

Invasive Exotic Plants of Canada Fact Sheet No. 13

European Water Chestnut - water chestnut, bull nut, Jesuit nut, water-caltrop

Trapa natans L.
Water-nut Family - Trapaceae

Field Recognition

European water chestnut is an aquatic plant, which is usually rooted in the mud and bears a rosette of floating leaves at the tip of the submersed stem. Stems are elongate and flexuous and typically about a metre long but may reach about 5 metres in length. The conspicuously toothed leaf blades are 2-4 cm long and rhombic in outline (with four sides); the long, spongy, inflated leaf stalks are up to about 15 cm long and provide the buoyancy for the terminal leafy portion of the plant. Green, feather-like, submersed leaves (considered by some to be roots) with very fine segments are present on the submersed stem and numerous finely branched roots develop along the lower stem that assist in anchoring the plant to the substrate. The inconspicuous flowers with their four white petals, each about 8 mm long, are borne singly on erect stalks located in the central area of the leafy rosette. The fruit is a four-horned, barbed, nut-like structure, about 3 cm wide, that develops under water.

Habitat

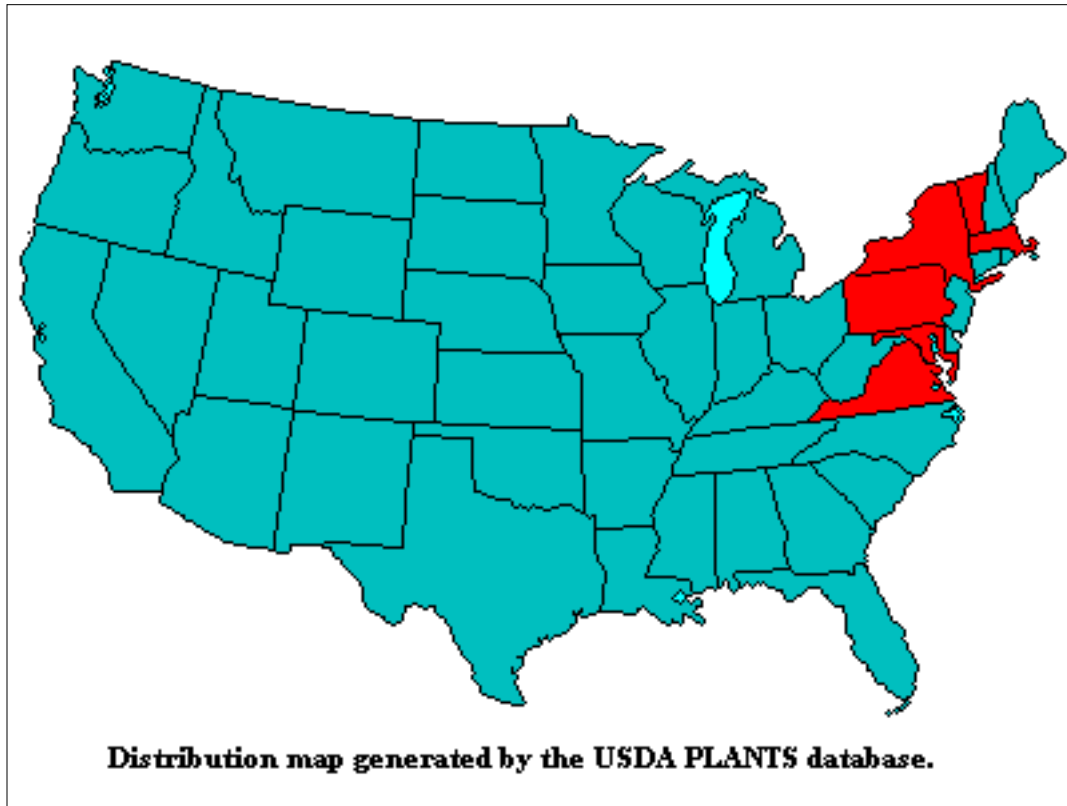
Plants grow in quiet streams, ponds, freshwater regions of estuaries and on exposed mud flats.

History of Introduction and Spread

European water chestnut is native to Eurasia, being found in paleotropical and warm temperate regions. It has become naturalized in Australia and in northeastern North America. It is a member



of a small family that includes a single genus and, depending on the view of the specialist, one, three or as many as thirty species (Heywood 1978). This discrepancy is based in large part on the highly variable shape of the fruits. Because the fruits have been used as a source of food and for their medicinal and puted magical properties, the plants became widely distributed throughout Europe. The plants seemingly were introduced into Switzerland at the period of the lake dwellings ([see web document](#)). Plants were first introduced to North America in about 1874 and were known to be cultured, in 1877, in the botanical garden of Asa Gray, an eminent botanist at Harvard University. By 1879, plants were already found in the local waters of the Charles River in Massachusetts.



The plants have become an aquatic nuisance species in North America because of their ability to reproduce rapidly and form extensive floating mats. Presently the species is found in northeastern North America in the states of Maryland, Massachusetts, New York, Pennsylvania and Vermont (see map generated by the USDA PLANTS database; red indicates states of occurrence). In 1998, it was reported for the first time in Canada, in southwestern Quebec, along a 5 km stretch of the Rivière du Sud, a tributary of the Richelieu River, just north of the US-Canada border. It is present from the mouth of the river, at 73° 15'W 45° 08' N, to about 5 km upstream. This would appear to be a natural expansion northward from the Lake Champlain watershed of New York and Vermont where it has been present for some time. The species is also known to occur at Sodus Bay, NY, on the south shore of Lake Ontario where annual control has been undertaken since the 1960s (Mills et al. 1993). Seemingly, it has not yet found its way to Canadian waters along the north shore of Lake Ontario.

Biology

European water chestnut is an annual that grows most commonly as a rooted, floating aquatic. It can, however, also grow on wet mucky substrates. It grows best in shallow, nutrient-rich lakes and rivers (Methe et al. 1993) and is generally found in North American waters with a pH range of 6.7-8.2 and alkalinity of 12-128 mg/l of calcium carbonate.

Flowers are produced singly on stalks arising from the center of the floating rosette of leaves. Each flower is bisexual, bearing a two chambered ovary, four stamens and four white petals. Four triangular sepals surround the flower and develop into barbed spines in the mature fruit. Once the ovules of the insect pollinated flowers are fertilized, the flower stalks curve downward with the result that the fruit develops under water. The fruit matures into a nut-like, barbed spiny fruit. Although there are two chambers in the ovary, each with an ovule, commonly only one seed per flower develops (Groth et al. 1996). The fruit technically is a drupe. Flowering begins in the northeastern United States in July and fruits ripen in about a month. Plants flower until killed by frost. Each seed can give rise to 10-15 rosettes, and each rosette may produce as many as 20 seeds (Northern Mosquito Control Association [web document by Rosmarie Kelly and David Henley](#);). Seeds can remain viable for up to about 12 years.

The fruits may be dispersed when individual plants are uprooted and float downstream. Fruits fall to the bottom of the water body in the autumn and the seeds overwinter just as in terrestrial annual species. It has been suggested that in warmer climates some plants may persist as short-lived perennials. Seeds germinate in the spring, with the young root (radicle) perforating the top of the fruit. The young plantlet develops narrow, opposite leaves. As the plant matures, the typical floating, leafy rosettes form at the end of the expanding stem at the surface of the water. Green, feathery submersed leaves (perhaps structurally actually representing adventitious roots) develop along the flexuous stem. The numerous filaments of the feathery structures likely provide a large absorptive surface area for nutrients and, as well, serve as photosynthetic organs. As soon as the initial shoot develops floating leaves, additional leafy offshoots are produced at a rapid rate.

Studies by Groth et al. 1996) have demonstrated that the success of this exotic weed at colonizing aquatic habitats is due to its ability to produce an abundance of vegetative growth quickly in response to low-density conditions. This feature is augmented by the allocation of considerable resources to the production of a greater biomass of reproductive structures resulting in greatly increased fruit production.

Environmental and Economic Impacts

European water chestnut has become a significant nuisance aquatic weed in the northeastern United States, especially in the Hudson and Potomac Rivers, Lake Champlain and in the Connecticut River Valley. Due to its dense, clonal, mat-forming growths the species impedes navigation; its low food value for wildlife potentially can have a substantial impact on the use of the area by native species. The dense surface mats, like those produced by European frog-bit (*Hydrocharis morsus-ranae*) in southeastern

Ontario, likely also reduce aquatic plant growth of other species beneath the shade of the floating canopy. The abundant detritus in the fall of each year and its decomposition could contribute towards lower oxygen levels in shallow waters and impact other aquatic organisms. The sharp spiny fruits can also be hazardous to bathers.

The concern over the extent of the spread of this exotic species and the impacts on the aquatic ecosystems of the northeastern United States has resulted in the listing of the species under [federal regulations that prohibit the interstate sale and transportation](#) of water hyacinths (*Eichornia crassipes*), alligator grass (*Alternanthera philoxeroides*) and water chestnut (*Trapa natans*). Concern over the spread of this species into more southern states is also reflected in the listing of European water chestnut as a species that is [illegal to possess, import or distribute in South Carolina](#). This exotic has also been listed as a prohibited noxious weed in Arizona. All species of *Trapa* are prohibited in Florida. However, the Chinese water chestnut, *Eleocharis dulcis*, especially the variety known as Hon Matai, is legally grown in Florida as a food crop.

Control Measures

Control of this species has consisted primarily of mechanical harvesting of the floating mats by means of weed harvesters used to unblock waterways (The Metropolitan District Commission 1994). Repetitive harvesting over a number of years may be effective in eradicating this aquatic weed in small enclosed bodies of water. However, such mechanical harvesting likely will only serve to control or eliminate major growths that hamper navigation in waterways on an interim basis and will not provide a long term solution to control in heavily infested areas of large lakes or streams.

Attempts have been made to find suitable biocontrol insects through searches conducted in 1992 and 1993 in China, Japan, South Korea and the Russian Far East but no appropriate candidates were found. A similar attempt was made in 1995 in Europe, including France, Germany, Italy and Poland without success. Potential natural enemies have been reported from warmer climates such as in India. Such species may not be suitable for the cooler regions of the northeastern United States but may become suitable subjects for study as biocontrol agents if European water chestnut extends its range further southward into warmer areas of the United States. See US Department of Agriculture, Agricultural Research Service [information notice on the web](#).

Interesting Facts

The name *Trapa* is derived from the Latin *calcitraba*, in reference to a caltrop (or caltrap), the name for a four-spined iron ball that was used in ancient warfare to hinder the advancing enemy calvary. The descriptive epithet *natans* means floating. The genus was once included within the evening primrose family (Onagraceae) but is now considered to be sufficiently distinct to warrant inclusion in a separate family. The common name European water chestnut is used here for *Trapa natans* to avoid confusion with another, quite unrelated plant, also commonly called water chestnut (*Eleocharis dulcis*), but better differentiated as Chinese water chestnut. This latter species is a rush-like plant with upright, long slender

tubular stems, up to one and a half metres tall. This plant arises from mahogany brown corms (short, underground, bulb-like stems), similar to gladiola corms. The white flesh of these corms is crisp, sweet and has a nutty taste. Chinese water chestnuts are widely cultivated in Asia as well as in western Australia and Florida. They are popular in Chinese cooking.

Species of the genus have been used for a variety of purposes. In northwestern India, singhara flour is made from the seeds of *Trapa bispinosa* Roxb. (Hutchinson 1969). This species is now considered to be a variant of the Eurasian and African species *Trapa natans* (*Trapa natans* L. var. *bispinosa* (Roxb.) Makino). The nuts of the Indian plants apparently have two (sometimes four) short slender spines, in contrast to the two large horns of the Chinese variants. The edible seeds, one per fruit or "nut", are eaten by many people in various ways including raw, boiled, roasted or fried (Murty and Subrahmanyam 1989). A more detailed account of this species, its cultivation and use as a food plant in India and Asia is given in an [AQUAPHYTE ONLINE document by S.H. Ahmad and A.K. Singh, Summer 1998](#).

Seeds of the European water chestnut (*Trapa natans*) likely have the same edible quality as the widespread Asian species. In fact, the entire genus may simply represent one highly variable species. A variety of medicinal uses have also been attributed to *Trapa natans*. Fruits have been used to make liniments to treat elephantiasis, rheumatism, sores and sunburn. It is also listed as one of the ingredients in a cancer preventative formula.

The widespread occurrence and use of *Trapa natans* and its variants in India and Asia and its weedy proliferation in aquatic habitats of the northeastern United States is in marked contrast with its present status as a rare species in a number of European countries. It appears to be vanishing in portions of its range in such countries as Belgium, Holland and Sweden. It is red listed in Baden-Württemberg (S Germany) and is listed on [Appendix I of the Bern Convention](#) (Council of Europe, Convention on the conservation of European wildlife and natural habitats) as a strictly protected species.

Acknowledgments

Photo credit: Plate of *Trapa natans* from Bilder ur Nordens Flora.

Selected References

Groth, A.T., Lovett-Doust, L. and Lovett-Doust, J. 1996. Population density and module demography in *Trapa natans* (Trapaceae), an annual, clonal aquatic macrophyte. *American Journal of Botany* 83: 1406-1415.

Heywood, V.H. 1978 (consultant editor). Flowering plants of the world. Mayflower Books, New York.

Hutchinson, J. 1969. Evolution and phylogeny of flowering plants. Dicotyledons: Facts and theory. Academic Press, London.

The Metropolitan District Commission. 1994. A survey of the aquatic plant community of the Charles River Lakes District, Waltham and Newton, Massachusetts. Report by Aquatic Control Technology, Inc. and Fugro East, Inc., Northborough, MA.

Methe, B.A., Soracco, R.J., Madsen, J.D. and Boylen, C.W. 1993. Seed production and growth of water chestnut as influenced by cutting. *J. Aquat. Plant Manage.* 31: 154-157.

Mills, E.L., Leach, J.H., Carlton, J.T. and Secor, C.L. 1993. Exotic species in the Great Lakes: A history of biotic crises and anthropogenic introductions. *Journal of Great Lakes Research* 19: 1-54.

Murty, A.V.S.S.S. and Subrahmanyam, N.S. 1989. A textbook of economic botany. Wiley Eastern Limited, New Delhi.



Prepared by: Erich Haber
National Botanical Services, Ottawa, ON, Canada
ehaber@magi.com
April, 1999
