Heartshape False Pickerelweed (*Monochoria vaginalis*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, May 2021
Revised, June 2021
Web Version, 8/26/2021

Organism Type: Plant
Overall Risk Assessment Category: Uncertain

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1 Native Range and Status in the United States

Native Range

From Narayanan and Kaliappan (2014):

"[…] commonly found in rice fields, throughout India and widely distributed in Asian countries like South Korea, Japan, China etc. (Zheng et al., 2013)."

From CABI (2019):

"This species has been recorded in Korea and Japan, through the Pacific Islands […], to the mainland of South-East Asia and across into India (Holm et al., 1977). However, specific references to some locations (for example, the individual Pacific Islands) were not found […].

Similarly, few detailed references were found on its distribution within individual countries, though its occurrence is acknowledged to be widespread. For example, *M. vaginalis* is said to occur throughout Indonesia (Soerjani et al., 1987); at a wide range of altitudes and probably in all districts of Bhutan (Parker, 1992); throughout India, from Kashmir to Assam (Kaul, 1986) and in East, Central and South China, as well as Hebei, Shaanxi, Gansu, Sichuan, Guizhow and Yunnan provinces (Wang, 1990)."

From Fan et al. (2013):

"[…] distributed in Japan, Malaysia, Philippines, India, Nepal, Bhutan, and the northern and southern provinces of China."

From Lansdown (2011):

"Wide distribution in South East Asia from Iran, Philippines and Indonesia, to China, Korea, Japan, and North Australia."

"Australia (Northern Territory, Coral Sea Is. Territory, Queensland, Western Australia); Bhutan; Cambodia; China; India; Indonesia (Maluku, Sulawesi, Kalimantan, Lesser Sunda Is., Sumatera, Jawa); Japan; Korea, Democratic People's Republic of; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Pakistan; Philippines; Russian Federation (Primoryi); Sri Lanka; Taiwan, Province of China; Thailand; Viet Nam"

From Flora of Australia Online (2021):

"Native to northern Australia, near Walcott Inlet, W.A., and in the Litchfield–Darwin–Arnhem Land area, N.T.; possibly native but previously overlooked at Cairns, Qld, where first collected in 1986; recently (1975) naturalised and extensive in a bore-drain south of Julia Creek, Qld. Also native to Japan, China, SE Asia, Philippines, Malaysia, Java and New Guinea."

Status in the United States

M. vaginalis has been reported as introduced to the United States. USDA, NRCS (2021) indicated that this species has been introduced to California and Hawaii. EDDMapS (2021) also indicated that this species has been introduced to the United States Territory of Guam, however no information on the establishment status was available.

From Beucke (2018):

"*Monochoria vaginalis* has been established in Butte County, California since the 1950s. There is one occurrence documented in Tehama County. […] it is reportedly a common weed in rice in the vicinity of Biggs, California, […]"

From Wagner and Herbst (1995):

"The following collection represents a **new island record** for Hawaii. *Monochoria vaginalis* was previously known to be naturalized on Kauai and Oahu."

Monochoria vaginalis was not found to be available for sale in the aquarium trade in the United States.

According to USDA, NRCS (2021) this species is listed as a Federal Noxious Weed. It is considered a Class A noxious weed in the States of Alabama, North Carolina, and Vermont. It is listed under Quarantine in California and Oregon. Florida lists this species has a Prohibited aquatic plant, Class 1. It is prohibited in Massachusetts. South Carolina considers it an invasive aquatic plant and plant pest. According to EDDMapS (2021), Indiana has this species listed on their Invasive Species Council Invasive Plant List, Indiana Pest Species List, and Indiana Prohibited Plant Species List. This species is also included in the Massachusetts Noxious Weeds, South Carolina Illegal Aquatic Plants, Texas Noxious Weeds, and USDA APHIS Regulated Pest List.

Means of Introductions in the United States

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

Remarks

According to WFO (2021), *Monochoria vaginalis* is the accepted name for this species. This species is also sometimes referred to as *Pontederia vaginalis* in the literature (e.g. Pellegrini et al. 2018). The valid name, *Monochoria vaginalis*, as well as synonyms recognized by WFO (2021), including *Pontederia vaginalis*, were used to conduct research for this assessment. See Taxonomic Hierarchy and Taxonomic Standing, below, for a full list of synonyms.

From CABI (2019):

"*M. vaginalis* is very variable and for this reason may be misidentified. Backer and Bakhuizen van den Brink Jr (1968) note that "Specimens with few-flowered inflorescences and small, often narrow, proportionally long leaves have wrongly been described as varieties or even separate species. They are either young or weak, or were collected in deep water"."

"*M. vaginalis* is occasionally cited as a native of tropical Africa, as well as Asia (e.g. Holm et al., 1977). However, in the Flora of West Tropical Africa (Hutchinson et al., 1968), earlier references to *M. vaginalis var. plantaginea* in the region are concluded to be erroneous and instead are re-categorized as *M. brevepetiolata*.

Patwary et al. (1989) suggest interspecific hybridization between *Monochoria vaginalis* and *Monochoria hastata* Solms. in populations grown in Bangladesh."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to WFO (2021), *Monochoria vaginalis* (Burm.f.) C.Presl is the current valid name of this species.

WFO (2021) recognized the following names as synonyms of *Monochoria vaginalis* (Burm.f.) C.Presl: *Boottia mairei* H.Lév., *Gomphima vaginalis* (Burm.f.) Raf., *M. junghuhniana* Hassk., *M. linearis* (Hassk.) Miq., *M. loureiroi* Kunth, *M. ovata* Kunth, *M. pauciflora* (Blume) Kunth, *M. plantaginea* (Roxb.) Kunth, *M. vaginalis* (Brum. f.) C. Presl ex Kunth, *M. vaginalis var. angustifolia* G.X.Wang, *M. vaginalis var. pauciflora* (Blume) Merr., *M. vaginalis var. plantaginea* (Roxb.) Solms, *Pontederia alba* Buch.-Ham. ex Wall., *P. cordata* Lour., *P. lanceolata* Wall. ex Kunth, *P. linearis* Hassk., *P. loureiroana* Schult. & Schult.f., *P. ovata* Hook. & Arn., *P. pauciflora* Blume, *P. plantaginea* Roxb., *P. racemosa* Buch.-Ham. ex Wall., *P. vaginalis* Burm.f., and *P. vaginata* Royle.

From ITIS (2021):

Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Lilianae
Order Commelinale
Family Pontederiaceae
Genus *Monochoria*
Species *Monochoria vaginalis* (Burm. f.) C. Presl ex Knuth

Size, Weight, and Age Range

From CABI (2019):

"It is 10-50 cm tall and stemless. […] In young plants without lamina, the leaves are 2-12.5 cm long and 0.5-10 cm wide. […] The petioles are soft and hollow, usually less than 30 cm in length and growing from buds at the base; […]"

Environment

From Fan et al. (2013):

"[…] typically found in flooded sites, swamps, rice fields, and edges of pools, ditches, and canals."

From CABI (2019):

"[…] plant of subaquatic to aquatic conditions (Ampong-Nyarko and De Datta, 1991) […]. It can occur in areas with a pronounced dry season, and is typically found in sunny sites in swamps, marshes, open wet places, along ditches and in all types of inundated rice (Soerjani et al., 1987). In Java it occurs […] in freshwater pools, mudflats in rivers, ditches, ricefields, and along canal banks (Backer and Bakhuizen van den Brink Jr, 1968). In Fiji it grows in shallow water, swampy ground, open drains, ricefields, or in very wet soils (Parham, 1958)."

From PIER (2021):

""An annual or pseudoannual in flooded ricefields, but may grow as a perennial in constantly flooded areas. [Holm et al. 1977]"

Climate

From EDDMapS (2021):

"*Monochoria vaginalis* is an aquatic herbaceous plant native to temperate and tropical Asia."

From CABI (2019):

"In Java it occurs from 0-700 m elevation […]"

From PIER (2021):

"It can be found from 0 to 1,500 m altitude in Indonesia. [Holm et al. 1977]"

From FAO (2021):

"Although it is considered a weed of temperate areas, […] it is found in various hot climatic countries of Asia and Southeast Asia."

Distribution Outside the United States

Native

From Narayanan and Kaliappan (2014):

"[…] commonly found in rice fields, throughout India and widely distributed in Asian countries like South Korea, Japan, China etc. (Zheng et al., 2013)."

From CABI (2019):

"This species has been recorded in Korea and Japan, through the Pacific Islands […] to the mainland of South-East Asia and across into India (Holm et al., 1977). However, specific references to some locations (for example, the individual Pacific Islands) were not found […]. Similarly, few detailed references were found on its distribution within individual countries, though its occurrence is acknowledged to be widespread. For example, *M. vaginalis* is said to occur throughout Indonesia (Soerjani et al., 1987); at a wide range of altitudes and probably in all districts of Bhutan (Parker, 1992); throughout India, from Kashmir to Assam (Kaul, 1986) and in East, Central and South China, as well as Hebei, Shaanxi, Gansu, Sichuan, Guizhow and Yunnan provinces (Wang, 1990)."

From Fan et al. (2013):

"[…] distributed in Japan, Malaysia, Philippines, India, Nepal, Bhutan, and the northern and southern provinces of China."

From Lansdown (2011):

"Wide distribution in South East Asia from Iran, Philippines and Indonesia, to China, Korea, Japan, and North Australia."

"Australia (Northern Territory, Coral Sea Is. Territory, Queensland, Western Australia); Bhutan; Cambodia; China; India; Indonesia (Maluku, Sulawesi, Kalimantan, Lesser Sunda Is., Sumatera, Jawa); Japan; Korea, Democratic People's Republic of; Lao People's Democratic Republic; Malaysia; Myanmar; Nepal; Pakistan; Philippines; Russian Federation (Primoryi); Sri Lanka; Taiwan, Province of China; Thailand; Viet Nam"

From Flora of Australia Online (2021):

"Native to northern Australia, near Walcott Inlet, W.A., and in the Litchfield–Darwin–Arnhem Land area, N.T.; possibly native but previously overlooked at Cairns, Qld, where first collected in 1986; recently (1975) naturalised and extensive in a bore-drain south of Julia Creek, Qld. Also native to Japan, China, SE Asia, Philippines, Malaysia, Java and New Guinea."

Introduced

From Beucke (2018):

"It has also been reported from Fiji, Central America, South America, Mexico, […]"

According to PIER (2021), *Monochoria vaginalis* is introduced, invasive, and cultivated in Fiji on Ovalau Island and Viti Levu Island, where is it "locally abundant."

No further information on introductions to Central or South America was found.

Means of Introduction Outside the United States

From PIER (2021):

“"In Fiji this species occurs as an adventive, as well as an ornamental, […] [Smith 1979]”

Short Description

From CABI (2019):

“*M. vaginalis* is a fleshy, tufted, annual or perennial herb with a glabrous, shiny appearance and a short rhizome. It is an aquatic herb, forming rosettes and spreading by short stolons.”

“The inflorescence is spicate, 3-6 cm long, basally opposite the sheath of the floral leaf with a large bract arising from a thickened bundle on the leaf stalk, about two-thirds of the way up the stalk from the base. […] Flowers number from 3-25 and open simultaneously or from top to bottom in quick succession, with six violet or lilac petals which are spreading at flowering and later spirally contorted.”

From Narayanan and Kaliappan (2014):

“Leaves are variable in size, 5-10 by 3.2-5 cm from linear to ovate or ovate-cordate, usually acuminate […]; petioles of the lower leaves are long, stout and terete, the peduncles emerge from the channeled sheaths of the uppermost leaves. Inflorescence is centripetal; flowers are blue, usually spotted with red; in subspicate racemes with one large anther and 5 small anthers. Ovary is ellipsoid and glandular. Fruit is ellipsoid, glandular outside. Seeds are 0.8 mm long, ellipsoid, rounded at each end, pale, with many brown ribs (Krithikar and Basu, 2012). Root stock is short, sub-erect and spongy […]”

“The flowers are bisexual and possess 6-perianth members, 6 stamens and tricarpellary, syncarpous ovary with many ovules. In cross sectional-view, the flower show 6 perianth members which include three outer and three inner members […] the perianth members are thick in the middle and generally thin on the lateral margins. Perianth has several vascular strands situated all along the median portions. Alternating with the vascular strands are wide chambers. Vascular strands are collateral having a small group of xylem elements and phloem elements. The ground tissue is parenchymatous and compact. The wall of the ovary is uniformly 100 µm thick, consisting of thin inner and outer epidermis of small thin walled cells. Small vascular strands are seen in the median part of the ovary wall […]. The ovary has three carpels and the axial placentum is divided into many thin radial segments. The ovules are attached on the surface of lobed placentum.”

“The ovary develops into a capsule in which numerous seeds are attached on the placentum with long funicle […] the seeds are cylindrical measuring 800 µm long and 350 µm thick.

Seed is densely endospermous, the endosperm is nuclear type lacking cell walls and cells. The seed has thin seed coat with small lignified cells and 10 short conical ridges found along the circumference. The embryo is cylindrical with long thick cotyledon […].”

Biology

From CABI (2019):

"Relatively little is known of the biology of *M. vaginalis* (Holm et al., 1977).

M. vaginalis may be an annual in flooded ricefields, but can also grow as a perennial in constantly flooded conditions (Holm et al., 1977). The plant roots in mud, with its upper portions growing above the water. Reproduction is mainly from seed, with occasional new growth from tubers (Pancho and Soerjani, 1978). Flowering can occur throughout the year in the Philippines (Merrill, 1912). *M. vaginalis* is characterized by prolific seed production: Gupta (1968) suggested that submergence of the fruits after pollination was beneficial for seed development.

Noda and Eguchi (1965) found that seedling emergence is greater in early planted ricefields in Japan and, with early planting, seedling emergence was higher in saturated soils than in dry soils. They also found that the patterns of seed germination varied greatly according to moisture levels. In submerged conditions, the majority of seedlings emerged within a short space of time, the peak germination being between 15 and 25 days. In contrast, in saturated or dried soils, germination occurred gradually throughout the season. Miyahara et al. (1989) studied seedling emergence from buried seed over a 15-year period and found that emergence declined from one year to the next more rapidly in well-drained than in poorly drained soils. Kim and Mercado (1987) suggest that *M. vaginalis* seeds develop a light requirement for germination when buried for 1 month or longer at depths of greater than 1 cm.

M. vaginalis is a rapidly growing, competitive C3 plant (Ampong Nyarko and De Datta, 1991). Its property of discontinuous germination allows it to evade control.

In Taiwan *M. vaginalis* produced higher fresh-weight yields in paddy fields than any other weed species (Lin, 1968)."

From Fan et al. (2013):

"*M. vaginalis* reproduces by sexual propagation, flowering in August and September, and fruiting in September and October in China."

From FAO (2021):

"Earlier seeding dates produce significantly greater plant height, more leaves and dry weight than those of later seeding dates. Earlier seeding dates result in earlier flowering, but the interval between dates of seeding and flowering decrease progressively as the seeding times are delayed.

This weed is propagated by tiny seeds, which are oblong, about 1 mm long."

Human Uses

From CABI (2019):

"All parts of *M. vaginalis* except for the roots are relished as a vegetable (Mabberley, 1990) and it is used locally as a medicine (Burkill, 1935; Mabberley, 1990). The roots are used against stomach and liver ailments and against toothache (Soerjani et al., 1987). It is also used as cattle fodder (Patwary et al., 1989)."

From Palani et al. (2011):

"The leaf juice of *Monochoria vaginalis* is used to treat cough and that of roots is used to treat stomach and liver problems, asthma and tooth ache (Yoganarasimman et al., 2000, Madhava chetty et al., 2008). In Siddha system, the root is used to treat cough, disease of pittam, venereal disease, thirst, fainting and fever (Yoganarasimman et al., 2000). The whole part of plant is considered as a functional food and is also been employed for the treatment of asthma and fever (Row et al., 2003)."

From Lansdown (2011):

"This plant has many uses across Indochina. The leaves are laxative and its paste is served to cattle with diarrhoea [sic]. It is also used for human consumption. It has also been used for the treatment of tooth ache, asthma, fever, sore and stomach ache. It also used to feed pigs and ducks."

Diseases

From CABI (2021):

"*M.* [sic] is reported to be a secondary host for the rice grassy stunt virus, transmitted by the brown planthopper, *Nilaparvata lugens* (IRRI, 1988) and for *Sarocladium oryzae* (Deka and Phookan, 1992). It is also a host of rice ragged stunt oryzavirus (RRSV) (Salamat et al., 1987), though it may not act as a reservoir of this virus (Parejarearn et al., 1988)."

Kim et al. (2011) report *Monochoria vaginalis* (under the synonym *M. plantaginea*) as a host for the flatid *Metcalfa pruinosa*.

Threat to Humans

From CABI (2019):

"*M. vaginalis* is a serious weed in ricefields in east and southern Asia. It is a principal weed of rice in Korea, Malaysia (Sarawak) and the Philippines. It is one of the three most serious weeds of rice in Indonesia, Japan and Taiwan and is a common weed of rice in Cambodia, Sri Lanka, China, India and Thailand (Holm et al., 1977). In Bhutan, it is a major weed of flooded rice, often the most abundant and dominant species and regarded as one of the most important by farmers (Parker, 1992).

With the exception of its recorded incidence in taro in Hawaii, all references to its occurring as a weed concern flooded rice in tropical Asia and the Pacific Islands (Holm et al., 1977). It occurs in all types of rice (except dryland rice) including transplanted, both wet and dry direct-seeded and in deepwater and tidal swamp rice (IRRI, 1989).

M. vaginalis is a rapidly growing, competitive C3 plant (Ampong Nyarko and De Datta, 1991). Its property of discontinuous germination allows it to evade control.

Sattar and Biswas (1991) recorded yield losses in rice of up to 82% at high densities of *M. vaginalis*. In competition studies in the Philippines, *M. vaginalis* was less competitive with rice than the other principal weed, the annual grass *Echinochloa crus-galli* (Lubigan and Vega, 1971). The critical weed population was 60 plants per square metre: a natural stand of 366 plants per square metre reduced rice yield by 35%. Lubigan and Vega (1971) concluded that *M. vaginalis* does not compete seriously for light and, being shallow rooted, the deeper-rooted rice plants are able to compete more vigorously for nutrients."

3 Impacts of Introductions

The following information details impacts *Monochoria vaginalis* has within its native range where it is an agricultural pest. While this information will not be considered when evaluating the history of invasiveness, the authors deemed it important to highlight as it could translate into impacts in introduced ranges.

From CABI (2019):

"*M. vaginalis* is a serious weed in ricefields in east and southern Asia. It is a principal weed of rice in Korea, Malaysia (Sarawak) and the Philippines. It is one of the three most serious weeds of rice in Indonesia, Japan and Taiwan and is a common weed of rice in Cambodia, Sri Lanka, China, India and Thailand (Holm et al., 1977). In Bhutan, it is a major weed of flooded rice, often the most abundant and dominant species and regarded as one of the most important by farmers (Parker, 1992)."

"*M. vaginalis* is a rapidly growing, competitive C3 plant (Ampong Nyarko and De Datta, 1991). Its property of discontinuous germination allows it to evade control."

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The following information pertains to potential impacts of introduction. "The pest" mentioned below refers to *M. vaginalis.*

From Beucke (2018):

"The pest could lower crop yield."

"The pest could lower crop value (includes increasing crop production costs)."

"The pest could trigger the loss of markets (includes quarantines)."

"The pest could negatively change normal cultural practices."

"The organism can interfere with the delivery or supply of water for agricultural uses."

"The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes."

"The pest could directly affect threatened or endangered species."

"The pest could impact threatened or endangered species by disrupting critical habitats."

"The pest could trigger additional official or private treatment programs."

"*Monochoria vaginalis* has been reported to occur in a variety of habitats in Asia, including streams, swamps, and ponds/pools, including ephemeral ponds in Cambodia that are dry for half of the year. Therefore, this plant may be capable of invading these habitats in California. Vernal pools are a particularly threatened habitat in California; it is estimated that only 3–10% of these pools remain on the Pacific Coast (Gerhardt and Collinge, 2003). If *M. vaginalis* invades vernal pools, riparian areas, or other similar habitats in California, it could compete with native plants, threatening both them as well as wildlife dependent on the native plants. Rare plants that could be threatened include Boggs Lake hedge hyssop (*Gratiola heterosepala* H. Mason & Bacigal.), delta tule pea (*Lathyrus jepsonii* E. Green var. jepsonii), prickly spiralgrass (*Tuctoria mucronata* (Crampton) Reeder), and false venus' looking glass (*Legenere limosa* (E. Greene) McVaugh) (Calflora). In addition, if *M. vaginalis* became a more widespread pest in rice fields, it could trigger additional treatment programs."

4 History of Invasiveness

M. vaginalis has been introduced and become established in California and Hawaii in the United States and in Fiji. This species is listed on the Federal Noxious Weed List. It is also listed on several State noxious weed and prohibited plant species lists including Alabama, California, Florida, Indiana, Massachusetts, Oregon, South Carolina, Texas, and Vermont. No documented actual impacts have been recorded in areas of California and Hawaii where *M. vaginalis* has been introduced in the United States or in Fiji. In its native habitat, this species grows rapidly and can become weedy, especially in rice fields where it competes with rice for resources. Reports have recorded yield losses in rice at high densities of *M. vaginalis* within its native range. There is no

indication that this species is in the ornamental trade within the United States. The history of invasiveness for this species is classified as Data Deficient. Although there are established, nonnative populations there is no information on impacts in areas of introduction. The species does not appear to be in trade.

5 Global Distribution

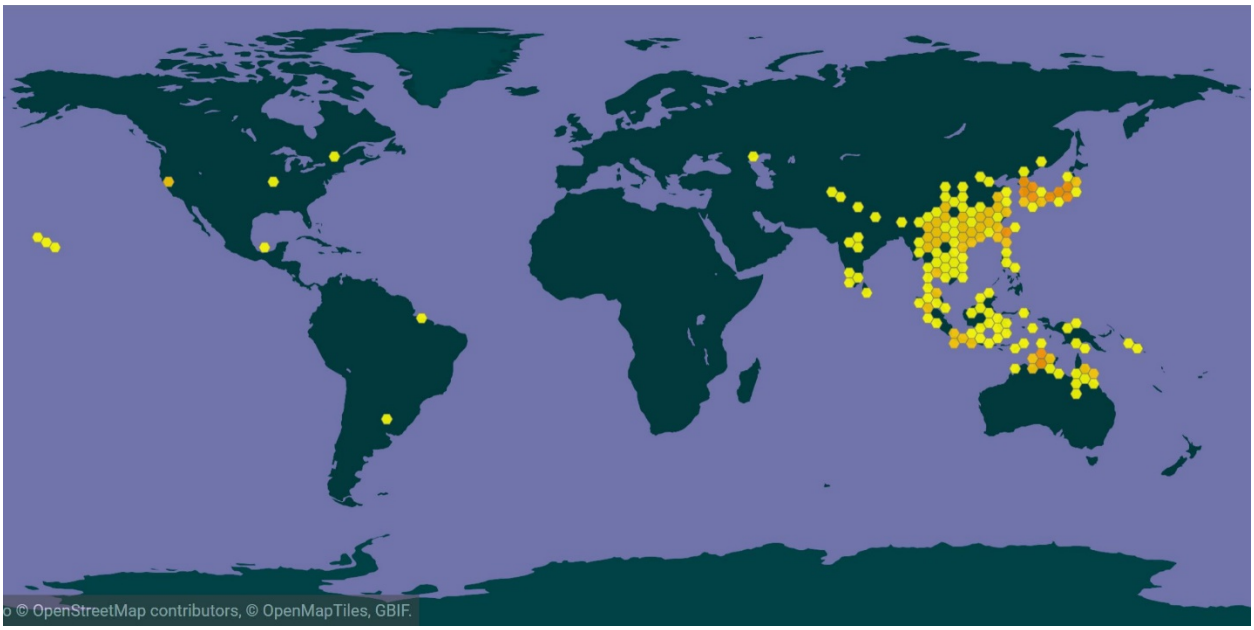

Figure 1. Known global distribution of *Monochoria vaginalis*. Observations are reported from Southern, Eastern, and Southeast Asia, Northern Australia, with scattered locations in North America, South America, Hawaii, and western Russia. Map from GBIF Secretariat (2021). Occurrence locations reported in Missouri, Quebec, Mexico, Brazil, Argentina, and western Russia were not used as source locations in the climate match as no literature was found to indicate established populations were present at these locations.

6 Distribution Within the United States

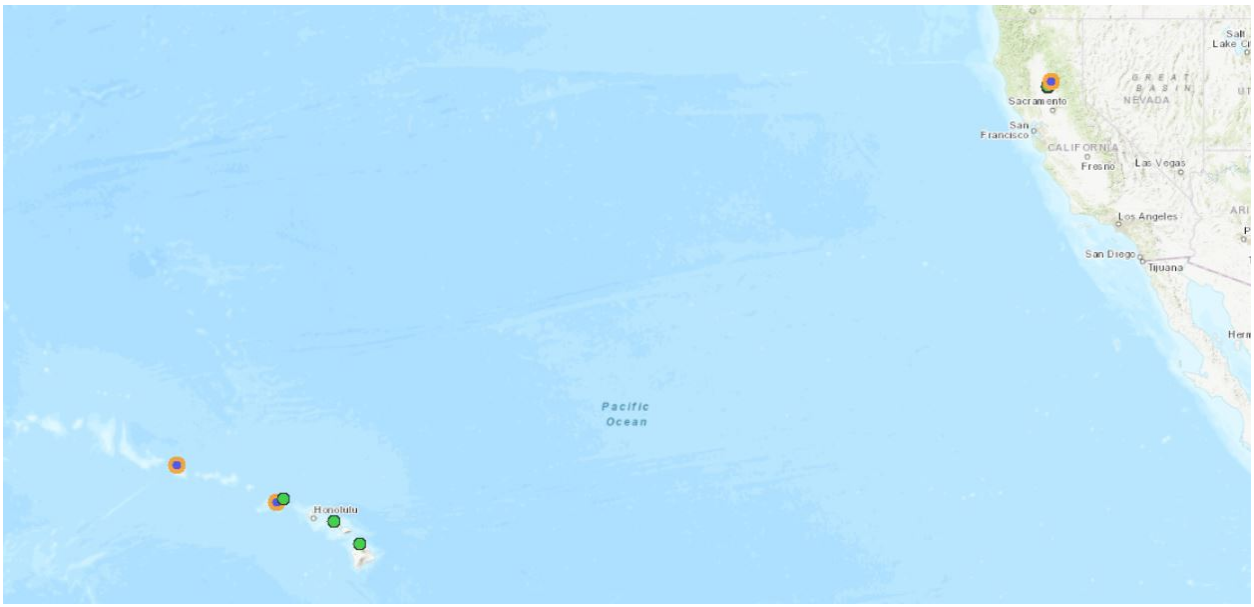

Figure 2. Known distribution of *Monochoria vaginalis* in the United States. Map from BISON (2021). In California, *M. vaginalis* has been reported north of Sacramento. In Hawaii, it has been reported on the islands of Hawai'i, Moloka'i, and Kauai. The farthest west location was not used in the climate match as it is not located on an island.

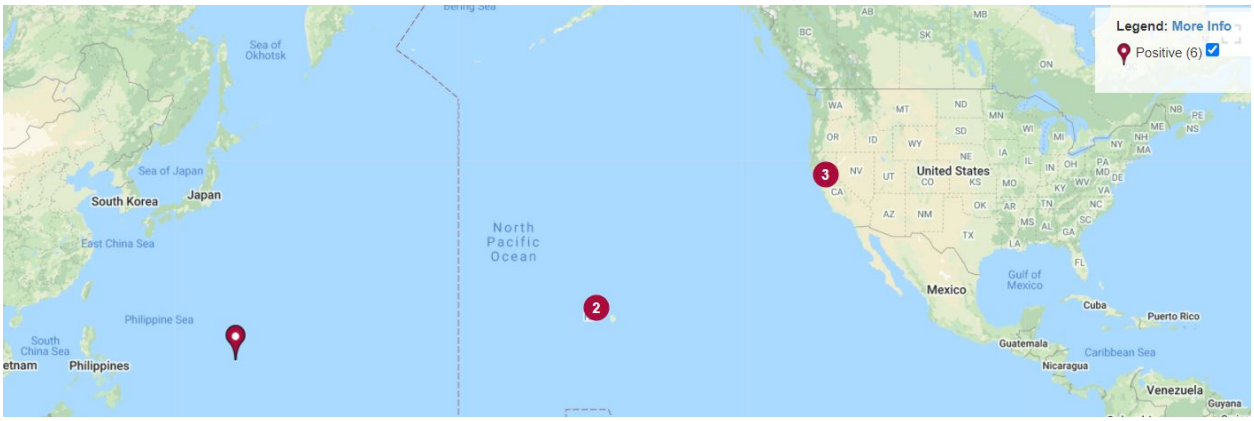

Figure 3. Additional map of known distribution of *Monochoria vaginalis* in the United States. Map from EDDMapS (2021). Locations are in California, Hawaii, and Guam. Location in Guam will not be used in the climate match as no further information has been documented to indicate an established population.

7 Climate Matching

Summary of Climate Matching Analysis

A majority of the contiguous United States had a medium to high climate match. High match was generally found in the Central United States from the northern border to the southern border including the Midwest and southern Appalachian Mountain region, along the interior southern

Pacific Coast, and along the majority of the southern Atlantic Coast from Virginia to Florida. Most of the mid-Atlantic, the Great Lakes, and much of the Rocky Mountains had medium matches. Areas of low match were found in the Northeast, Pacific Northwest, the interior of the Southeast, and in small patches in the Rocky Mountains. All remaining areas generally had medium match. The overall Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.537, high. (Scores of 0.103 and greater are classified as high.) The following States had medium individual Climate 6 scores: Alabama, Arkansas, New York, Utah, and Washington. The following States had low individual Climate 6 scores: Connecticut, Louisiana, Massachusetts, Maine, Mississippi, New Hampshire, Rhode Island, and Vermont. All other States had high individual scores.

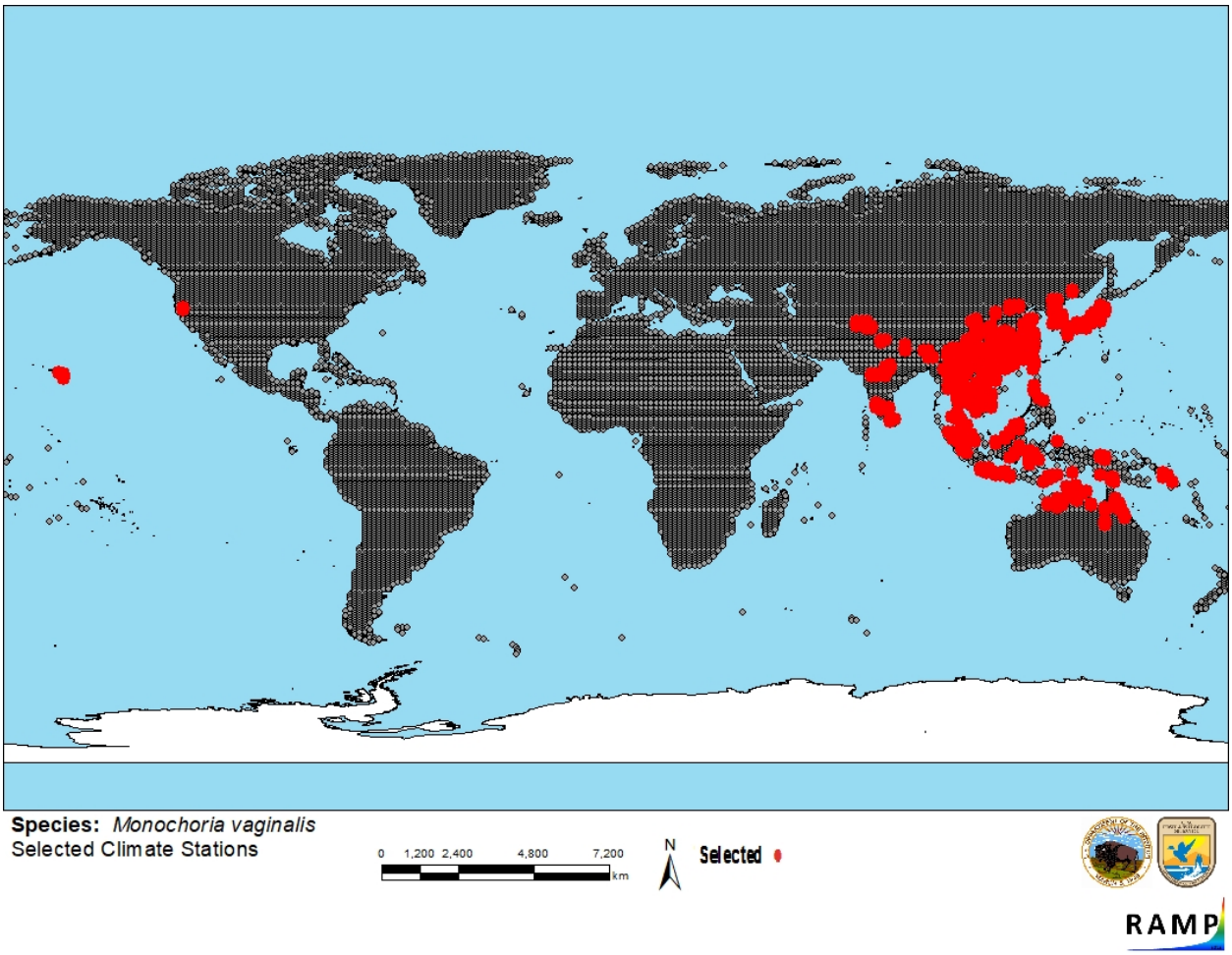

Figure 4. RAMP (Sanders et al. 2018) source map showing weather stations in Eastern Asia and the United States selected as source locations (red; India, Sri Lanka, Nepal, Bhutan, Myanmar, Thailand, Cambodia, Vietnam, Laos, China, Taiwan, North Korea, South Korea, Japan, Malaysia, Indonesia, Papua New Guinea, Solomon Islands, Australia, and in Hawaii and California in the United States) and non-source locations (gray) for *Monochoria vaginalis* climate matching. Source locations from GBIF Secretariat (2021). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

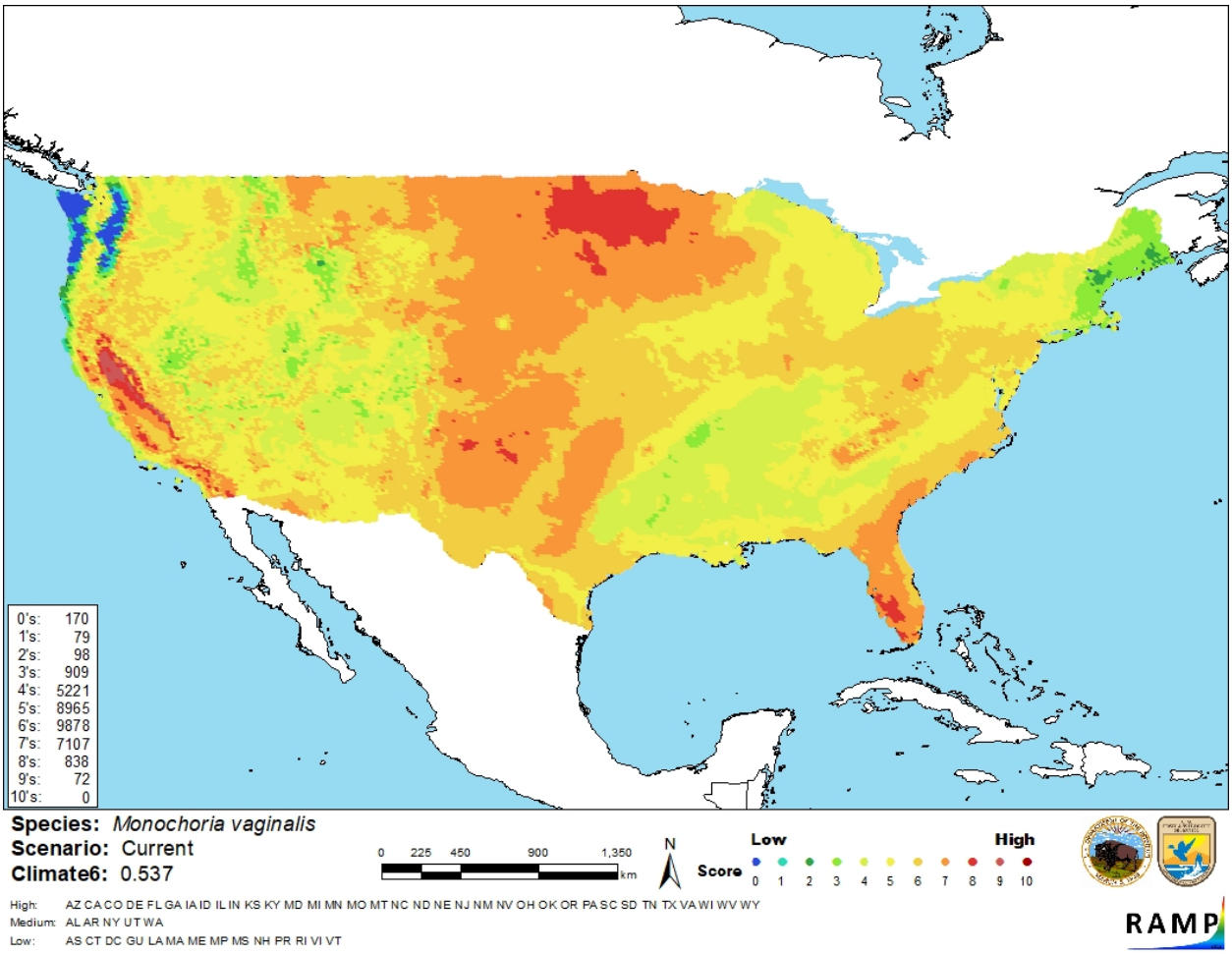

Figure 5. Map of RAMP (Sanders et al. 2018) climate matches for *Monochoria vaginalis* in the contiguous United States based on source locations reported by GBIF Secretariat (2021). Counts of climate match scores are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

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≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

Adequate biological, ecological, and distribution information was available about *Monochoria vaginalis*. No actual impacts of introduction have been documented, only information on potential impacts is available. Given the lack of information regarding actual impacts of introductions, the certainty of assessment for this species is Low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Monochoria vaginalis, Heartshape false pickerelweed, is a rooted flowering aquatic plant native to aquatic habitats of Southern, Eastern, and Southeast Asia, as well as Northern Australia. There was no indication that this species is in the ornamental trade, but it has been commonly reported as a contaminate in rice seed. Within the native range it is used as a food source for both humans and livestock, as well as in traditional medicine. Also within the native range, *M. vaginalis* is a weed of rice paddies, causing economic losses. This species has been introduced to the United States, and established populations can be found in California and Hawaii. It is listed as a Federal Noxious Weed and is also on multiple State prohibited lists. It has also been introduced to and become established Fiji. Pathways of these introductions are unknown. *M. vaginalis* is on the Federal Noxious Weed List and several State noxious weed and prohibited plant species lists including Alabama, California, Florida, Indiana, Massachusetts, North Carolina, Oregon, South Carolina, Texas, and Vermont. The history of invasiveness for this species is Data Deficient due to the lack of information on impacts of introductions. The overall climate match for the contiguous United States was High, with high match occurring in the Central United States from the northern border to the southern border including the Midwest and southern Appalachian Mountain region, along the interior southern Pacific Coast, and along the majority of the southern Atlantic Coast from Virginia to Florida. The certainty of assessment was Low due to the lack of information regarding actual impacts of introduction. The overall risk assessment category for *Monochoria vaginalis* 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 species is listed as a Federal Noxious Weed.
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

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11 Literature Cited in Quoted Material

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