Fragrant Waterlily (*Nymphaea odorata*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, February 2015
Revised, May 2018
Web Version, 11/20/2020

Organism Type: Plant
Overall Risk Assessment Category: Uncertain

Photo: Mary Keim. Licensed under Creative Commons BY-NC-SA 2.0. Available: https://www.flickr.com/photos/38514062@N03/5710984877/.

1 Native Range and Status in the United States

Native Range

GISD (2017) lists *Nymphaea odorata* as native in the Bahamas, Canada, Cuba, El Salvador, Honduras, Mexico, Nicaragua, Puerto Rico, and the United States.

From NatureServe (2018):

"*Nymphaea odorata* ssp. *odorata* occurs natively throughout eastern North America, from Manitoba and Ontario to the Atlantic Provinces south to Texas and Florida. […] Its occurrence

has been recorded in the following provinces and states; British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Illinois, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin (Scoggan 1978, Flora of North America Editorial Committee 1997, USDA-NRCS 1999, Biota of North America Program [no date]). It is also known to occur natively in Mexico, Bahamas, Cuba, Honduras, El Salvador, Nicaragua, and has been naturalized in Guyana (Flora of North America Editorial Committee 1997).”

“*Nymphaea odorata* ssp. *tuberosa* has a smaller range than *N. odorata* ssp. *odorata*, and is reported to occur natively in the following provinces and states: Manitoba, Ontario, Quebec, Connecticut, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New York, Ohio, Oklahoma, Pennsylvania, Vermont, and Wisconsin (Flora of North America Editorial Committee 1997, USDA-NRCS 1999).”

“British Columbia: southwest and south-central British Columbia (G. Douglas pers. comm.).”

“Manitoba: ssp. *odorata* - east side of Lake Winnipeg, and Hill Lake (northwestern side of Lake Winnipeg) westward to the Saskatchewan border. ssp. *tuberosa* - southeastern 1/6 of the province (to just north of the Winnipeg River), at the northwestern limit of its range (E. Punter pers. comm.).”

“Ontario: widespread in southern and central Ontario, particularly on the Precambrian (Canadian) Shield. Not sure of northern limit (M. Oldham pers. comm.).”

“Quebec: ssp. *odorata* - across southern Quebec up to the 48th latitude. ssp. *tuberosa* - mainly restricted to the St. Lawrence River system (J. Labrecque pers. comm.).”

Status in the United States

GISD (2017) lists *Nymphaea odorata* as alien and established, but invasiveness unspecified in Alaska; and as alien, established, and invasive in California, Oregon, and Washington.

From GISD (2017):

“*N. odorata* ssp. *odorata* has been collected in southeast Alaska from muskeg pool on Baranof Island near Sitka in 1997 (Alaska Natural Heritage Program, 2006).”

“An aerial photograph of Giffin Lake taken in April 1974 shows open water and data indicate that 11-25 percent of the lake was covered by emersed plants (unknown species). Twenty years later, 100 percent of the lake s surface was covered by waterlilies (Washington Department of Ecology, 2003).”

From NatureServe (2018):

"*Nymphaea odorata* is known from historical occurrences in South Dakota. It has recently been reported in Missouri River marshes in Yankton County along border with Nebraska but it is not known for certain whether the occurrences were in Nebraska or South Dakota (South Dakota Natural Heritage Database)."

"The Flora of North America Editorial Committee (1997) cites the occurrence of *Nymphaea odorata* in […] and New Mexico while the Biota of North America Program does not. […], and the New Mexico Natural Heritage Program reported that it is not known from New Mexico."

"Alaska: one record from Baranof Island in south-east Alaska (Alaska Natural Heritage Program)."

"Arizona: found in Clear Creek Reservoir, Navajo County, and Yavapai (Arizona Heritage Data Management System)."

"California: under elevations of 2,700 m in scattered localities including Lake Tahoe, Sacramento Valley (Butte County) and the San Bernardino Mountains (California Natural Diversity Database)."

"Colorado: reported in Colorado (Biota of North America Program, Herbarium COLO)."

"Delaware: occurs in piedmont and coastal plain (Delaware Natural Heritage Program)."

"Florida: occurs through the state (Wunderlin et al. 1995)."

"Georgia: known from 25 counties mostly in the southern half of the state (USDA-NRCS 1999)."

"Idaho: most common in and perhaps restricted to approximately the northern third of the state (M. Mancuso pers. comm.)."

"Illinois: occurs statewide (W. McClain pers. comm.)."

"Indiana: mostly confined to northern 1/4 of the state (Indiana Natural Heritage Data Center)"

"Iowa: frequent in Lakes Area of north-west Iowa; infrequent to rare elsewhere (Iowa Department of Natural Resources)."

"Kansas: widely scattered throughout the eastern three-fourths of Kansas, but apparently most common in the southeastern sixth (C. Freeman pers. comm.)."

"Kentucky: reported in 9 counties scattered throughout the state (USDA-NRCS 1999)."

"Louisiana: occurs statewide (Louisiana Natural Heritage Program)."

"Massachusetts: occurs in every county in Massachusetts (USDA-NRCS 1999)."

"Maine: occurs in every county (Haines and Vining 1998, D. Cameron pers. comm.)."

"Michigan: common and widespread throughout state (Michigan Natural Features Inventory)."

"Minnesota: occurs statewide (Minnesota Natural Heritage)."

"Missouri: scattered occurrences in central and southern portions of state (T. Smith pers. comm.)"

"Nevada: introduced in Nevada (Nevada Natural Heritage Program)."

"New York: occurs in every county of the state (S. Young pers. comm.)."

"North Carolina: recorded in 40 counties throughout the state (North Carolina Natural Heritage Program, Radford et al. 1968)"

"Ohio: occurs throughout state (Ohio Natural Heritage Data Base)."

"Rhode Island: occurs in all but one county in the state (USDA-NRCS 1999)"

"South Carolina: recorded in 26 counties scattered throughout the state (Boyle et al. [no date])."

"South Dakota: historically documented from 2 sites in Minnehaha county [sic] in the south-east (Larson 1993, South Dakota Natural Heritage Database)."

"Tennessee: known to occur in 7 counties scattered throughout the state (The APSU Center for Field Biology and University of Tennessee Herbarium 1999)."

"Utah: occurs in Kane, Utah, and Washington (?) counties [sic] (B. Franklin pers. comm.)."

"Virginia: reported in about 25 counties mostly in the south-east portion of the state (USDA-NRCS 1999)."

"Vermont: ssp. *odorata* ubiquitous while ssp. *tuberosa* is restricted to more alkaline waters, mostly in the Lake Champlain Valley (R. Popp pers. comm.)."

"Wisconsin: occurs throughout the state (K. Westad pers. comm.)."

"West Virginia: occurs in 6 counties in western two-thirds of the state (USDA-NRCS 1999)."

"*Nymphaea odorata* ssp. *tuberosa* is endemic to continental North America, and tends to be weedy in the eastern part of its range (Flora of North America Editorial Committee 1997). It is

listed a [sic] noxious weed in California (California Natural Diversity Database, Arizona Heritage Data Management System)."

According to USDA, NRCS (2018), *N. odorata* is listed as a Class C noxious weed in Washington.

N. odorata is on the Aquatic Life Approved Species List of Illinois (Illinois DNR 2015), which means the species is "considered to be approved for aquaculture, transportation, stocking, importation, and/or possession in the State of Illinois."

N. odorata is in trade within the United States (e.g. Pond Deals 2020).

Means of Introductions in the United States

No information on means of introduction in the United States for *Nymphaea odorata* was found.

Remarks

From Nierbauer et al. (2009):

"For hybridising, he used the European white water lily (*Nymphaea alba*), the North American fragrant water lily (*Nymphaea odorata* Aiton), the pygmy water lily (*Nymphaea tetragona* Georgi) and the yellow water lily (*Nymphaea mexicana* Zucc.). Varieties relevant for breeding were the red-flowered *Nymphaea alba* var. *rubra* from Sweden as well as pink- and white-flowered forms of *Nymphaea odorata* (*N. o*. var. *rosea* and var. *tuberosa*)."

"*Nymphaea alba* is placed in the subgenus *Nymphaea* together with *N. odorata*, *N. candida*, *N. tetragona*, *N. tuberosa* and *N. mexicana*. Hybridisation occurs among the species of subgen. *Nymphaea*. Most of the hybrids can be easily identified morphologically. However, certain white-flowering hybrids of *N. alba* with *N. odorata* cannot be distinguished based on morphological characters alone."

Although *Nymphaea odorata* is native to some of the contiguous United States, it is considered invasive in other areas including Alaska, Oregon, Washington, and California. As per the Service ERSS standard operating procedures, to determine the full extent of the *Nymphaea odorata*'s risk to Alaska, Oregon, Washington, and California, an ERSS for the contiguous United States is completed before a more specific climate match can be completed for Alaska, Oregon, Washington, and California.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

"Taxonomic Status:
Current Standing: accepted"

Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Nymphaeanae
Order Nymphaeales
Family Nymphaeaceae
Genus *Nymphaea*
Species *Nymphaea odorata* Aiton

Two sub-species are recognized in the United States: *Nymphaea odorata* ssp. *odorata* and *N. odorata* spp. *tuberosa* (NatureServe 2018).

Size, Weight, and Age Range

No information on the size, weight, or age range of *Nymphaea odorata* was found.

Environment

From Maiz-Tome (2016):

"The species grows in slightly acidic to basic water […]"

Climate

No information on the climate requirements or range of *Nymphaea odorata* was found.

Distribution Outside the United States

Native

Part of the native range for *Nymphaea odorata* is within the United States. See Section 1 for a full description.

GISD (2017) lists *Nymphaea odorata* as native in the Bahamas, Canada, Cuba, El Salvador, Honduras, Mexico, and Nicaragua.

From NatureServe (2018):

"*Nymphaea odorata* ssp. *odorata* occurs natively throughout eastern North America, from Manitoba and Ontario to the Atlantic Provinces south […]. Its occurrence has been recorded in the following provinces and states; British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, […] (Scoggan 1978, Flora of North America Editorial Committee 1997, USDA-NRCS 1999, Biota of North America Program [no date]). It is also known to occur natively in Mexico, Bahamas, Cuba, Honduras, El Salvador, Nicaragua, and has been naturalized in Guyana (Flora of North America Editorial Committee 1997)."

"*Nymphaea odorata* ssp. *tuberosa* has a smaller range than *N. odorata* ssp. *odorata*, and is reported to occur natively in the following provinces and states: Manitoba, Ontario, Quebec, […] (Flora of North America Editorial Committee 1997, USDA-NRCS 1999)."

"British Columbia: southwest and south-central British Columbia (G. Douglas pers. comm.)."

"Manitoba: ssp. *odorata* - east side of Lake Winnipeg, and Hill Lake (northwestern side of Lake Winnipeg) westward to the Saskatchewan border. ssp. *tuberosa* - southeastern 1/6 of the province (to just north of the Winnipeg River), at the northwestern limit of its range (E. Punter pers. comm.)."

"Ontario: widespread in southern and central Ontario, particularly on the Precambrian (Canadian) Shield. Not sure of northern limit (M. Oldham pers. comm.)."

"Quebec: ssp. *odorata* - across southern Quebec up to the 48th latitude. ssp. *tuberosa* - mainly restricted to the St. Lawrence River system (J. Labrecque pers. comm.)."

Introduced

From Maiz-Tome (2016):

"This species also occurs in western North America, i.e., British Columbia, […] where it has been introduced. […] It has been naturalized in Guyana (NatureServe 2014)."

From NatureServe (2018):

"British Columbia: southwest and south-central British Columbia (G. Douglas pers. comm.)."

According to Nierbauer et al. (2009), *Nymphaea odorata* is established in the wild in Germany.

Shah and Reshi (2014) list *N. odorata* spp. *tuberosa* (under the synonym *N. tuberosa*) as present in Kashmir Hymalayan freshwater systems in India.

Randall (2001) lists *N. odorata* as invasive in Australia.

Means of Introduction Outside the United States

From GISD (2017):

"*N. odorata* is a common and popular ornamental for ponds and it is easily available at nurseries (Alaska Natural Heritage Program, 2006)."

Nymphaea odorata is available in trade around the world (e.g. Latour-Marliac 2020; Perry's Water Gardens 2020).

Short Description

From GISD (2017):

"*Nymphaea odorata* is an aquatic perennial plant with floating leaves and branched creeping rhizomes. The horizontal creeping and branching rhizomes (2-3cm in diameter) are attached by adventitious roots arising in groups below the leaf bases and the rhizomes are densely covered with short black hairs. The petioles leave crescent-shaped scars on the rhizome when shed. Mature *N. odorata* leaves are spherical, cleft at the base, smooth to 25cm across, and usually purple on the lower surface. Leaves are attached to underwater stalks rising from thick fleshy rhizomes. Flowers rise on long solitary stalks and are borne at the surface of the water or elevated slightly above it. Flowers measure up to 25cm across and have yellow centers surrounded by 25 or more petals. Flowers are fragrant and can be white or pink with yellow centers. After the flower has finished, the stalk forms a spiral and draws the fruit below the water. The fruit is an ovoid berry-like capsule 1-2cm in diameter containing many seeds (2-3mm long) (Alaska Natural Heritage Program, 2006; Flora of North America, undated; and Washington Department of Ecology, 2003)."

Biology

From GISD (2017):

"Each spring new shoots appear from the rhizomes and grow up through the water until they reach the surface. The flowers appear from in late summer. Each blossom opens in the morning and closes in the early afternoon for two to five consecutive days. Pollination is performed mainly by beetles, but bees have also been observed visiting the flowers. After the flowers have closed for the final time, the flower stalk "corkscrews" and draws the developing fruit below the water. The plant senesces in the fall and over winters as the rhizome (Washington Department of Ecology, 2003)."

"*Nymphaea odorata* grows rooted in mucky or silty sediments in water up to six to seven feet deep and can survive in both acid and alkaline waters. This species grows in shallow ponds, lakes and their margins, ditches, swamps, slow streams. It tends to form dense monospecific stands that can cover hundreds of acres that persist until senescence in the fall (Alaska Natural Heritage Program, 2006; and Washington Department of Ecology, 2003)."

"*Nymphaea odorata* seed germination requires light and the presence of ethylene, a gas whose production is stimulated when seeds are crowded together. Germination is enhanced by cold stratification for several months. When adult density is high, seedlings are rare but a large number of seeds will germinate after the removal of adult plants when increased light levels break dormancy and stimulates germination (Alaska Natural Heritage Program, 2006)."

Human Uses

From NatureServe (2018):

"The recent popularity of water lilies for landscaping gardens make it likely that *Nymphaea odorata* is collected by individuals from the wild for this purpose (D. Cameron pers. comm., R.

Popp pers. comm., T. Smith, pers. comm). Most water lilies sold in nurseries are from cultivar rather than wild stock (G. Douglas pers. comm., E. Punter pers. comm.). However, aquatic plant nurseries in the Fox River Valley, Wisconsin, for example, have apparently collected stock from the wild (K. Westad pers. comm.)."

"There is little reference to the modern use of *N. odorata* for medicinal purposes. Extracts from the rhizome are purported to have astringent, demulcent, and anti-microbial properties, and may be used to treat chronic diarrhea, pharyngitis and leucorrhoea (Healthlink Online Resources). Traditionally, the rhizome of this species was used; by the Chippewa to treat sores in the mouth, by the Micmac to treat colds, coughs and grippe, and swelled limbs, and by the Ojibwa as a cough medicine for tuberculosis (Moerman)."

N. odorata is in trade within the United States (e.g. Pond Deals 2020).

Diseases

No information on parasites or pathogens of *Nymphaea odorata* was found.

Threat to Humans

No information on threats to humans from *Nymphaea odorata* was found.

3 Impacts of Introductions

From GISD (2017):

"*Nymphaea odorata* form[s] dense floating mats of vegetation, preventing light penetration for native aquatic plants. These mats alter distributions of phytoplankton, zooplankton, aquatic insects, and fish populations. *N. odorata* in moderate proportions provides important habitat for fish, frogs, and invertebrates, but once 40% surface area coverage is exceeded declines occurs. These extensive infestations may alter water quality by creating low oxygen conditions beneath the canopy, changing nutrient dynamics, pH level or light regimes while simultaneously promoting exotic species like carp, which easily tolerate low oxygen conditions to establish. Dense infestations may also accelerate the natural siltation process in shallow bodies of water (Alaska Natural Heritage Program, 2006 and Washington Department of Ecology 2005). Left unmanaged, *N. odorata* will restrict lake-front access and eliminate swimming opportunities. *N. odorata* can clog irrigation ditches or streams, retarding water flow and accelerating water loss through transpiration (Washington Department of Ecology, 2003)."

"Extracts from leaf petioles, and rhizomes have allelopathic potential and may suppress the germination and growth of other aquatic species (Quayyum et al. 1999, Spence 1998). Often noxious plants such as Hydrilla can also be introduced to lakes when waterlilies are planted (Washington Department of Ecology 2005)."

The following information pertains to laboratory experiments and not field observations. The results of the experiments demonstrate the mechanism by which *Nymphaea odorata* could inhibit the growth of native plants.

From Quayyum et al. (1999):

"Free-floating and submerged species such as white water lily (*Nymphaea odorata* Aiton), yellow water lily (*Nuphar variegatum* Engelm), bur reed [*Sparganium fluctuans* (Morong) Robinson], *Ceratophyllum* spp., and *Myriophyllum* spp. are also reported to be detrimental to wild rice (Aiken et al., 1988)."

"Among all the extracts [of the species tested for allelopathic potential], aqueous extracts of *Nymphaea odorata* leaves and petioles, *Nymphaea odorata* rhizomes, and entire plants of *Cabomba caroliniana* Gray., *Brasenia schreberi* Gmel., *Myriophyllum spicatum* Fernald, and *Vallisneria americanum* Michx., were most inhibitory [of duckweed (*Lemna minor* L.) and lettuce seed (*Lactuca sativa* L.) germination] as determined by both the bioassays."

"The aqueous extracts of rhizomes of *Nymphaea odorata* and *Potamogeton natans* and the whole-plant extract of *Myriophyllum verticillatum* were most inhibitory, causing nearly 75% reduction in lettuce root length. […] In contrast to root length, the shoot length of lettuce seedlings was stimulated by several plant extracts except the rhizome extract of *Nymphaea odorata* […], where shoot length was significantly reduced."

"Total root length of wild rice seedlings in rhizome extracts of *Scirpus acutus*, *Potamogeton natans*, *Nymphaea odorata*, and *Nuphar variegatum* and shoot extracts of *Eleocharis smallii* and *Myriophyllum verticillatum* was significantly less than that of the control […]. Shoot length of wild rice was inhibited significantly only in the rhizome extract of *Nymphaea odorata* […]."

4 History of Invasiveness

Nymphaea odorata is a plant species native to the Eastern United States, Canada, and parts of Mexico and Central America. It has been introduced to the western United States, although the vector is unknown. The plant may have documented impacts to native plant populations and entire ecosystems, particularly when it becomes the dominant plant in the system. However, supporting information for the few statements found on actual impacts of the species was not available. *Nymphaea odorata* has successfully invaded parts of Germany, Canada, and Australia. *N. odorata* is found in trade within the United States and internationally but no specific numbers of the duration or volume of trade were found. Although some information on impacts exists, the species history of invasiveness is still classified as "Data Deficient."

5 Global Distribution

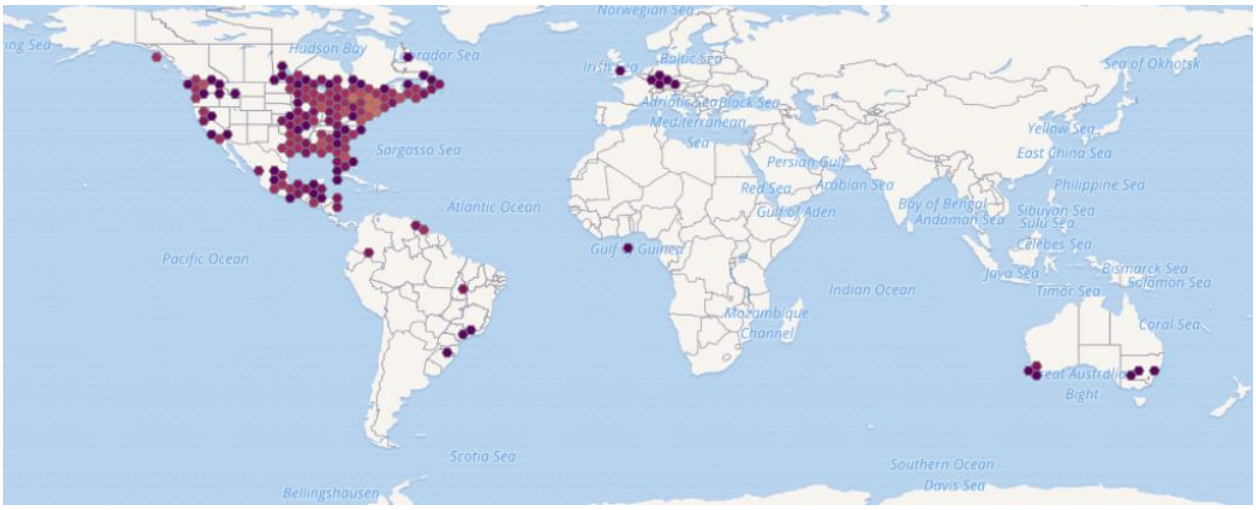

Figure 1. Known global distribution of *Nymphaea odorata*. Locations are in North and South America, Europe, and Australia. Map from GBIF Secretariat (2018).

The location in the UK is a single record from 1974 (GBIF Secretariat 2018). No other sources indicate *Nymphaea odorata* as present in the wild in the UK. This location was not used as a source point in the climate match.

The location off the west coast of Africa was not used as a source point in the climate match. The record indicated the specimen was collected in Connecticut (GBIF Secretariat 2018).

N. odorata is listed as present in India (Shah and Reshi 2014) but a specific location was not given and therefore it could not be used as a source point in the climate match.

6 Distribution Within the United States

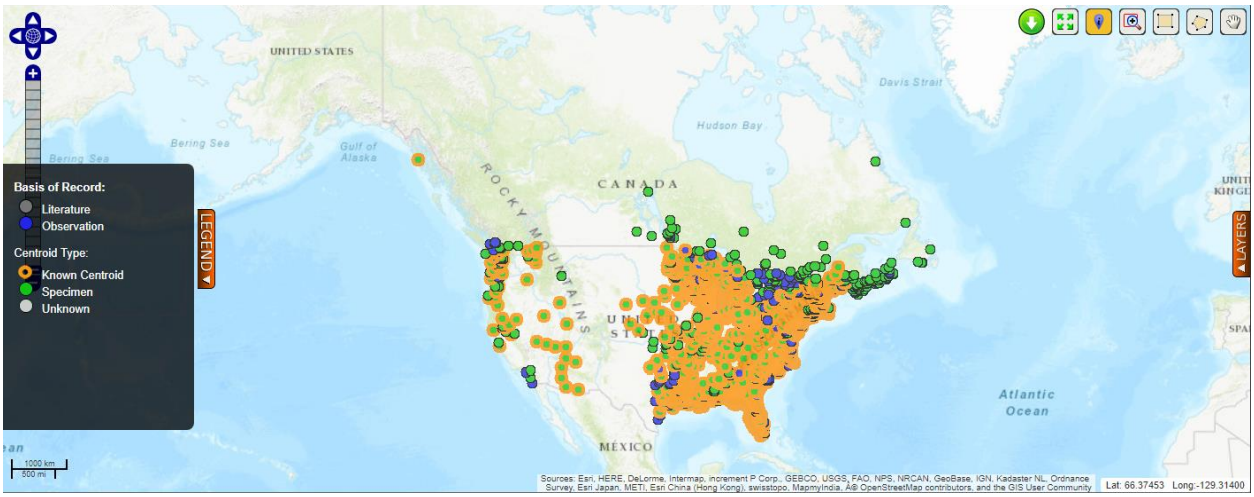

Figure 2. Known distribution of *Nymphaea odorata* in the United States. Map from BISON (2018). The eastern United States is within *N. odorata*'s native range (NatureServe 2018).

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Nymphaea odorata* is high for virtually all of the contiguous United States. There were small areas of medium match in the Great Plains. The eastern United States is included in *N. odorata*'s native range and there are already established populations in many western areas. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.997, high (scores 0.103 and greater are classified as high). All states in the contiguous United States had high individual climate scores.

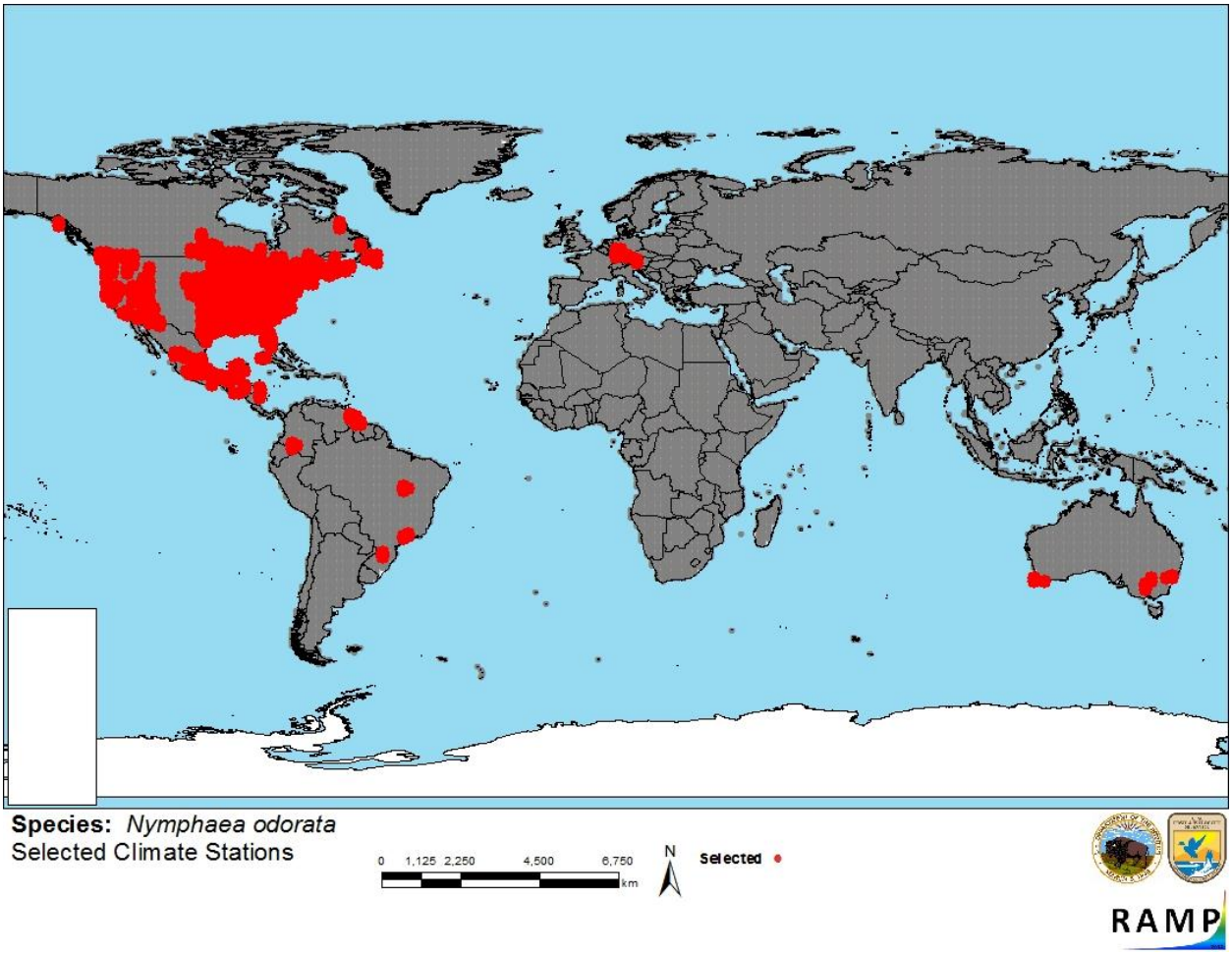

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations in North and South America, Germany, and Australia selected as source locations (red) and non-source locations (gray) for *Nymphaea odorata* climate matching. Source locations from BISON (2018) and GBIF Secretariat (2018). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

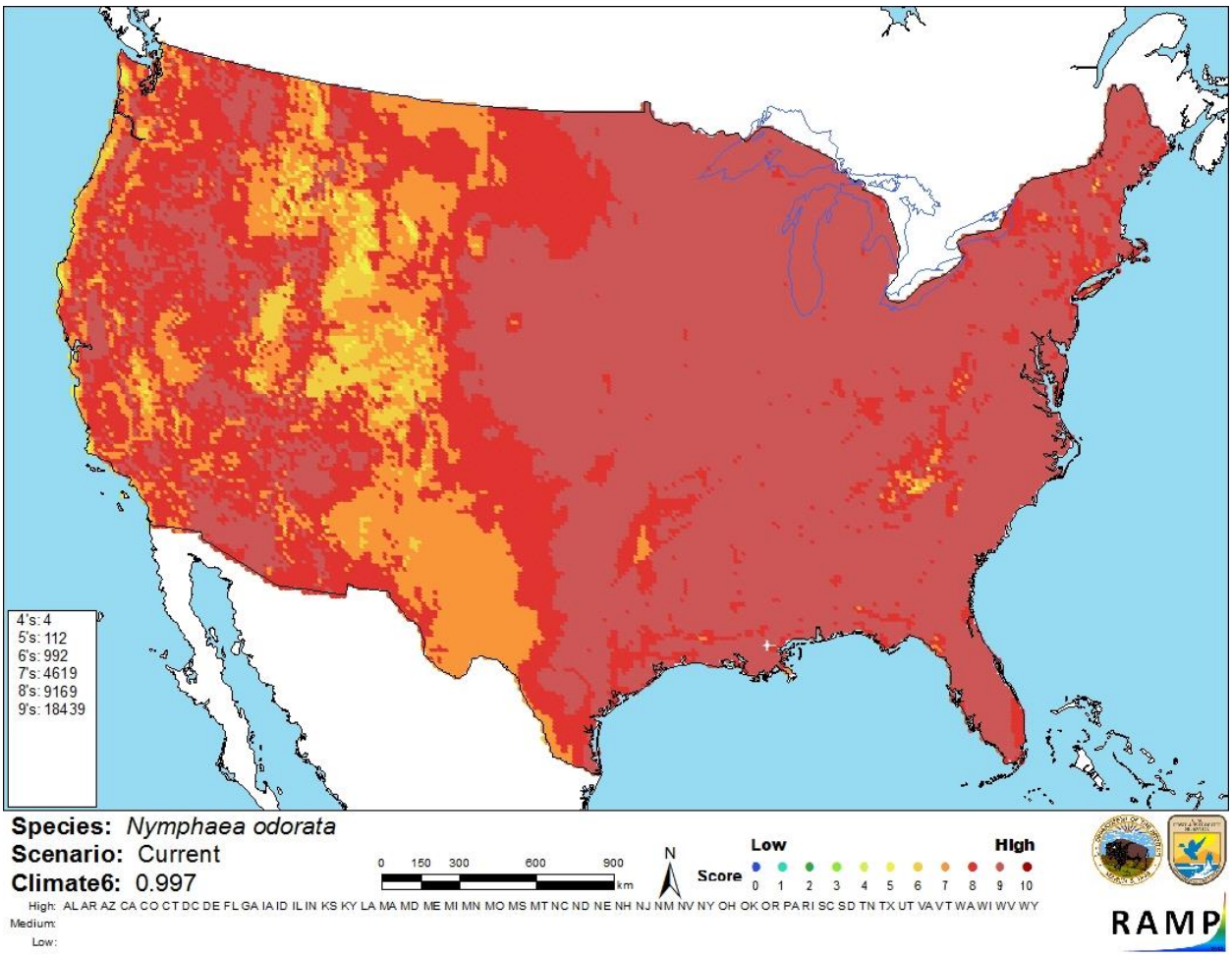

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Nymphaea odorata* in the contiguous United States based on source locations reported by BISON (2018) and GBIF Secretariat (2018). Counts of climate match are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

The certainty of assessment is medium. Information on the invasion history and impacts of this species is minimal, with some peer-reviewed literature. Only laboratory experiments concerning impacts of *Nymphaea odorata* impacts were available in the peer-reviewed literature.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Nymphaea odorata is a floating leaved aquatic plant native to parts of North America and the Caribbean. The history of invasiveness for *N. odorata* is classified as "Data Deficient." This ornamental species has been introduced by humans into new environments. This plant is suggested to alter water chemistry, change plankton communities, and negatively affect local fish populations. It grows in dense mats on the surface of the water, potentially limiting recreational use. A peer-reviewed laboratory experiment showed that *N. odorata* has the ability to suppress germination and growth of native species. Climate matching indicated the contiguous United States has a high climate match. This is unsurprising given the fact that *N. odorata* is established in most American states. It is native to the eastern United States and is considered an invader in the west. The certainty of assessment is medium. The overall risk assessment category is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): Data Deficient**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Medium**
- **Remarks/Important additional information:** No additional information
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

BISON. 2018. Biodiversity Information Serving Our Nation. U.S. Geological Survey. Available: https://bison.usgs.gov (April 2018).

GBIF Secretariat. 2018. GBIF backbone taxonomy: *Nymphaea odorata* Aiton. Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/2882412 (May 2018).

[GISD] Global Invasive Species Database. 2017. Species profile: *Nymphaea odorata*. Gland, Switzerland: Invasive Species Specialist Group. Available: http://www.iucngisd.org/gisd/speciesname/Nymphaea+odorata (April 2018).

[ITIS] Integrated Taxonomic Information System. 2018. *Nymphaea odorata* Aiton. Reston, Virginia: Integrated Taxonomic Information System. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=18384 (April 2018).

Illinois [DNR] Department of Natural Resources. 2015. Aquatic life approved species list. Springfield, Illinois: Illinois Department of Natural Resources. Available: https://www.ifishillinois.org/programs/aquaculture/aquatic_approved_species.pdf (November 2020).

Latour-Marliac. 2020. Hardy water lilies. Le Temple-sur-Lot, France: SARL Latour-Marliac. Available: http://latour-marliac.com/en/12-hardy-water-lilies (November 2020).

Maiz-Tome L. 2016. *Nymphaea odorata*. The IUCN Red List of Threatened Species 2016: e.T64318950A67730237. Available: http://www.iucnredlist.org/details/full/64318950/0 (April 2018).

NatureServe. 2018. NatureServe Explorer: an online encyclopedia of life. NatureServe version number 7.1. Arlington, Virginia: NatureServe. Available: http://explorer.natureserve.org (May 2018).

Nierbauer KU, Kanz B, Zizka G. 2009. The widespread naturalisation of *Nymphaea* hybrids masking the decline of wild-tyoe *Nymphaea alba* in Hesse, Germany. Flora 209:122–130.

Perry's Water Gardens. 2020. Water lily – retail sale. Franklin, North Carolina: Perry's Water Gardens. Available: http://perryswatergarden.net/sale.asp (November 2020).

Pond Deals. 2020. Odorata – white hardy water lily. Canton, Ohio: Lilyblooms Aquatic Gardens. Available: https://www.ponddeals.com/odorata-white-hardy-water-lily/ (November 2020).

Quayyum HA, Mallik AU, Lee PF. 1999. Allelopathic potential of aquatic plants associated with wild rice (*Zizania palustris*): I. bioassay with plant and lake sediment samples. Journal of Chemical Ecology 25:209–220.

Randall R. 2001. Garden thugs, a national list of invasive and potentially invasive garden plants. Plant Protection Quarterly 16:138–171.

Sanders S, Castiglione C, Hoff M. 2014. Risk Assessment Mapping Program: RAMP. Version 2.81. U.S. Fish and Wildlife Service

Shah MA, Reshi ZA. 2014. Characterization of alien aquatic flora of Kashmir Himalaya: implications for invasion management. Tropical Ecology 55:143–157.

USDA, NRCS. 2018. *Nymphaea odorata*. The PLANTS database. Greensboro, North Carolina: National Plant Data Team. Available: https://plants.usda.gov/core/profile?symbol=NYOD (May 2018).

11 Literature Cited in Quoted Material

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.

Aiken SG, Lee PF, Stewart JM. 1988. Wild rice in Canada. Agriculture Canada.

Alaska Natural Heritage Program. 2006. *N. odorata* ssp. *odorata* Ait. Non-native plant species of Alaska. University of Alaska Anchorage, Environment and Natural Resources Institute.

APSU Center for Field Biology and University of Tennessee Herbarium. 1999. Atlas of Tennessee vascular plants. Knoxville: University of Tennessee Herbarium.

Arizona Heritage Data Management System. [Source material did not give full citation for this reference.]

Biota of North America Program. No date. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. North Carolina Botanical Garden and Museum Informatics Project. Berkley: University of California.

Boyle K, Eastman C, Mousseau T. No date. South Carolina plant atlas. Available: http://cricket.biol.sc.edu/herb (January 2000).

California Natural Diversity Database. [Source material did not give full citation for this reference.]

Delaware Natural Heritage Program. [Source material did not give full citation for this reference.]

Flora of North America. No date. *Nymphaea odorata* Aiton. Available: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500828 (April 2006).

Flora of North America Editorial Committee. 1997. Flora of North America north of Mexico, volume 3. Magnoliophyta: Magnoliidae and Hamamelidae. New York: Oxford University Press.

Haines A, Vining TF. 1998. Flora of Maine, a manual for identification of native and naturalized vascular plants of Maine. Bar Harbor, Maine: V.F.Thomas.

Healthlink Online Resources. [Source material did not give full citation for this reference.]

Herbarium COLO. No date. Colorado vascular plant list. Boulder: University of Colorado.

Indiana Natural Heritage Data Center. [Source material did not give full citation for this reference.]

Iowa Department of Natural Resources. [Source material did not give full citation for this reference.]

Larson GE. 1993. Aquatic and wetland vascular plants of the Northern Great Plains. Washington, D.C.: USDA Forest Service. General Technical Report RM-238.

Louisiana Natural Heritage Program. [Source material did not give full citation for this reference.]

Michigan Natural Features Inventory. [Source material did not give full citation for this reference.]

Minnesota Natural Heritage. [Source material did not give full citation for this reference.]

NatureServe. 2014. NatureServe Explorer: An Online Encyclopedia of Life. Arlington, Virginia. Available: http://explorer.natureserve.org (July 2014).

Nevada Natural Heritage Program. [Source material did not give full citation for this reference.]

North Carolina Natural Heritage Program. [Source material did not give full citation for this reference.]

Ohio Natural Heritage Data Base. [Source material did not give full citation for this reference.]

Radford AE, Ahles HE, Bell CR. 1968. Manual of the vascular flora of the Carolinas. Chapel Hill: University of North Carolina Press.

Scoggan HJ. 1978. The flora of Canada. National Museum of Natural Sciences. Publications in Botany 7(1).

South Dakota Natural Heritage Database. [Source material did not give full citation for this reference.]

Spence. 1998. [Source material did not give full citation for this reference.]

USDA-NRCS. 1999. [Source material did not give full citation for this reference.]

Washington Department of Ecology. 2003. Technical information about *Nymphaea odorata* - the fragrant water lily. Available: http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua005.html (April 2006).

Wunderlin RP, Hansen BF, Bridges EL. 1995. Atlas of Florida vascular plants. Tampa: University of South Florida, Department of Biology, Institute for Systematic Botany.