

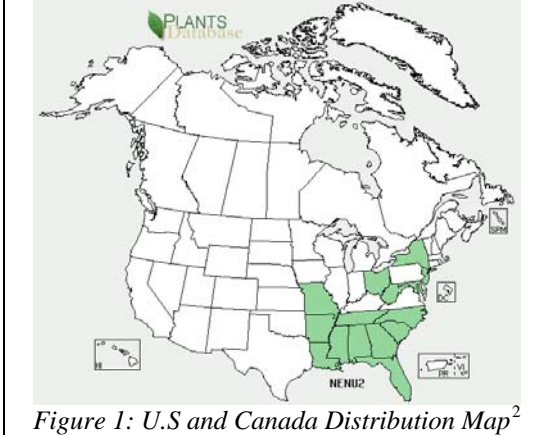
Aquatic Plant

Sacred lotus; Asian lotus; Indian lotus

I. Current Status and Distribution *Nelumbo nucifera*

a. Range	Global/Continental	Wisconsin
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Native Range
Asia¹



Recently confirmed in Delavan Lake, Walworth Co.³; may possibly be a hybrid cultivar³

Abundance/Range
Widespread:
Locally Abundant:
Sparse:

Temperate and tropical Asia
Southeastern United States
Northeastern United States

Undocumented
Undocumented
Delavan Lake, Walworth Co.³

Range Expansion
Date Introduced:

Rate of Spread:

Cultivated throughout Asia for thousands of years; possibly introduced to the United States in the mid-late 19th century⁴
Undocumented

First recorded in 2010⁽³⁾

Rapid; expanded its range from 15 x 100 ft to 52 x 163 ft in about one month³

Density
Risk of Monoculture:

Facilitated By:

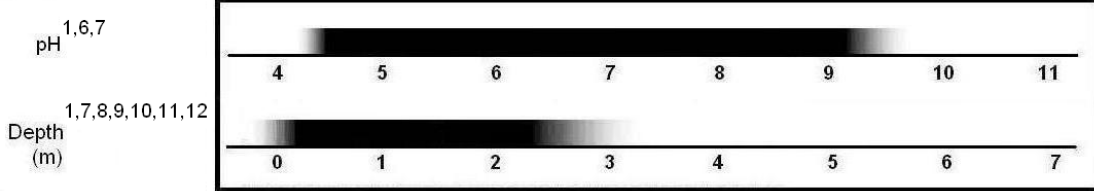
Densities of 4,000 to 8,000 plants per hectare reported¹; yields from 8 to 40 tons per hectare¹
Undocumented

Likely high in shallow waters

Undocumented

b. Habitat
Ponds, lakes, slow-moving streams, rivers, reservoirs, freshwater tidal waters, wetlands^{1,5}


Tolerance
Chart of tolerances: Increasingly dark color indicates increasingly optimal range



Preferences

Rich and fertile organic soils^{1,13,14}; can tolerate low levels of salinity¹; can tolerate acidic and alkaline waters⁷; full sun⁸; high nutrients⁸; stagnant conditions⁸; leaf area positively correlated with temperature, day length, rainfall, relative humidity, chl-a, nitrates, and pH⁸; low tolerance to flooding and wave action¹¹

c. Regulation	
Noxious/Regulated ² :	<i>Not regulated</i>
Minnesota Regulations:	<i>Not regulated</i>
Michigan Regulations:	<i>Not regulated</i>
Washington Regulations:	<i>Not regulated</i>
II. Establishment Potential and Life History Traits	
a. Life History	Aquatic perennial floating-leaved to emergent rhizomatous plant ¹
Fecundity	High
Reproduction	
Importance of Seeds:	Seeds may survive for hundreds of years ^{1,6,15,16} ; fruits with dry mass of 0.7-0.9 g sink and are capable of germination, whereas fruits that float are most often nonviable ¹⁶ ; germination rates between 0-93% ¹⁷
Vegetative:	Very important; rhizomatous (tubers and stolons) ¹
Hybridization	Hundreds of ornamental cultivars and variations ^{1,18} ; <i>N. nucifera</i> x <i>N. lutea</i> hybrid ^{18,19}
Overwintering	
Winter Tolerance:	Rhizome of lotus cannot endure low temperatures (<5°C) ¹⁸ ; lotus plants can tolerate air temperatures of -30°C and lower as long as the soil bed remains unfrozen ⁶
Phenology:	In southern California, seedlings enter dormancy in December when night temperatures drop below 5°C and day length <10 hrs ⁽⁶⁾ ; dormancy is broke when temperatures reach 10°C and new growth begins in February when night temperatures are at 11°C and day length >11 hrs ⁽⁶⁾ ; flowers begin growing in April when night temperatures are 12°C and day length is 13 hrs with buds appearing in early May ⁶ ; flowers from April to May/June in Thailand and Bangladesh ^{8,13} ; flowers and fruits from March to October in India ⁷ ; leaves begin to decompose and die in autumn ^{8,20}
b. Establishment	
Climate	
Weather:	Requires at least 6 months with temperatures greater than 15°C ¹
Wisconsin-Adapted:	Likely
Climate Change:	Undocumented
Taxonomic Similarity	
Wisconsin Natives:	High; <i>Nelumbo lutea</i> ²
Other US Exotics:	Low
Competition	
Natural Predators:	Aphids, thrips, beetles ⁷ ; leaf miners and gallmidges ²¹ ; <i>Callosobruchus chinensis</i> (bean weevil) ^{22,23}
Natural Pathogens:	<i>Pseudomonas</i> , <i>Botrytis</i> , and <i>Colletotrichum</i> ¹ ; <i>Erysiphe magnifica</i> (mildew) ²⁴
Competitive Strategy:	Ability to shade out other macrophytes and reproduce by both seed and through hardy rhizomes
Known Interactions:	Multi-year case study in Japan where newly established <i>N. nucifera</i> population became dominant over established <i>Nymphoides indica</i> , <i>Myriophyllum spicatum</i> , and <i>Hydrilla verticillata</i> populations ¹⁰

Reproduction	
Rate of Spread:	Multi-year case study of newly established population in Japan showed a radial expansion rate of 4 to 21 meters (13 to 69 feet) per year ¹¹
Adaptive Strategies:	Ability to reproduce by both hardy rhizomes and seeds
Timeframe	Undocumented
c. Dispersal	
Intentional:	Ornamental ^{1,5,7,13, 25} ; cultivated as food source ^{1,7,13,18,25}
Unintentional:	Water currents ⁷
Propagule Pressure:	High; seeds and fragments easily accidentally introduced
	
<p>Figure 2: Courtesy of Rebekah D. Wallace, Bugwood.org²⁶</p> <p>Figure 3: Courtesy of Heidi Bunk, WDNR³</p>	
III. Damage Potential	
a. Ecosystem Impacts	
Composition	May outcompete other floating and submerged aquatics due to shading ^{5,9,14}
Structure	Major changes in invertebrate species composition ¹⁴
Function	Dense populations can block waterways and reduce light availability in the water column ^{5,14}
Allelopathic Effects	Undocumented
Keystone Species	Undocumented
Ecosystem Engineer	Exhibits typical pioneer characteristics in an environment of frequent disturbances ²⁰
Sustainability	Undocumented
Biodiversity	Declines in macrophyte and invertebrate richness and diversity ¹⁴
Biotic Effects	May impact wildlife populations such as muskrat and waterfowl ⁵
Abiotic Effects	Undocumented
Benefits	Undocumented
b. Socio-Economic Effects	
Benefits	Ornamental trade ^{1,5,7,13,25} ; dried fruits used in floral arrangements ²⁷ ; roots, leaves, stems, seeds, and other parts are edible food sources ^{1,7,25} ; plants are thought to have multiple beneficial medicinal properties ^{1,13,18,25,28,29,30,31,32,33,34,35} ; cultural and religious significance ^{1,13,18} ; flowers used in production of perfumes ¹ ; can absorb heavy metals and may be used in water purification ^{7,36,37,38}
Caveats	Risk of release and population expansion outweighs benefits of use

Impacts of Restriction	Increase in monitoring, education, and research costs
Negatives	Dense populations can block waterways ⁵
Expectations	Undocumented
Cost of Impacts	Decreased recreational value; decline in ecological integrity; increased research expenses
“Eradication” Cost	Extremely difficult to control or eradicate due to dense growth and extensive rhizome system ^{5,27}
IV. Control and Prevention	
a. Detection	
Crypsis:	High; very similar to <i>N. lutea</i> ; hundreds of cultivars and variations in the ornamental trade
Benefits of Early Response:	Important; plants produce extensive rhizomes and many long-lived seeds
b. Control	Undocumented

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² United States Department of Agriculture, Natural Resource Conservation Service. 2011. The PLANTS Database. National Plant Data Center, Baton Rouge, LA, USA. Retrieved March 25, 2011 from: <http://plants.usda.gov/java/profile?symbol=NENU2>

³ Bunk, H. 2011. Personal communication.

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⁶ Shen-Miller, J., J.W. Schopf, G. Harbottle, R. Cao, S. Ouyang, K. Zhou, J. Southon, G. Liu. 2002. Long-living lotus: germination and soil gamma-irradiation of centuries old fruits, and cultivation, growth, and phenotypic abnormalities of offspring. American Journal of Botany 89(2):236-247.

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¹² Unni, K.S. 1971. An ecological study of the macrophytic vegetation of the Doodhadhari Lake, Raipur, M.P., India. 1. Distribution and seasonal change in aquatic plants. Hydrobiologia 38:139-155.

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