DEPARTMENT OF NATURAL RESOURCES

Prickly Waterlily (*Euryale ferox*)

Introduction

Prickly waterlily (*Euryale ferox*) is a floating-leaf aquatic plant from the Nymphaeaceae family, native to Southern and Eastern Asia. It has large, spiny leaves and thrives in still waterbodies, such as ponds and wetlands. Its ability to establish dense populations can cause significant ecological impacts, including altering water quality and displacing native aquatic plants. This species has recently been discovered in Minnesota in a small pond in the Twin Cities area, suggesting it can adapt to new environments outside its native range. This document summarizes *E. ferox's* biological traits, ecological effects, and potential management strategies to mitigate its spread.

Biology

Morphology and Growth

Prickly waterlily is the only member of the *Euryale* genus in the Nymphaeaceae family and is native to Southern and Eastern Asia (Qian et al., 2022). Its leaves can grow up to two meters in diameter (Wu et al., 2022). The top side of the leaf is bright green while the underside is deep purple. The leaves, stems, and fruits are covered in sharp spines. Its fruits are spongy and holds seeds that are roughly the size of peas (Kumar et al., 2020). Each fruit contains an average of 15-30 seeds (Kumar et al., 2020). The roots are cord-like, fibrous, and completely penetrate the sediment.

Underside of leaf
Credit: Capitol Region Watershed District

Underside of leaf
Credit: Ramsey County

Immature leaf
Credit: Capitol Region Watershed District

Habitat

Prickly waterlily prefers stagnant fresh waterbodies and is best suited to grow in ponds, wetlands, and lakes (Jana, 2018). This plant prefers mesotrophic conditions and thrives in floodplain wetlands where water permeability in the bottom sediment is poor (Kim et al., 2018). The plant favors shallow and open areas where there is enough space to establish a monotypic stand (Kim et al., 2018). It grows best in silty or sandy sediments, but it can also grow well in clay (NC State Extension, n.d.). In its native range, *E. ferox* prefers hot, dry summers and cold winters. Ideal conditions for development include air temperatures ranging from 20°C to 35°C, relative humidity between 50% and 90%, and an annual rainfall of 100cm to 250cm (Kumar et al., 2017).

Reproduction and Life Cycle

Prickly waterlily has been reported as both an annual and a perennial (Chaudhuri & Dutta, 2006; Semwal et al., 2021; Kumari et al., 2014). The growth cycle of *E. ferox* is comprised of four distinct stages: seeding , seedling, growth, and if cultivated, harvesting (Verma & Datta, 2007). Mature seeds can be propagated and transplanted into suitable waterbodies (Singh & Gupta, 2006). It is reported that prickly waterlily seeds possess the ability to remain dormant for several decades when the external environmental conditions are unsuitable for germination (Imanishi & Imanishi, 2014). This mechanism ensures that germination occurs only in optimal environments, thereby increasing the seeds' chance of survival. One study found that 30% of *E. ferox* seeds were able to break dormancy after chilling at 2°C to 3°C for one month, while seeds stored at room temperature during the same period showed no signs of germination (Kumaki, 1973). An additional study found that breaking dormancy was more strongly seen at 4 °C compared to higher temperatures (Imanishi & Imanishi, 2014). The same researchers also examined light as a factor for germination and found that *E. ferox* seeds can germinate in both light and darkness (Imanishi & Imanishi, 2014). Most flowers are cleistogamous, giving them the ability to be self-pollinated. Jana (2018) examined flower characteristics and found that peak pollination was observed 60 to 70 days after transplanting, during which the temperature ranged from 29°C to 31°C and the humidity levels were between 79% and 81%.

Predators

There are several pests that predate on prickly waterlily in its native range. In India, two common pests of *E. ferox* are *Parapoynx crisonalis*, a species of moth, and *Rhopalosiphum nymphaeae* (Linnaeus), an aphid; both species feed on the leaves of prickly waterlily. In addition, *Donacia sp*. damages the roots, *Frankliniella intonsa* (Trybom) damages the flowers, *Bagous vicinus* (Hustache) damages the fruits, and *Tyrophagus putrescientiae* (Schrank) damages the stored seeds (Jha et al., 1991). Case worms (*Elophila depunctalis* W. and *Elophila crisonalis* W.) are also a pest of *E. ferox;* they eat at the leaf surface and

create cases which they then use for shelter. Lastly, *Chironomous* sp. are rib borers that easily move inside the cavities of the leaves which causes leaf damage and decay (Nath et al., 2018).

Waterlily Aphid *(Rhopalosiphum nymphaeae)*. Photo Credit: petri_kuhno, iNaturalsit.com

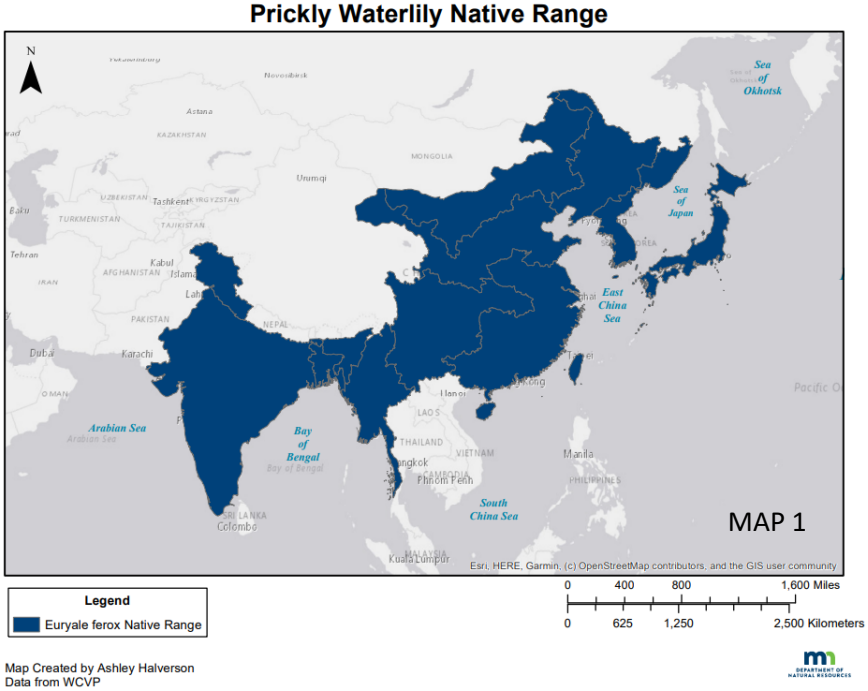
Trybom *(Frankliniella intonsa)* Credit:Gillessanmartin, iNaturalsit.com

Origin and Spread

Native Range

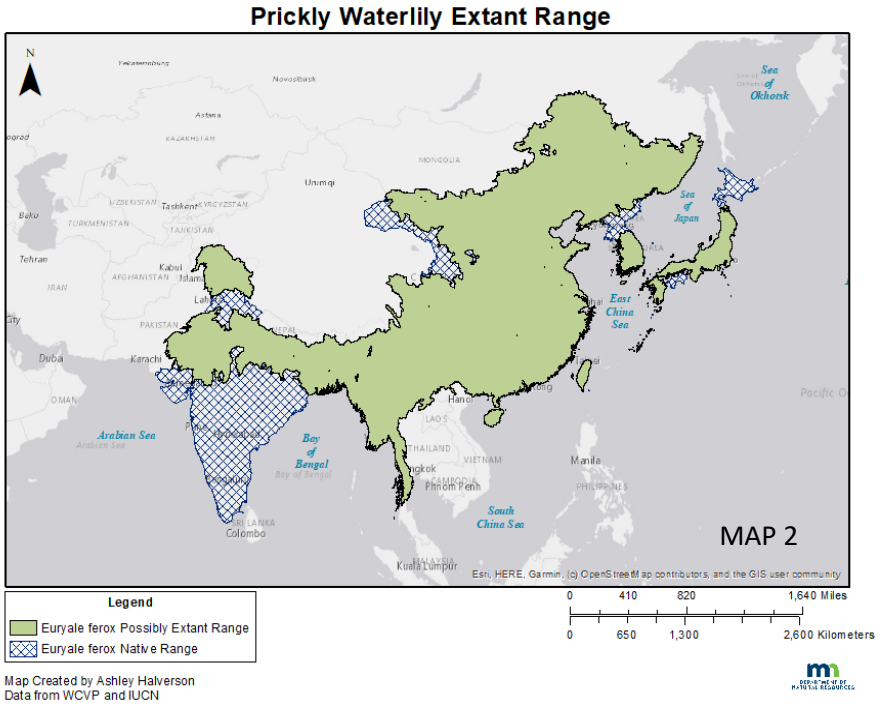
Prickly waterlily is primarily limited to the tropical and subtropical regions of Southeast and East Asia (Kumar et al., 2020). Native populations can be found in China, India, Japan, Korea, Taiwan, and Myanmar (USDA National Plant Germplasm System, 2024). Additionally, the native range extends north into the valley of the Ussuri River in Russia (see Map 1). The northernmost point in the native range lies on the 53rd parallel north.

Prickly Waterlily Native Range



Current Distribution

Euryale ferox has lost significant habitat due to several factors. In portions of Japan, prickly waterlily has experienced habitat loss due to land reclamation and water pollution (Imanishi & Imanishi, 2014). Compared to the species' native range, the current possible extant range shows habitat loss in southern India, northern Japan, North Korea, and portions of China, as shown in Map 2 (IUCN). Researchers created a habitat prediction model using projected climate data and found that highly suitable *E. ferox* habitat will continue to shrink in eastern India (Semwal et al., 2021).



Spread

Prickly waterlily can spread through seed transplanting. This method is a common way to start a cultivation pond (Kumar et al., 2020). It is not known if waterfowl are a common way for prickly waterlily seeds to be transported but Živković et al suggested that waterfowl was how *E. ferox* established a wild population in Serbia (2023). Naturally, *E. ferox* can spread when its fruits split open after maturity and release its seeds (Goren-Inbar et al., 2014). The seeds have a mucilaginous arillus that allows them to float for several days before they sink to the sediment (Goren-Inbar et al., 2014).

Floating leaves. Capitol Region Watershed District

Ecological Threat

The growth period of adult leaves occurs in two stages: underwater and above-water. The underwater leaf grows in a tightly wound-up form until it reaches the surface. Once it is above-water it rapidly unfolds and expands to 100 centimeters in surface size within one day and will continuously grow to reach 200 centimeters by day ten. This rapid expansion occurs due to adaptive evolution and the need to maximize space to ensure survival (Wu et al., 2022). This

can cause dense mats to form which allows the plant to develop a monoculture (Kim et al., 2018). Dense stands of *E. ferox* could significantly disrupt aquatic ecosystems and water quality. Rapid proliferation of prickly waterlilies could lead to a reduction in sunlight penetration, inhibiting the growth of submersed aquatic vegetation. Additionally, dense mats of prickly waterlilies could obstruct water flow, causing stagnant areas that promote harmful algal blooms. Both algal blooms and lack of sunlight contribute to a reduction in oxygen levels which can negatively alter the aquatic environment. Furthermore, as plants decay, they can contribute to increased nutrient loading which further degrades water quality (Hinneh et al., 2024).

Current Invasive Range

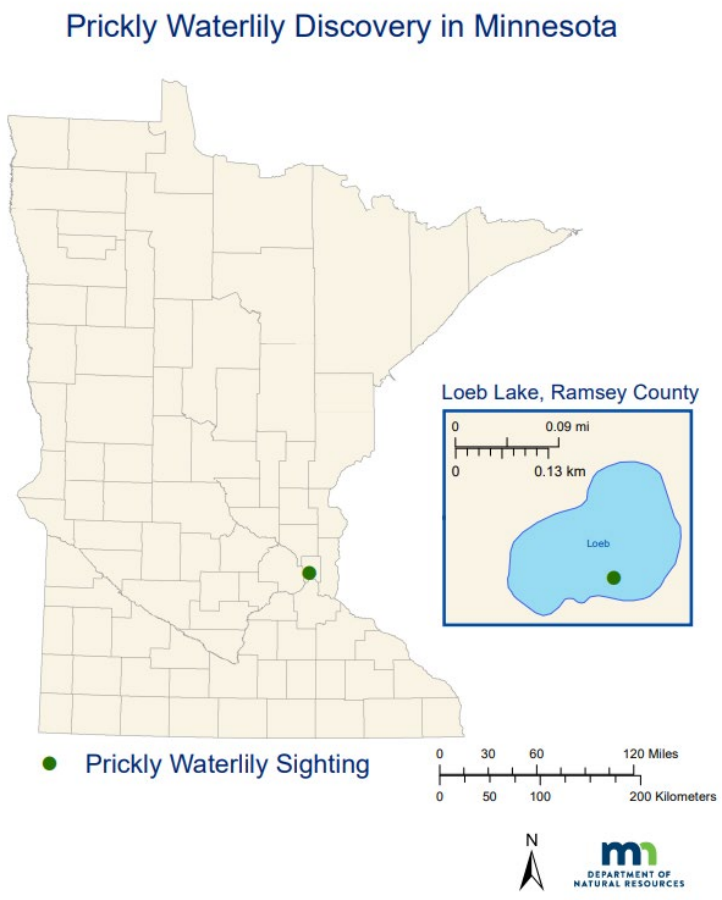
International Status

Although part of Russia falls within the native range of *Euryale ferox*, there are additional populations that exist beyond this area (Tsyrenova, 2023). One such population in Russia exists in the city of Birobidzhan which lies on the 48th parallel north (Tsyrenova, 2023). A paper by Jha and Barat (1991) also mentions a wild population existing in North America, although it has yet to be supported. Furthermore, there has been a report of a wild population in Serbia (Živković et al., 2023).

Minnesota Status

The first known discovery of prickly waterlily in the Midwest occurred on September 24, 2024 in Minnesota. Capitol Region Watershed District staff made the discovery in Loeb Lake, Ramsey County. Historical satellite images suggest that prickly waterlily has been present in Loeb Lake since 2021. It is unclear if the plant is overwintering or if it is being replanted every year. Prickly waterlily is currently an unlisted nonnative species in Minnesota.

The extent of overwintering and potential nuisance from prickly waterlily in Minnesota is unknown. The Minnesota DNR invasive species program plans to monitor this population to better understand its ability to adapt to Minnesota's climate.



Management

Due to the lack of information on prickly waterlily as a nonnative species in its invasive range, there is little information surrounding management. However, it is a highly cultivated species and management techniques from that process can be examined. During cultivation, mechanical removal of the plant is common through an operation called thinning. This method of management requires the removal of a whole plant to maintain a 1x1 m space between each *E. ferox* plant (Singh et al., 2018). An additional method of mechanical management could be cutting which has been shown to be successful in other species. *Typha* species have well developed aerenchyma in the emergent shoots and leaves. Cutting these shoots below the water surface allows water to flow into the specialized cells causing the roots to not receive an adequate amount of oxygen. Repeated cutting will eventually kill the plants, and it is a recommended method of management for *Typha* species (Jordan & Whigham, 1988). Prickly waterlilies have aerenchyma and may be able to be managed in a similar way (Wu et al., 2022; Tsyrenova, 2023). Fragrant waterlily (*Nymphaea odorata*) has also been managed by cutting. Removing the leaves of fragrant waterlily plants reduces the ability of the plant to adequately photosynthesize causing it to use up its stored carbohydrates. It takes a couple seasons of mechanical removal for the plants to completely die (King County, 2010).

The use of pesticides is another possible management strategy for *E. ferox*. Prickly waterlily is a part of the family Nymphaeaceae and is considered a waterlily. It can be assumed that herbicides used to target waterlilies would be effective. Commonly used herbicides for water lily management include 2,4-D, glyphosate, triclopyr, and endothall (Texas A&M AgriLife Extension, n.d.). There is limited information regarding the use of aquatic herbicides for prickly waterlily control, so it is important to conduct thorough research to determine the optimal product for management.

Conclusion

Prickly waterlily (*Euryale ferox*) is a native species to Southern and Eastern Asia (Qian et al., 2022). In its native range, it is best suited to grow in ponds, wetlands, and lakes (Jana, 2018). In these environments it favors growing in shallow open areas (Kim et al., 2018). It has been reported that prickly waterlily is both an annual and a perennial plant that can overwinter in freezing conditions (Chaudhuri & Dutta, 2006; Semwal et al., 2021; Kumari et al., 2014; Kumar et al., 2017). In its native range, the species is often spread through cultivation as the seeds are an important food source and cash crop (Kumar et al., 2020). Natural spread could be facilitated by seed pods releasing seeds and possibly waterfowl, though the latter is not well documented (Goren-Inbar et al., 2014; Živković et al., 2023). Once established, prickly waterlily can quickly grow large floating leaves that mat the water's surface and block light from reaching the lake bottom, often leading to a monoculture (Wu et al., 2022; Kim et al., 2018). Management of this species is not well documented, but repeated cutting of the plant's stems below the water's surface could be effective (Jordan & Whigham, 1998). Alternatively, herbicides such as 2,4-D, glyphosate, triclopyr, and endothall are all effective against other waterlily species and could provide control for prickly waterlily (Texas A&M AgriLife Extension, n.d.). Currently, there is only one known population of prickly waterlily in Minnesota, which is located in Loeb Lake in Ramsey County. This population was first reported in 2024, but historical aerial imagery suggests it may have been present in the lake since 2021. The Minnesota DNR, Capitol Region Watershed District, and Ramsey County will continue to monitor this population to better understand its ability to adapt to Minnesota's climate.

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