about 6.6-7.2.”

From Pfingsten et al. (2018):

“*Najas minor* is an annual submersed rooted or floating plant (Haynes 1979).”

Climate/Range

From GISD (2018):

“[...] and temperatures down to 8°C.”

Distribution Outside the United States

Native

From Pfingsten et al. (2018):

“*Najas minor* is native to Europe, western Asia, and northern Africa (Meriläinen 1968; Triest 1988).”

From GISD (2018):

“*Najas minor* is a submerged aquatic herb native to Europe and Asia [...]”

From Lansdown (2014):

“Native: Afghanistan; Algeria; Austria; Belgium; Bulgaria; Canada; China (Fujian, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Nei Mongol, Shaanxi, Shandong, Sichuan, Xinjiang, Yunnan, Zhejiang); Czech Republic; Egypt; France (France (mainland)); Germany; Hong Kong; Hungary; India (Assam); Iran, Islamic Republic of; Iraq; Italy; Japan (Nansei-shoto); Kazakhstan; Korea, Democratic People's Republic of; Lebanon; Libya; Liechtenstein; Luxembourg; Nepal; Netherlands; Pakistan; Palestinian Territory, Occupied; Poland; Portugal; Romania; Russian Federation (Amur, Buryatiya, Khabarovsk, Primoryi); Saint Pierre and Miquelon; Spain; Sri Lanka; Switzerland; Syrian Arab Republic; Taiwan, Province of China; Tajikistan; Thailand; Tunisia; Turkey; Uzbekistan; Viet Nam”

Introduced

According to GISD (2018), *Najas minor* is established in two locations within Canada.

Means of Introduction Outside the United States

From Pfingsten et al. (2018):

“The vector of introduction of *N. minor* to North America is not clear. It could have been accidentally introduced with more commonly cultivated species, such as rice (McIntyre and Barrett 1985; Les and Mehrhoff 1999). Alternatively, it could have been introduced to the Great Lakes, the Hudson River, or upper Chesapeake Bay by shipping (Mills et al. 1993; Mills et al. 1997).”

From GISD (2018):

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Short Description

From GISD (2018):

“*Najas minor* is a submersed, annual, aquatic herb. Its growth is usually compact and relatively bushy. The stems may reach up to 2.5 m long and are profusely branched near their apex. Leaves are opposite or subopposite, about 1 mm wide and 0.5 to 3.5 cm long, becoming stiff and recurved with age. Leaves have 7 to 15 small, but conspicuous teeth along each side of the leaf. Sheaths at the base of the leaf are truncate to auriculate, with fine teeth along the upper margin. Flowers are small, inconspicuous, and borne in the leaf axils on the same plant. Fruits are single seeded but abundantly produced. Fruits are 1.5 to 3.0 mm long and slightly curved with rectangular areolae arranged in distinct longitudinal rows. (EL-ERDC, 2007; Cao, 2010).”

Biology

From GISD (2018):

“The reproductive season of *Najas minor* starts in July, when flowers appear. Seed production peaks in September, and continues into October. During the late summer or early fall, the stems become brittle, and the profusely branched apical portions of the stem break into small fragments. Seeds remain attached in the leaf axils, and the fragments are dispersed by wind and water currents. Seed germination occurs in early spring to late summer (Cao, 2010; DNR, 2007).”

Human Uses

From GISD (2018):

“*Najas minor* is a preferred food source for waterfowl who readily consume its abundant seed supply (DNR, 2007).”

Diseases

No diseases reported.

Threat to Humans

From GISD (2018):

“[...] it grows very densely under the surface producing shoots up to a meter long that shade out other plants and interfere with recreational activity such as swimming, boating, and fishing and reduce the aesthetic value of waters.”

3 Impacts of Introductions

From GISD (2018):

“*Najas minor* establishes dense monocultures that may exclude other native aquatic plants and replaces native *Najas* species. Unlike some of the other invasive aquatic plants *N. minor* does not produce long stems that spread on the surface of the water; it grows very densely under the surface producing shoots up to a meter long that shade out other plants and interfere with recreational activity such as swimming, boating, and fishing and reduce the aesthetic value of waters. It is also believed to induce conditions that are adverse to fish and waterfowl. *N. minor* may reduce the discharge capacity of channels as well. Its negative effects are typically amplified in enriched, low-energy systems (DNR, 2007; Hellquist & Straub, 2002; Cao, 2010; Capers et al, 2005).”

From Pfingsten et al. (2018):

“Great Lakes Impacts: *Najas minor* has a moderate environmental impact in the Great Lakes. Realized: Brittle waternymph starts growing early in the season, which often leads to the block the sunlight from reaching native species and inhibiting their growth (Ohio EPA 2001, Robinson

2004). This species can also out-compete nearby plants for space (Office of Water Resources 2010). *Najas minor* grows aggressively in shallow waters and has formed dense, monospecific stands in the shallow waters of Lake Erie (U.S. EPA 2008). *Najas minor* can also form dense underwater meshes with other exotic species such as *Hydrilla verticillata* (Kay and Hoyle 1999). These dense plant communities can produce unfavorable conditions for fish and waterfowl (Kay and Hoyle 1999, Office of Water Resources 2010).”

“Potential: Animals may also be driven out of *N. minor* dominated ecosystems if they are dependent on the displaced native vegetation for survival (Robinson 2004). Although, this species typically invades shallow water, in North Carolina dense shoals of *N. minor* have grown in waters up to 4 meters deep (Kay and Hoyle 1999). Dense populations of brittle waternymph have increased sedimentation rates and clogged waterways in Massachusetts (Robinson 2004). As dense mats of brittle waternymph die and decompose, the amount of oxygen in nearby water and sediment maybe be significantly decreased (Robinson 2004). In extreme cases, anoxic conditions can lead to fish kills (Robinson 2004).”

Najas minor has a moderate socio-economic impact in the Great Lakes.

Realized: *Najas minor* populations can reduce the discharge capacity (quantity of water) of channels (WI DNR 2010). Dense stands of *N. minor* can hinder recreational activities such as, boating, fishing, and/or swimming (Office of Water Resources 2010, U.S. EPA 2008, WI DNR 2010). Along with reduced recreational ability, populations of brittle waternymph can also diminish the aesthetic value of the surrounding areas (WI DNR 2010).

“Potential: Limited recreational use and a decline in aesthetic value associated with large *N. minor* infestations can lead to reduced property values around the effected [*sic*] waterbody (Robinson 2004).”

4 Global Distribution



Figure 1. Known global distribution locations of *Najas minor*. Map from GBIF Secretariat (2018). Points in Mexico and Estonia were not included in climate matching analysis because they could not be verified as established populations.

5 Distribution Within the United States

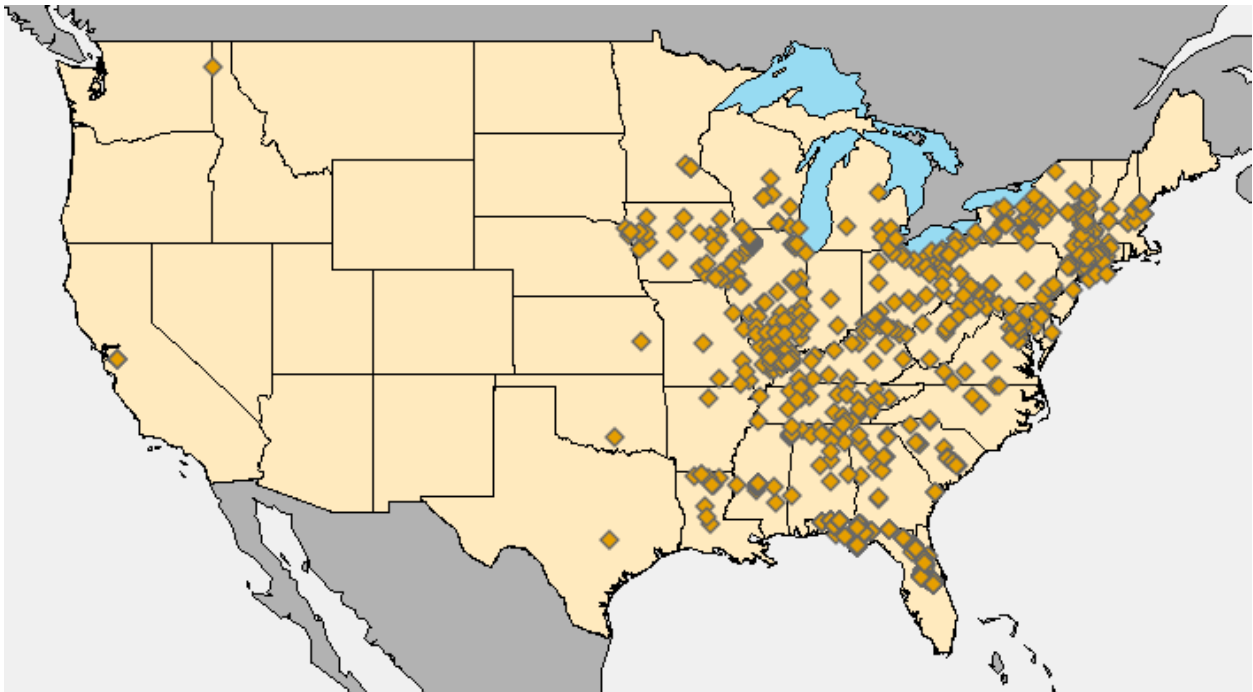


Figure 2. Distribution of *Najas minor* in the United States. Map from GBIF Secretariat (2018).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) of *N. minor* was high throughout the eastern half of the contiguous United States, California, and the northern Rocky Mountains. Most of the western United States was a medium match and only western Washington, southwestern Arizona, and a small area in the southern Appalachian Mountains was a low match. The range of Climate 6 scores indicating a high climate match is 0.103 and greater. The Climate 6 score of *N. minor* within the contiguous United States was 0.886. All states in the contiguous United States had high climate scores.

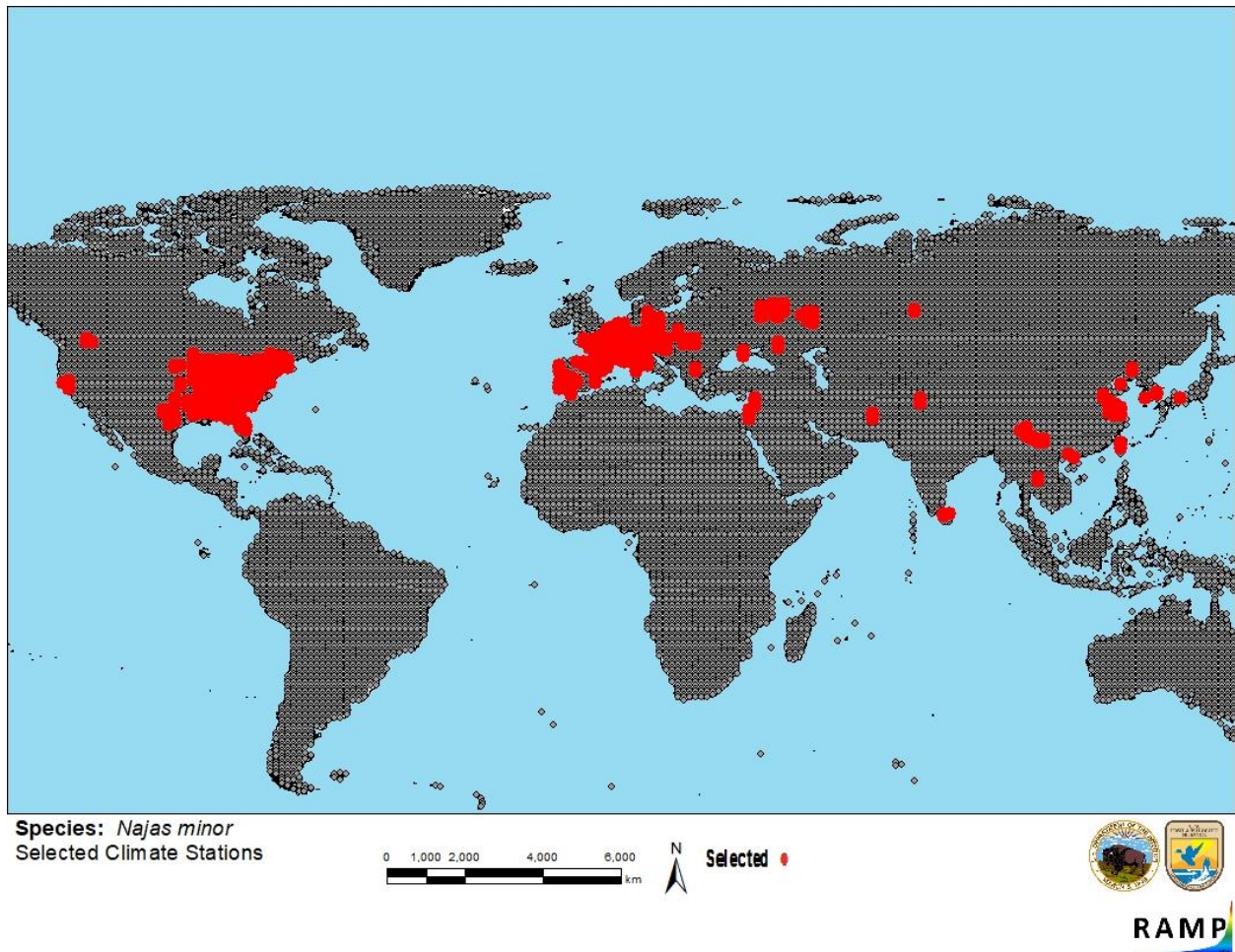


Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations across the world selected as source locations (red) and non-source locations (gray) for *Najas minor* climate matching. Source locations from GBIF Secretariat (2018).

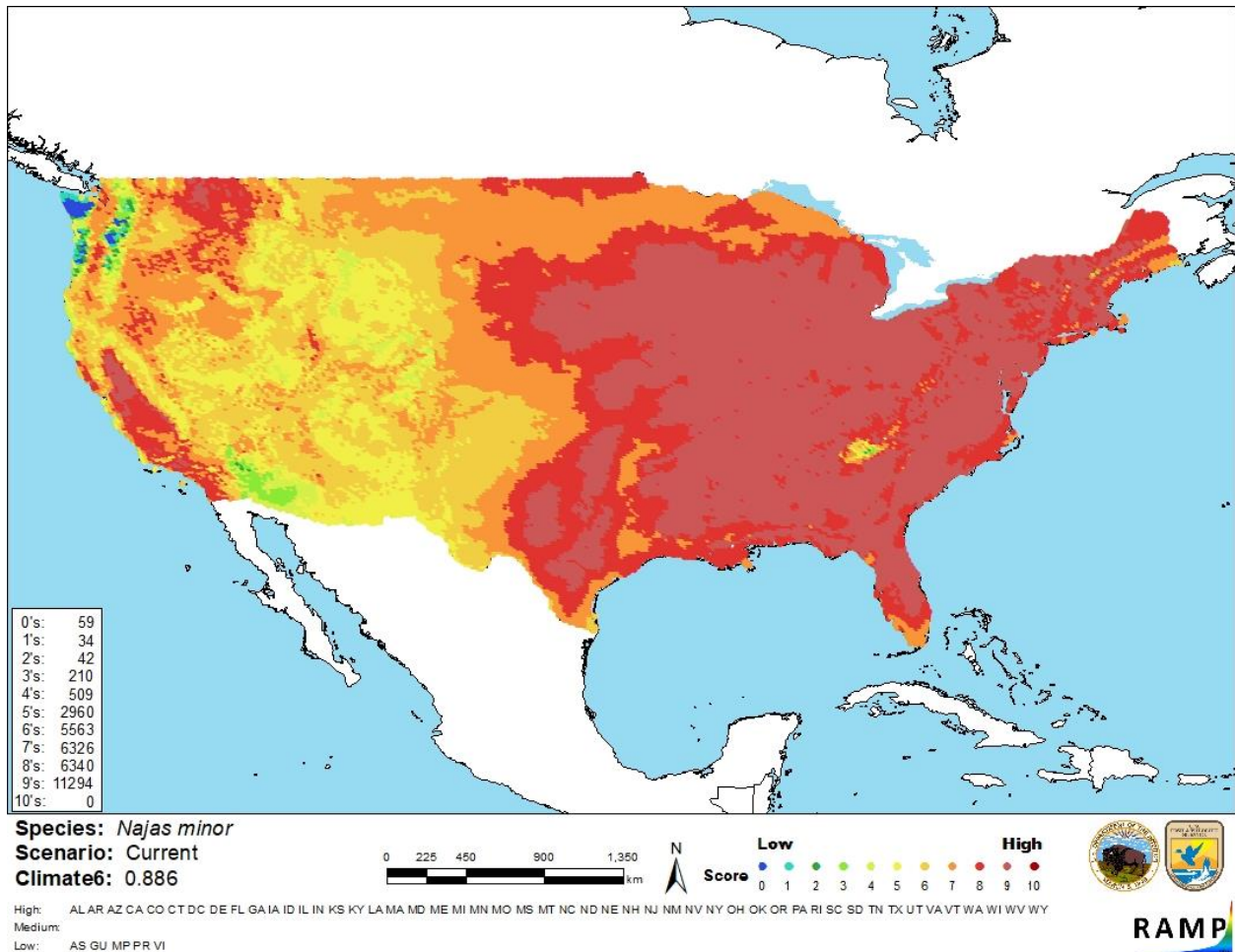


Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Najas minor* in the contiguous United States based on source locations reported by GBIF Secretariat (2018). Counts of climate match scores are tabulated on the left. 0=Lowest match, 10=Highest match.

The “High”, “Medium”, and “Low” climate match categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 < X < 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

Information on the biology, ecology, distribution, and impacts of *Najas minor* is available for review. Minor discrepancies exist over the range of the species, but this uncertainty does not greatly affect the overall risk assessment of the species. Information on impacts is relatively abundant in the gray literature, such as in state agency reports, but little information is available in the peer-reviewed scientific literature. Given all factors, the certainty of assessment is medium.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Najas minor is a submerged aquatic plant with a far-reaching native range that includes countries within Africa, Europe, and Asia. Species within the *Najas* genus are morphologically similar, which can make identification of the various species somewhat difficult. Distribution of established populations beyond this native range includes thirty-six states within the contiguous United States and two locations within Canada. Establishment often leads to dense monocultures, reduction of water discharge capacity, and compromised habitat. Negative impacts to humans can include interference with recreational activity such as swimming, boating, and fishing, as well as reduced aesthetic value of waters. Climate match within the contiguous United States was very high, with high scores for all states. Given all factors, the overall risk of *Najas minor* within the contiguous United States is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Medium**
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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