DEPARTMENT OF NATURAL RESOURCES

Floating Pennywort (*Hydrocotyle ranunculoides*)

Introduction

Floating pennywort (*Hydrocotyle ranunculoides*) is a perennial floating aquatic plant belonging to the Ginseng family (*Araliaceae*), previously the carrot family (*Apiaceae*) (Minnesota Wildflowers, n.d.). It is believed this species evolved in South America and increased its native range to include Central America and the southern United States (Djeddour, 2017). Outside of its native range, this species can form dense floating mats that block sunlight and limit native plant growth, reduce dissolved oxygen levels, negatively impact biodiversity, and impede navigation (WI DNR, n.d.). Floating pennywort can thrive in nutrient rich lakes and can persist through freezing temperatures (Robert et al., 2013; Walsh et al., 2013). It is a common ornamental plant and has been spread through this trade. Additionally, spread has likely been facilitated by waterfowl and fragment attachment to watercrafts. In Minnesota, the first report of Floating Pennywort was documented in 2007 within the Twin Cities Metropolitan area (USGS, n.d.). Since then, only a few more reports have been documented, all occurring within the metro region. This literature review serves to compile available research and information on the biology, invasiveness, and management of floating pennywort to inform future prevention and management decisions.

Biology

Morphology and Growth

Floating Pennywort has leaves that are 2-6 cm in diameter, round with 3-7 lobes (WI DNR, n.d.). Its leaf edges are smooth to scalloped. The roots and stems form mats which may extend 50 cm down into the water, while leaves may grow up to 40 cm out of the water (Djeddour, 2017). The leaf stalks are slender and 5-35 cm long (Invasives.org, n.d.). Stems have nodes every 2-15 cm from which stalks and roots can grow (Djeddour, 2017). Floating pennywort develops pale yellow flowers that are about 3 mm in diameter and grow in a cluster, usually of 9, below the leaf canopy (WI DNR, n.d.). The fruit is 1-3 mm long, elliptic to round in shape and is flattened and divided into two halves (Invasives.org, n.d.).

Images – Left: Top-down view of leaves. Middle: Flower stalk. Right: Stems sprouting from a stolon.

Image Credit: Shaun Winterton, Aquarium and Pond Plants of the World, Edition 3, USDA APHIS PPQ, Bugwood.org

Image Credit: Joseph M. DiTomaso, University of California – Davis, Bugwood.org

Image Credit: Robert Vidéki, Doronicum Kft., Bugwood.org

Habitat

Floating pennywort prefers stagnant or slow-moving fresh waterbodies and may grow in rivers, streams, ditches, ponds, lakes, canals and freshwater marshes. It can also grow on shore (Invasives.org, n.d.). The plants can float on top of the water and can develop into floating mats in both shallow and deep water. The root system consists of masses of fine fibrous roots; these roots can penetrate the soil or drift in the water from the stems (Hilty, 2019). Floating pennywort thrives in high nutrient conditions and can be an indicator of eutrophication, which can lead to rapid microorganism growth that depletes oxygen (Robert et al., 2013). It can survive cold winters, as its submerged stems and leaves overwinter under the ice (Walsh et al., 2013).

Reproduction and Life Cycle

Floating pennywort is a perennial. It can spread both through seed and fragmentation if plant parts contain a growth node. Seeds germinate on mudbanks during the spring (Djeddour, 2017). Plants grow slowly from seeds or small plant fragments once the ice melts. At first, these plants form small leaves that float on the surface, but as temperature and light intensity increase, the leaves enlarge and may reach up to 40 cm above the water. During the summer months, flowering and fruiting occurs. In the autumn, floating pennywort grows small new leaves and will have both floating and submerged leaves. During the winter, floating leaves die, but the submerged stems and leaves overwinter (Hussner et al., 2012).

Predators

In the U.S., insects generally found in southern states are the primary predators of floating pennywort. These include *Cercospora hydrocotyles*, *Entyloma fimbriatum*, *Entyloma hydrocotyles*, *Liriomyza munda*, *Synclita obliteralis, Physoderma hyrdrocotylidis*, and *Puccinia hydrocotyles* (Djeddour 2022). There are many insect species in Argentina that are known to feed on floating pennywort, including *Listronatus elongatus*, Diptera species (Chloropidae, Sphaeroceridae, Chironmidae, and Ephydridae), Lepidoptera species (Arctiidae and Noctuidae), *Puccinia hydrocotyles*, and *Cercospora hydrocotyles* (Walsh et al., 2013. Cattle and nutria (*Myocastor*

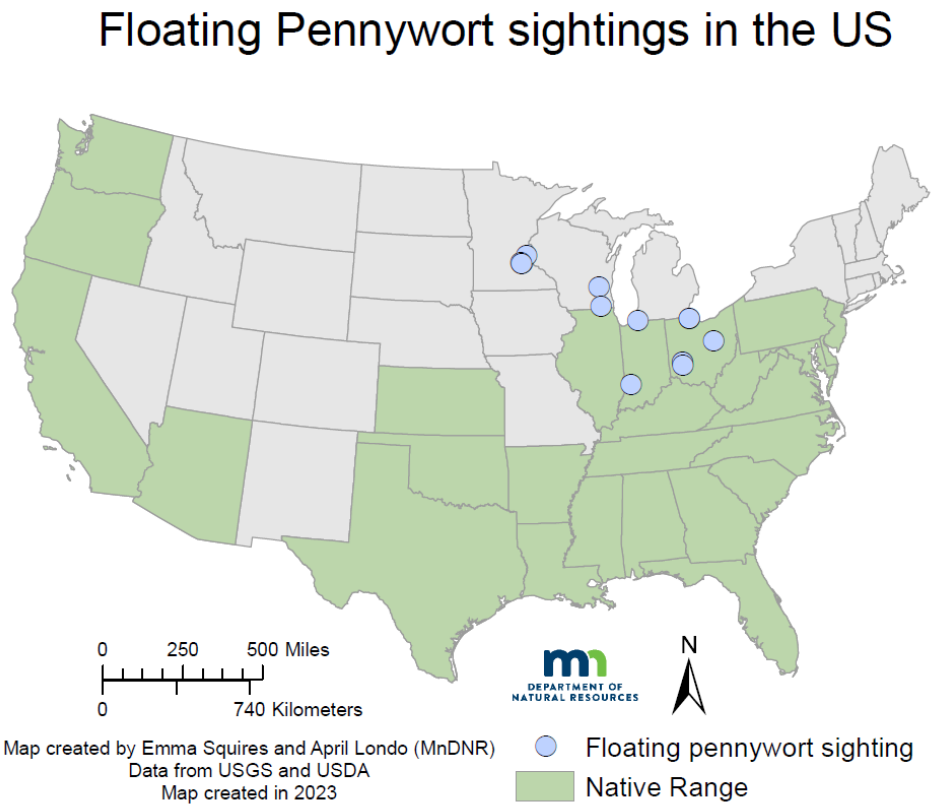
coypus) have been seen eating floating pennywort when it grows near shore, but this has not prevented its establishment (Robert et al., 2013).

Origin and Spread

Native Range

Floating pennywort has a wide range of distribution and is considered native to South America, Central America and the southern U.S. Based on the abundance of natural predators in South America and the lack of them in Central America and the U.S., it is likely that floating pennywort evolved in South America and later expanded its range to Central America and the southern U.S. (Djeddour, 2017).

Current Distribution



Within the U.S., the native range includes 29 states in the south, the east coast, and the west coast. Although native to those states, it likely originated in South America, where there is a wealth of natural predators. The geographic expansion of floating pennywort likely began from South America and continued to Central and North America (Djeddour, 2017). Floating pennywort is listed as endangered in New York, New Jersey and Illinois (Djeddour, 2017), though it is only considered to be native to one county in Illinois (Hilty, 2019). Wisconsin lists floating pennywort as an invasive species (Invasives.org, n.d.; WI DNR, n.d.) while in Minnesota it is an unlisted nonnative species. States that have reports of floating pennywort outside of its native range include Minnesota, Wisconsin and Michigan (USGS, n.d.).

Spread

In Europe, floating pennywort is a common ornamental plant making its way into waterways from dumped aquariums or excess plants from garden ponds. In some cases, it has been spread intentionally, as it accumulates heavy metals and phosphorus, so it has potential for phytoremediation (EFSA Scientific Panel on Plant Health, 2007). Floating pennywort uptakes nutrients and heavy metals and translocates them into shoots

and roots (Demarco et al, 2018). In Portland, Oregon, field trials have been conducted to assess the use of floating pennywort to remove total petroleum hydrocarbons (TPH), lead (Pb), and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) with promising results (Bretsch, 2003). Floating pennywort has also been tested for phytoremediation capabilities in Germany (Robert et al., 2013).

It can also spread by waterfowl and from attachment to watercraft as it grows easily from plant fragments. In addition, management activities that cause fragmentation can also cause spread within a waterbody. A stem fragment 1 cm long with a node can grow into a new plant. Leaves or stem fragments without nodes do not regenerate (Hussner et al., 2012). Floating pennywort can grow and spread quickly once introduced (Djeddour, 2017).

Robert Vidéki, Doronicum Kft., Bugwood.org

Ecological Threat

Floating pennywort grows quickly (20 cm per day), can grow 15 m from the bank in a single season and double their biomass in 3 to 7 days (WI DNR, n.d.). Floating pennywort can form dense mats on the surface of a waterbody, blocking gas exchange between the atmosphere and the water, reducing the oxygen levels in the water. These mats also block sunlight, which inhibits other submersed plant growth. Furthermore, the mats block access to the water for animals (WI DNR, n.d.) and recreationists. The dense mats make navigation of waterways difficult for boaters. In addition, it also can block channels and increase the risk of flooding (Djeddour, 2017). Due to limiting oxygen and sunlight, floating pennywort decreases biodiversity by creating a monotypic plant community.

Current Invasive Range

International Status

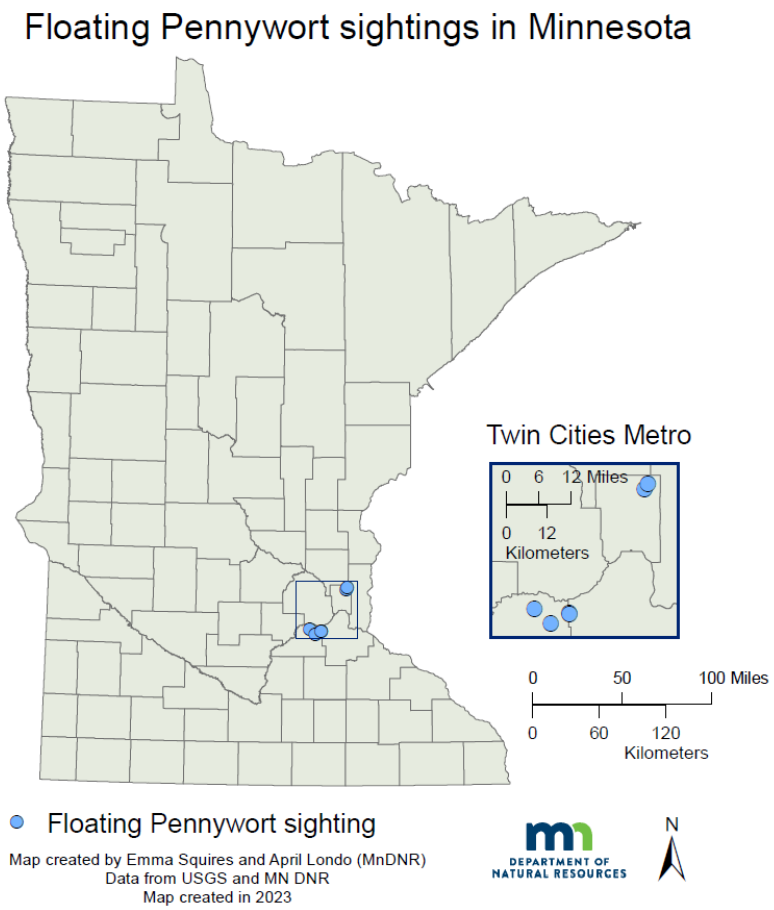
Floating pennywort is invasive in many countries across the world. In Europe, it is present from the United Kingdom in the north to Italy in the south, France in the west, and Hungary in the east. It is present in Syria and Iran in the Middle East and is found in parts of Africa including Kenya, Uganda and Madagascar. It is also present in Japan and Australia (Djeddour, 2017).

In the UK and the Netherlands, floating pennywort has caused habitat modification and economic damage through damage to waterways (EFSA Scientific Panel on Plant Health, 2007). In Australia in 1992, floating pennywort had become so problematic in the Canning River Regional Park that in some places it stretched from bank to bank, where the estimated plant volume was 40,000 m^3 (Klemm, 1993).

Minnesota Status

The U.S. Geological Survey has four reports of floating pennywort in Minnesota. All are within the Twin Cities Metropolitan area. The first report is from 2007 (USGS, n.d.). The Minnesota DNR has received three reports, one in 2014 and two in 2023.

Additional sightings have been reported in the metro region on Minnesota Wildflowers (Minnesota Wildflowers, n.d.) and EDDMapS. The extent of overwintering and nuisances from floating pennywort in Minnesota is unknown. The Minnesota DNR invasive species program plans to track these populations, to better understand its success and growth in the state.



Management

Prior to treatment, managers should be certain they have correctly identified floating pennywort (*Hydrocotyle ranunculoides).* Minnesota is home to a-look-alike species of the same genus, American water pennywort (*Hydrocotle americana*). American water pennywort is a species of special concern and care should be taken to avoid misidentifying and managing it.

Floating pennywort has been known to be resistant to herbicides, making it difficult to control (Invasive.org). A variety of herbicides have been tested, with varying degrees of success. One paper found that floating pennywort is most susceptible to 2,4-D but resistant to glyphosate (Hussner et al., 2012). Management of invasive floating pennywort has been most documented in Europe, where herbicide use is heavily restricted to glyphosate only; thus, limiting data on additional herbicide use (Djeddour, 2017). If glyphosate is used, a mechanical removal followed by chemical application may prove more effective at controlling floating pennywort, though complete eradication may be impossible (Hussner et al., 2012). Glyphosate is not effective at

treating dense patches of floating pennywort, as the waxy leaf surface limits the amount absorbed by the plants. Furthermore, floating pennywort has poor translocation of chemicals, excretes glyphosate through its roots, and the apical buds are resistant to glyphosate (Djeddour, 2017). 2,4-D, which has several formulations that can be used for aquatic plants, may prove more useful in management of this plant.

Any mechanical or manual harvesting of plants that produces plant fragments can promote spread. In Belgium, mechanical removal that limited the production of plant fragments has had promising results when manual removal was continued until the site was free of floating pennywort (Hussner et al., 2012). In the U.K. and the Netherlands, manual removal has been successful, particularly for smaller infested areas. Any removed material must be left far away from the water (Djeddour, 2017).

A study of predators of floating pennywort in Argentina found that *Listronotus elongatus* could be a good candidate for biocontrol. The species *L. elongatus* is a South American weevil with an average survival time of 33 days and may be able to establish populations in cooler climates (Walsh et al., 2013). U.K. studies further suggest that use of *L. elongatus* could be a good bio-control method, as it has a strong preference for floating pennywort. Following a risk assessment of the potential biocontrol agent submitted to U.K. regulators in 2017 (Djeddour, 2017), *L. elongatus* was released at several sites in 2022. This was the first use of a biocontrol in the world for floating pennywort management (Department for Environment, Food, & Affairs et al., 2022). Other potential biocontrol agents are two insect species native to the southern U.S., *Eugaurax floridensis* and *E. basigera*. Both were found to severely damage floating pennywort in laboratory studies but were not released in the U.K. as they were not sufficiently preferential to floating pennywort (Djeddour, 2017).

Conclusion

While uncommon, wild populations of Floating pennywort (*Hydrocotyle ranunculoides*) have been found in Minnesota with reports being made as recently as 2023. These reports have fortunately been isolated to a relatively small geographical location, residing within the Twin Cities Metropolitan area. The Minnesota DNR and other organizations have concerns with the potential invasiveness of this species and risk of spread beyond the metro area. Floating pennywort has shown the ability to grow rapidly and form dense floating mats that limit native aquatic plant growth and recreation (WI DNR, n.d.). Problematically for Minnesota, it has also been shown to overwinter (Walsh et al., 2013). Management of established populations appears to be difficult, costly, and time intensive with eradication being nearly impossible. If chemical management is to be pursued, a report by Hussner et al. (2012) found floating pennywort was resistant to glyphosate but susceptible to 2,4-D. When mechanically managing the species, it is important to limit the production of plant fragments. Removal efforts may need to be repeated until a site is free of all visible floating pennywort for effective control to occur (Hussner et al., 2012). The Minnesota DNR will continue to monitor populations of this species to better understand its ability to establish in the State and to determine what impacts it may have on the local ecosystem.

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