

Sacred Lotus (*Nelumbo nucifera*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, August 2012

Revised, August 2019

Web Version, 11/12/2020

Organism Type: Plant

Overall Risk Assessment Category: Uncertain



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1 Native Range and Status in the United States

Native Range

From Sharip et al (2014):

“In contrast, *N. nucifera* is an Asiatic floating-leaved plant species that has been found in areas ranging from the Caspian Sea, Japan, India, and South East Asia to the Northern Territory of

Australia (Schulthorpe 1967). This species is a native in Malaysia with four specimens originating from states such as Pahang, Negeri Sembilan and Selangor being recorded in FRIM Herbarium (Pers. comm. Phoon Sook Ngoh).”

Status in the United States

USGS (2019) reports established populations of *Nelumbo nucifera* in the following states: Alabama, Arkansas, Florida, Georgia, Hawaii, Illinois, Louisiana, Missouri, Mississippi, New Jersey, New York, North Carolina, South Carolina, Tennessee, and West Virginia. USGS (2019) also reports *N. nucifera* as collected in Ohio.

NatureServe (2019), also list *Nelumbo nucifera* as introduced in Kentucky.

Nelumbo nucifera is found in trade in the United States. It was found to be available at a rate of \$5 for a 4 pack of seeds (Top Tropicals 2019).

According to the Wisconsin Invasive Species Identification, Classification and Control (2017), *Nelumbo nucifera* is listed as a prohibited species.

Means of Introductions in the United States

No information on means of introduction in the United States was found.

Remarks

No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2019):

Kingdom Plantae
Subkingdom Viridiaeplantae
Infrakingdom Streptophyta
Division Tracheophyta
Subdivision Spermatophytina
Infradivision Angiospermae
Class Magnoliopsida
Superorder Proteanae
Order Proteales
Family Nelumbonaceae
Genus *Nelumbo*
Species *Nelumbo nucifera* Gaertn

Size, Weight, and Age Range

From Pal and Dey (2013):

“Leaves are large, of both types, aerial as well as floating orbicular 20-90 cm. [...] The usual length varies from 24.00 to 33.00 cm. in case of aerial leaves and 23 to 30 cm in case of floating, [...]”

“[Flowers] Solitary, large, 10-25 cm in diameter, [...]”

“The rhizomes are 60-140 cm long 0.5 to 2.5 cm in diameter, [...]”

Environment

From Pal and Dey (2013):

“A range of shallow (up to about 2.5 m deep) wetland habitats, including flood plains, ponds, lakes, pools, lagoons, marshes, swamps and the backwaters of reservoirs.”

From EOL (2019):

“The minimum water depth should not be lower than 30 cm (12 in). In colder climates such a low water level, which heats up more quickly, is helpful for better growth and flowering. Lotus germinates at temperatures above 13 °C (55 °F) [Sou and Fujishige 1995]. Most varieties are not cold-hardy [Dictionary of gardening 1992]. In the growing season from April to September (northern hemisphere), the average daytime temperature needed is 23 to 27 °C (73 to 81 °F) [Phillips 1995]. In regions with low light levels in winter, the sacred lotus has a period of dormancy. The tubers are not cold resistant, but can resist temperatures below 0 °C (32 °F) if they are covered with an insulating cover of water or soil [Tian 2008].”

Climate

From Pal and Dey (2013):

“Warm-temperate to tropical climates, [...]”

Distribution Outside the United States

Native

From Sharip et al (2014):

“In contrast, *N. nucifera* is an Asiatic floating-leaved plant species that has been found in areas ranging from the Caspian Sea, Japan, India, and South East Asia to the Northern Territory of Australia (Schulthorpe 1967). This species is a native in Malaysia with four specimens originating from states such as Pahang, Negeri Sembilan and Selangor being recorded in FRIM Herbarium (Pers. comm. Phoon Sook Ngoh).”

Introduced

According to Cook (1985), *Nelumbo nucifera* has been introduced to Europe, North Africa, and North America.

According to DAISIE (2019), *Nelumbo nucifera* has been introduced and became established in Italy and Romania. *N. nucifera* has been introduced to France and Hungary where the population statuses are unknown and not established respectively.

According to Pagad et al (2018), *Nelumbo nucifera* has been reported and verified as introduced in Taiwan, Guyana and Cook Islands. *N. nucifera* has been also been reported as introduced in Canada, France, Malaysia, and Suriname.

GBIF Secretariat (2019) list human observations in Mauritius, Cote d'Ivoire, Colombia, Trinidad and Tobago. No further information was found on the status of the populations in these locations and therefore will not be used as source locations in the climate match.

Means of Introduction Outside the United States

From EOL (2019):

“Today the species also occurs in [...] this is probably the result of human translocations.”

From Sharip et al (2014):

“The species is also grown as ornamental plants in many countries.”

Short Description

From Pal and Dey (2013):

Leaves

Leaves are large, of both types, aerial as well as floating orbicular 20-90 cm. In diameter, abruptly acute to form a short tip, petiolate, entire glaucous, non-wettable, strong cupped in case of aerial leaves and flat in case of floating ones, radiantly nerved, the fresh leaves are leathery, but [sic] on drying they are nearly membranous and brittle, there is more or less brownish red blotching on the lower surface, petioles of the aerial leaves are erect and stout white those of the floating ones are not strong enough. The usual length varies from 24.00 to 33.00 cm. in case of aerial leaves and 23 to 30 cm in case of floating, petioles are smooth, greenish or greenish brown in colour with small brown dots sometimes rough with very small, but distinct prickles [tiny hair like structures], odour is distinct, fracture is fibrous. When transversely cut, the petiole of leaf stalk always shows four distinct, large cavities in the centre and small cavities in the periphery.

Fruits and Seeds

Fruit is an aggregate of indehiscent nut-lets. Ripe nutlets are ovoid, roundish or oblongish up to 1.0 cm long 1.5 cm broad, with hard smooth, brownish or greyish black pericarp which is faintly longitudinally striated, pedunculated and one seeded. Seeds fill in the ripe carpel. Fruits of

N. nucifera have remarkable power of dormancy and indeed the proved longevity of its seeds exceeds that of any known species of flowering plant. Robert Brown, first keeper of botany in the British museum, experimented with fruits of *Nelumbo* at various times between 1843- 1845 showed that they retained the power of germination after 150 years of confinement in glass-topped box.

Flowers

Solitary, large, 10-25 cm in diameter, white pink or pinkish white fragrant peduncles arising from the nodes of the rhizomes, sheathing at the base, 1-2 cm long, green or blackish green, hard and stout, smooth or rough due to the presence of numerous small scattered prickles, sepals, petals and stamens are spirally arranged passing gradually one into another.

Rhizomes

The rhizomes are 60-140 cm long 0.5 to 2.5 cm in diameter, yellowish white to yellowish brown in colour, smooth longitudinally striated with brown patches, Nodes and internodes are present. When freshly cut is [sic] exudes mucilaginous juice and show [sic] a few large cavities surrounded by several larger ones, fracture is tough and fibrous. Odour is indistinct. (Mukherjee et al. 1996).”

Biology

From Kunii and Maeda (1982):

“*Nelumbo nucifera* This species propagates by seeds and rhizomes, and its germination began in late April when the water temperature became higher than 15 °C. Almost all the leaves of this plant were of the floating type in its early growing stage but the emergent type (aerial) gradually became abundant. The plant entered into its flowering period in early July and the florescence continued till mid-September. The blossom is a splendid pink among large and flat leaves (ca. 30-80 cm in diameter). The maximum growth of this plant occurred in August and September when it was in full bloom. At its maximum growing season, the plant was distributed at all depths from the margin to the deeper region of about 3 m in depth in the western part of the pond. In winter, many dead petioles without leaves remained emerging from the water surface.

From Sharip et al (2014):

“*N. nucifera* is a flood-tolerant species that inhabits not only lakes, ditches and other floodplain systems, but also rice fields (which experience fluctuating water levels).”

Human Uses

From Pal and Dey (2013):

“Virtually, all parts of the lotus plant are used: the rhizome is used as food, seed as medicine, thalamus as fruit, leaves as plate (thali), stalks as pickle, petals for colour extraction, and tender leaves as food after being blended with vegetables. (Mandal and Bar 2013)”

From Kanabkaew and Puetpaiboon (2004):

“Lotus is a floating attached plant, which is an important and popular cash crop in many Asian countries. Lotus has multiple uses, for example, stems and rhizomes as fresh vegetables; seeds as dessert and medicine; flowers as religious ornaments, and several parts as raw materials to produce cosmetics (Yi, Lin and Diana, 2002).”

“Based on the results presented, the system with lotus showed the best removal efficiency for pollutant removal in domestic wastewater as post treatment [...].”

From Sharip et al (2014):

“The species is also grown as ornamental plants in many countries.”

“In Lake Chini, *N. nucifera* is an important icon of tourism to the area.”

From Swaenkar and Katewa (2008):

“Many plants are cultivated by tribals abundantly and sold in nearby market. These plants have much nutritional value. [...], *Nelumbo nucifera*,[...] are wild tuberous plants which are used by tribals as food . If proper strategies are proposed then this plants may become the [sic] part of tribal economy.”

Swaenkar and Katewa (2008) list *N. nucifera* as both an edible and medicinal plant.

N. nucifera was found to be available at a rate of \$5 for a 4 pack of seeds (Top Tropicals 2019).

From EOL (2019):

“Lotus thread is used to weave a special robe for the Buddha at Inle lake, Myanmar. The distinctive dried seed heads, which resemble the spouts of watering cans, are widely sold throughout the world for decorative purposes and for dried flower arranging. In Asia, the petals are sometimes used for garnish, while the large leaves are used as a wrap for food, not frequently eaten (for example, as a wrapper for zongzi). A unique fabric from the lotus plant fibers is produced only at Inle lake, Myanmar and in Siem Reap (Cambodia) is used for weaving special robes for Buddha images called kya thingahn (lotus robe).”

Diseases

CABI (2019) states:

“Major host of:

Donacia provosti (rice rootworm); *Scirtothrips dorsalis* (chilli thrips)

Minor host of:

Alternaria tenuissima (nailhead spot of tomato); *Cochliobolus lunatus* (head mould of grasses, rice and sorghum); Dasheen mosaic virus (dasheen mosaic)

Wild host of:

Aspergillus niger (black mould of onion); *Hirschmanniella oryzae* (rice root nematode);
Pomacea canaliculata (golden apple snail)

Host of (source - data mining):

Calonectria quinqueseptata (leaf spot of *Hevea* spp.)”

According to Poelen et al (2014), *Nelumbo nucifera* is a host of *Bacillus cereus*, *Rhopalosiphum nymphaeae* (water lily aphid), and has pathogen *Cuscuta japonica* (Japanese dodder).

Threat to Humans

No information on threat to humans was found.

3 Impacts of Introductions

From Kunii and Maeda (1982):

“*Nelumbo [nucifera]* has also been increasing its distribution range and biomass considerably in these seven years, since it was transplanted here in the 1960s for aesthetic purposes. In 1971, this species was restricted to a shallow area in one of the southern coves. Now it is the most dominant species [...], probably due to its vigorous and steady rhizomatous propagation.”

“While the leaves of *Nymphoides* cannot emerge from the water surface, those of *Nelumbo* can rise above the water surface and grow over the other aquatic plants including floating-leaved ones (usually called shading effect or shade effect). It is reasonable that the taller a plant grows and the longer it occupies a space, the more advantageous it will be for the plant to compete for light. This, in turn, means that if two different species are associated in one place, the taller one will become dominant. In this respect, *Nelumbo*, which develops leaves on and above the pond's surface, has the most advantage in the pond and the shade-intolerant species under cover are compelled to be eliminated (Bernatowicz 1966; Bolen et al. 1975).”

“It is expected that sooner or later the physiognomy of the pond will become monotypic and be represented mainly by the tall and large surface covering plant, *Nelumbo*.”

4 History of Invasiveness

Nelumbo nucifera is a species native to Japan, India, Australia, India and the surrounding areas. The species has been introduced to areas in Europe, North Africa, and North America, and Europe, is established in most of these locations, and has presumably been introduced via human translocations as it is available in trade. The species is ornamental, used as food and medicine, and is raised as a cash crop. The impacts of the plant are not well documented but they are theorized to compete with native species by shading. Due to the lack of scientifically defensible information on demonstrated impacts of introduction the history of invasiveness for *N. nucifera* is Data Deficient.

5 Global Distribution



Figure 1. Known global distribution of *Nelumbo nucifera*. Map from GBIF Secretariat (2019). Localities in Pitcairn Islands, the western United States, France, Hungary, Germany, Greece, Bermuda, Gabon, Benin, Columbia, Peru, and Paraguay could not be confirmed as established and therefore were not used to select source points for the climate match.

6 Distribution Within the United States



Figure 2. Known United States distribution of *Nelumbo nucifera*. Map from USGS (2019). Localities in Ohio and New York do not represent established populations and therefore were not used to select source points for the climate match.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Nelumbo nucifera* in the contiguous United States is generally very high. Only a small area of low match was found in the most northwest corner of the country. Medium match is found in the western states while central and eastern states had much higher match. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.733, high (scores 0.103 and greater are classified as high). All States had high individual Climate 6 scores except Idaho, Oregon and Washington, which all had medium scores.

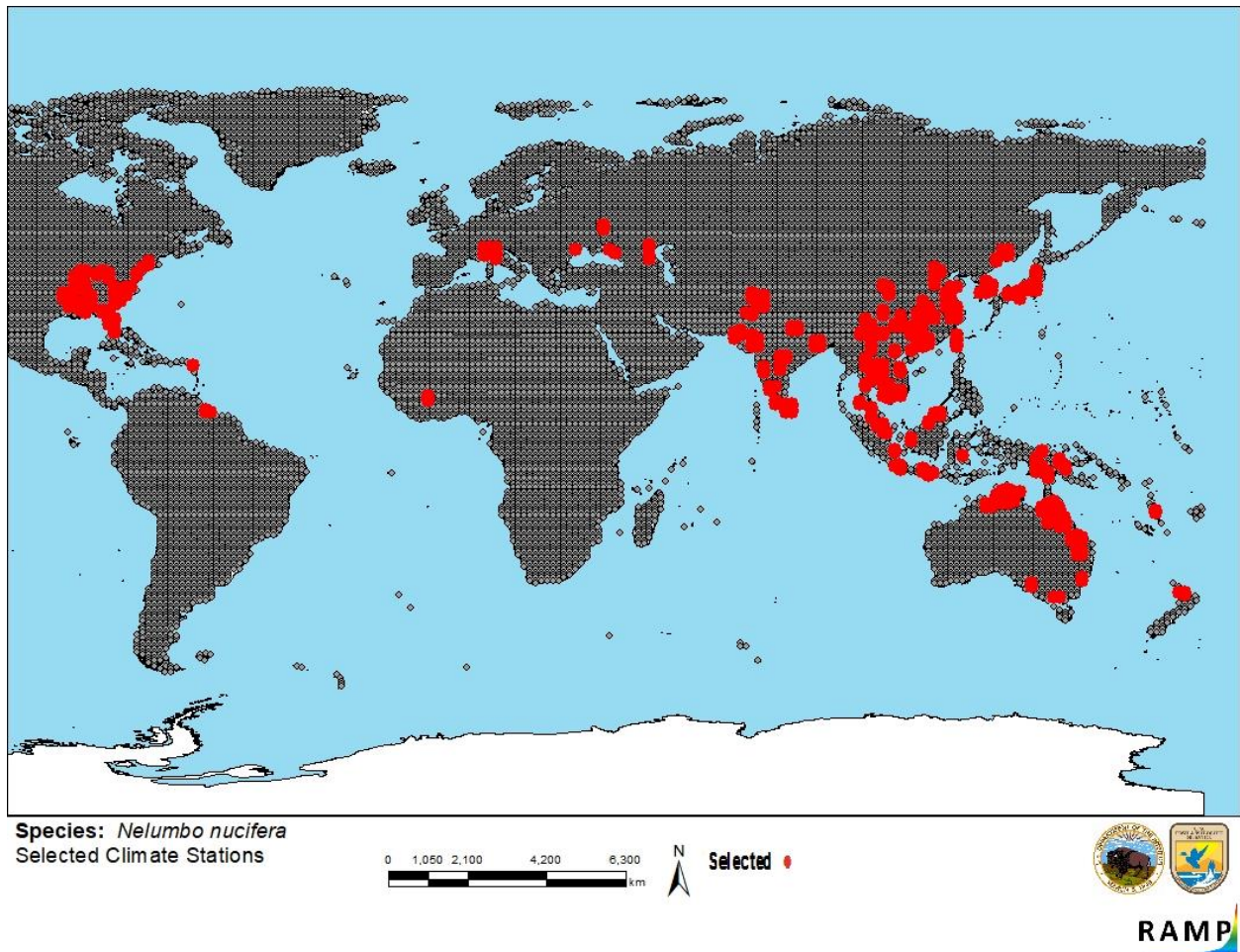


Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations on every continent except Antarctica selected as source locations (red; United States, Australia, Italy, Romania, Malaysia, Suriname, Trinidad and Tobago, Taiwan, India, Japan, China, Cambodia) and non-source locations (gray) for *Nelumbo nucifera* climate matching. Source locations from GBIF Secretariat (2019) and USGS (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

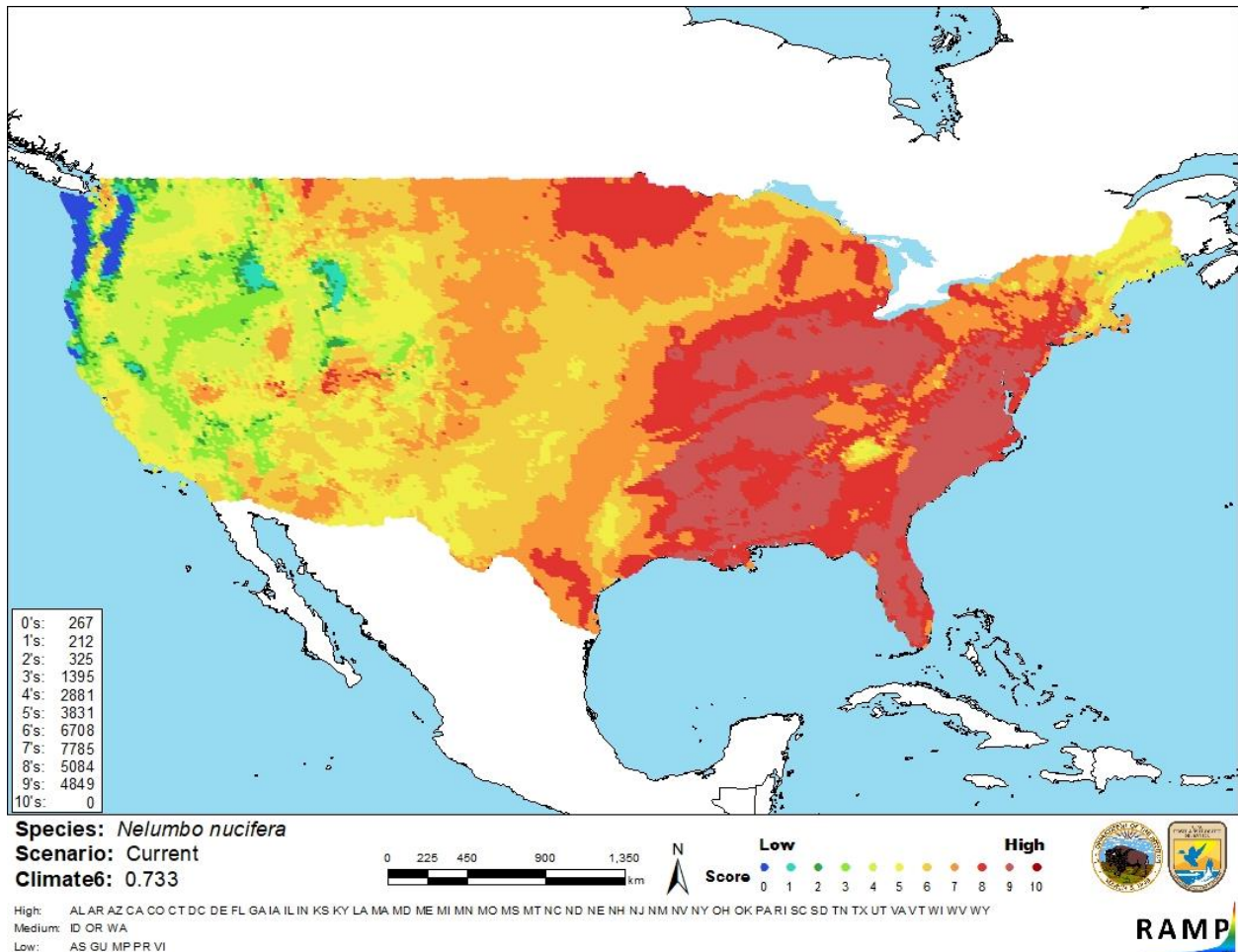


Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Nelumbo nucifera* in the contiguous United States based on source locations reported by GBIF Secretariat (2019) and USGS (2019). Counts of climate match are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

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 |
|--|--------------------------------------|
| $0.000 \leq X \leq 0.005$ | Low |
| $0.005 < X < 0.103$ | Medium |
| ≥ 0.103 | High |

8 Certainty of Assessment

Nelumbo nucifera is a popular plant around the world, which has provided vast details on the biology and environment of this species. There are multiple records of introduction leading to established populations. There is some information on potential impacts from those introductions

but nothing conclusive. The certainty of assessment is low due to the lack of information regarding the history of invasiveness.

9 Risk Assessment

Summary of Risk to the Contiguous United States

The Sacred Lotus (*Nelumbo nucifera*) is native to much of Asia. This species has been cultivated by humans for hundreds of years both for its nutritional value and for its medicinal uses. This species has many other human uses including: crop harvest, pollutant remover in domestic wastewater, a unique thread, and an ornamental plant. *N. nucifera* has been introduced to Europe, North America, and Africa. No records were found of documented impacts from introductions. The history of invasiveness is classified as Data Deficient. The climate match with the contiguous United States was High. Nearly all states scored individually high climate matches. The certainty of assessment is Low due to the lack of information on impacts. The overall risk assessment category for *Nelumbo nucifera* is Uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): Data Deficient**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Low**
- **Remarks/Important additional information:** This plant is heavily used in food and medicine worldwide.
- **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.

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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.

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