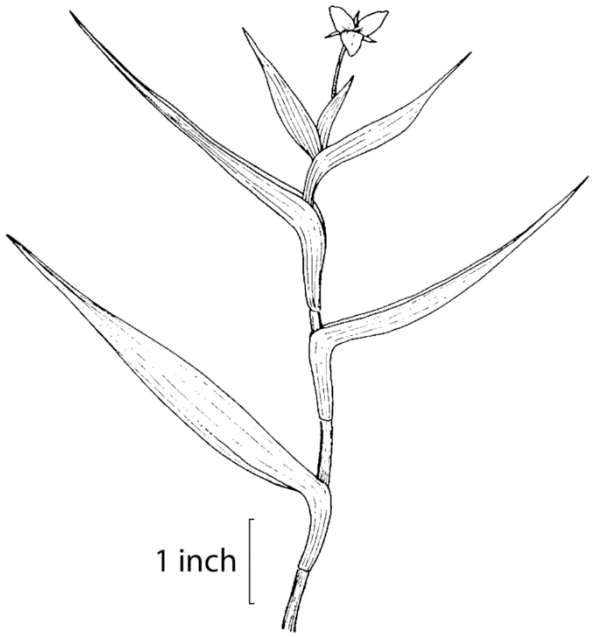
Marsh Dewflower (*Murdannia keisak*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, December 2022
Revised, May 2023
Web Version, 4/11/2024

Organism Type: Flowering Plant
Overall Risk Assessment Category: High



Drawing: USDA, NRCS. Public domain. Available: https://plants.usda.gov/home/plantProfile?symbol=MUKE (December 2022).

1 Native Range and Status in the United States

Native Range

From POWO (2022):

"Native to: Amur [Russia], China Southeast, Japan, Khabarovsk [Russia], Korea, Laos, Manchuria [China], Nansei-shoto [Japan], Nepal, Primorye [Russia], Taiwan, Vietnam"

Status in the United States

From POWO (2022):

"Introduced to: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oregon, South Carolina, Tennessee, Virginia, Washington"

According to USGS (2024), *Murdannia keisak* is established in the following states: Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, New Jersey, North Carolina, Oregon, South Carolina, Tennessee, Virginia, Washington, and West Virginia.

From Dunn and Sharitz (1990):

"The first published account of *Murdannia keisak* in the U.S. was in 1935 (Hotchkiss 1940) from Minim Island in the Santee River delta (Georgetown County, South Carolina); however, an earlier specimen from Louisiana (dated 1927) is in the New York Botanical Garden herbarium (P. Holmgren, pers. comm.)."

From Jordan et al. (2008):

"This species appears to still be expanding its range in the United States (Dunn & Sharitz, 1990; Flora of North America Editorial Committee, 2000). Furthermore, its native range indicates that it is hardy enough to occur in New York (Zheng & Raven, 2000; Flora of Korea Editorial Committee, 2007)."

From Ferrero et al. (2012):

"*Murdannia keisak* (Hassk.) Handel-Mazz., also known as *Aneilema keisak* or by the common name Marsh dayflower, has been reported as a weed in South Carolina cultivated rice paddies (Swearingen et al., 2002), and has become established and naturalised in other cultivated or natural areas (Dunn and Sharitz, 1990a, Dunn and Sharitz, 1990b) of the USA."

Murdannia keisak is present in the aquarium trade in the United States. For example, it is available for sale from U.S.-based online retailers Aquarium Roots ($15.99 per potted plant; Aquarium Roots 2024) and Aquarium Plants Factory ($12.99 for bunched plants; Aquarium Plants Factory 2024).

Regulations

Murdannia keisak is listed as a quarantine species in Washington (Washington State Noxious Weed Control Board 2020), an invasive species in Delaware (Delaware Code 2022), and a prohibited species in New York (New York Department of Environmental Conservation 2022).

While effort was made to find all applicable regulations, this list may not be comprehensive.

Means of Introductions within the United States

From Dunn and Sharitz (1990):

"It appears likely that *Murdannia keisak* was introduced into the U.S. with rice culture, but did not spread from former rice fields until recently. The first line of evidence for such introduction includes strikingly similar vegetation in disturbed wetlands in southeast Asia and in the southeastern U.S., such as on the Savannah River floodplain in South Carolina."

From Buthod and Hoaglund (2013):

"[…] the presence of *Murdannia keisak* in Oklahoma may be attributed to waterfowl. *M. keisak* can produce 9,000-70,000 seeds/m^2, and they have been found in great abundance in the stomachs of ducks (Dunn and Sharitz 1990a; Hotchkiss 1940, 1951)."

Remarks

Other common names used for *Murdannia keisak* include aneilema (Virginia DCR and the Virginia Native Plant Society 1999), Asian dayflower (EPPO 2024), Asian spiderwort (Stahlman 2016), and marsh dayflower (Tennessee Invasive Plant Council 2022).

From Tennessee Invasive Plant Council (2022):

"*Commelina erecta* L., Slender Dayflower, is a native perennial from Tennessee that is very similar in size, flower color and weak succulent stem [to *M. keisak*]. The difference, other than it's native, is that it grows in dry soils along roadsides and wood edges. *Commelina virginica* L., Virginia Dayflower, is a native perennial from Tennessee that is similar is flower color but it much larger in size getting up to 4 feet in height. It grows in moist or wet woods. *Tradescantia virginiana* L., Virginia Spiderwort, is also a native perennial from Tennessee very similar to Marsh Dayflower but it is found mostly in moist woods."

From Pellegrini et al. (2016):

"[The *Murdannia keisak* complex] is a widely distributed species complex, being very common and well collected in Asia. Nevertheless, the morphologic limits between *M. keisak* and *M. triquetra*, as well as the application of these names, varies greatly according to each author. […] It is the authors [of this article's] opinion that a study focusing on the specific boundaries between these taxa is necessary."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2022):

Kingdom Plantae
  Subkingdom Viridiplantae
    Infrakingdom Streptophyta

Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophyta
Class Magnoliopsida
Superorder Lilianae
Order Commelinales
Family Commelinaceae
Genus *Murdannia*
Species *Murdannia keisak* (Hassk.) Hand.-Mazz.

According to WFO (2022), *Murdannia keisak* is the current valid name for this species. Synonyms for *Murdannia keisak* include *Aneilema aquetii*, *Aneilema coreanum*, *Aneilema keisak*, *Aneilema oliganthum*, and *Phaeleilema oliganthum*.

Size, Weight, and Age Range

From Chowdhury et al. (2015):

"Perennial, thick mat forming herbs. […] Stems creeping proximally, ascending distally, branched to 41 cm; […]"

From Virginia DCR and the Virginia Native Plant Society (1999):

"[…] prostrate stems 12 to 30 inches long, rooting at the lower nodes, with upturned tips. The alternate leaves taper rapidly from the sheath to a very narrow blade 1 to 2½ inches long."

Environment

From Stahlman (2016):

"It can be found in water depths of up to 7.5 cm (3 in)."

"Most common in coastal marshes, Asian spiderwort [*M. keisak*] can also be found inland in freshwater marshes, ditches, creeks, rivers, swamps, bogs and along the edges of ponds, lakes, and streams."

Climate

From Pellegrini et al. (2016):

"The genus [*Murdannia*] has a Pantropical and Warm Temperate distribution […]"

From Jordan et al. (2008):

"This species appears to still be expanding its range in the United States (Dunn & Sharitz, 1990; Flora of North America Editorial Committee, 2000). Furthermore, its native range indicates that it is hardy enough to occur in New York (Zheng & Raven, 2000; Flora of Korea Editorial Committee, 2007)."

Distribution Outside the United States

Native

From POWO (2022):

"Native to: Amur [Russia], China Southeast, Japan, Khabarovsk [Russia], Korea, Laos, Manchuria [China], Nansei-shoto [Japan], Nepal, Primorye [Russia], Taiwan, Vietnam"

Introduced

From Ferrero et al. (2012):

"In Italy *M. keisak* was first found in 1974 (Pignatti, 1982) in spontaneous vegetation; significant rice field infestations have only been reported since the late '90s (Berti et al., 2006; Tesio et al., 2004)."

From Chowdhury et al. (2015):

"[…] the present report of occurrence of *Murdannia keisak* from the Duars of Jalpaiguri [eastern India] is now treated for its first record for India."

From Pellegrini et al. (2016):

"In South America, it [*M. keisak*] is known from only two collections, one from Venezuela and one from Colombia."

PlantNET (2024) reports *Murdannia keisak* as naturalized occasionally in New South Wales, Australia.

Means of Introduction Outside the United States

No information available.

Short Description

From Stahlman (2016):

"Asian spiderwort [*M. keisak*] is a shallow water succulent plant and member of the dayflower family. It produces long trailing shoots that root at nodes, […]"

From Swearingen et al. (2010):

"It is a low growing, sprawling herbaceous plant with lance-shaped leaves and small solitary flowers with three equal sized petals that are pink to bluish in color. Flowers are borne in the upper leaf axils beginning in late summer (September). Fruits are capsules."

Biology

From Swearingen et al. (2010):

"It prefers damp soil along the edges of freshwater tidal marshes, pond margins and slow-moving streams and can also be found inhabiting stream banks, canals, ditches, swamp forests, and other moist to wet disturbed places. Its vigorous growth enables it to out-compete native plants by forming dense mats. Seeds are dispersed by wildlife and it can spread by root fragments during flood events."

Human Uses

From EPPO (2024):

"Cultivated as an aquarium plant, and recently introduced as such into Europe"

Murdannia keisak is present in the aquarium trade in the United States. For example, it is available for sale from U.S.-based online retailers Aquarium Roots ($15.99 per potted plant; Aquarium Roots 2024) and Aquarium Plants Factory ($12.99 for bunched plants; Aquarium Plants Factory 2024).

Diseases

No information was found on diseases associated with *Murdannia keisak*.

Threat to Humans

No information was found on threats to humans from *Murdannia keisak*.

3 Impacts of Introductions

From Knapp (2011):

"At one site in coastal Delaware just a few miles from the Maryland line, marsh dayflower has become so abundant it is now the dominant plant. This dominance has left little physical habitat for native plants and is believed to be the reason for the decline of many rare plant species located in these wetlands."

From Buthod & Hoagland (2013):

"According to Newberry (1991), *Murdannia keisak* may reduce rates of water flow because of its rhizomatous growth and fibrous roots. It grows fast and forms a thick mat, allowing it to outcompete native vegetation (Ferrero et al. 2012). It has also been shown to easily adapt to different environmental conditions (Dunn & Sharitz 1991)."

From North Carolina Aquatic Nuisance Species Management Plan Committee (2015):

"Impacts and Uses of Marsh Dayflower in NC
Ecological: Alters native habitat by outcompeting native emerged vegetation.

Economic: Can inhibit shoreline access for recreation and impede water intakes. Impedes navigation in waterways; impacts recreational activities and fouls water intakes"

From Virginia Department of Conservation and Recreation and the Virginia Native Plant Society (1999):

"The aggressive nature of this plant has now been clearly displayed by its ability to establish itself in freshwater wetlands and crowd out native vegetation by forming a solid mat of vegetation. Even in its native region, this species is a troublesome weed. Not only does it produce thousands of very small seeds, it can reproduce vegetatively."

From Ferrero et al. (2012):

"The ability of this plant to out-compete native vegetation is mainly caused by its fast growth and its development of a dense canopy mat (King et al., 2000; Rundell and Diamond, 1999). According to Dunn and Sharitz (1991), the flexibility of *M. keisak* allows it to adapt readily to new environments. *M. keisak* is considered invasive in marshes, swamps, ditches, creek and riverbanks, and around ponds and lakes as it rapidly crowds out desired native herbaceous vegetation by forming dense floating pads. Even in its native areas, this species is a difficult paddy field weed as it grows rapidly in shade rather than in full sun (Dunn and Sharitz, 1990a, Dunn and Sharitz, 1990b)."

Murdannia keisak is listed as a quarantine species in Washington (Washington State Noxious Weed Control Board 2020), an invasive species in Delaware (Delaware Code 2022), and a prohibited species in New York (New York Department of Environmental Conservation 2022).

4 History of Invasiveness

The History of Invasiveness for *Murdannia keisak* is classified as High. *Murdannia keisak* was introduced to the United States in the 1930s through rice agriculture in South Carolina; from there it has spread to surrounding States. The species is established in multiple States outside of its native range. It forms dense floating mats, crowding out native vegetation and reducing rates of water flow. It has also been reported to impede shoreline access, waterway navigation, and recreational activities and to clog water intakes.

5 Global Distribution

Figure 1. Reported global distribution of *Murdannia keisak*. Map from GBIF Secretariat (2023). Observations are reported from the United States, Italy, Colombia, Eastern Asia, and Oceania. Points in Tibet, Indonesia, the Solomon Islands, and Colombia are not known to represent established populations and were excluded from the climate matching analysis.

An additional georeferenced occurrence was available for India from Chowdhury et al. (2015).

6 Distribution Within the United States

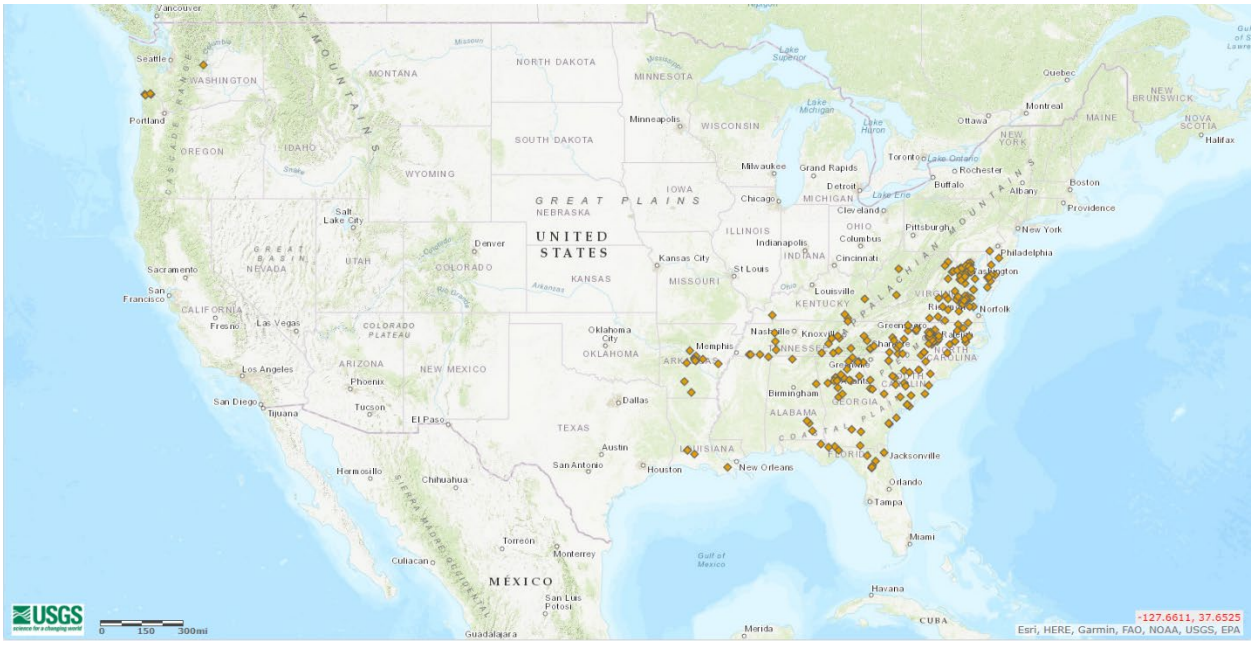


Figure 2. Reported established distribution of *Murdannia keisak* in the United States. Map from NAS (2022). Observations are reported from Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, New Jersey, North Carolina, Oregon, South Carolina, Tennessee, Virginia, Washington, and West Virginia.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Murdannia keisak* was very high in the Southeast and Mid-Atlantic regions of the contiguous United States, from New Jersey south to Florida and west to eastern Texas, also extending into the southern Midwest. Other areas of high climate match were found in northwestern Minnesota and eastern North Dakota, as well as from the Pacific Northwest south and east into the Great Basin. Areas with a lower climate match were found in the Rocky Mountains, the Sonoran Desert, and in small areas of the Cascade Mountains and Olympic Peninsula in Washington. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.849, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Murdannia keisak* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

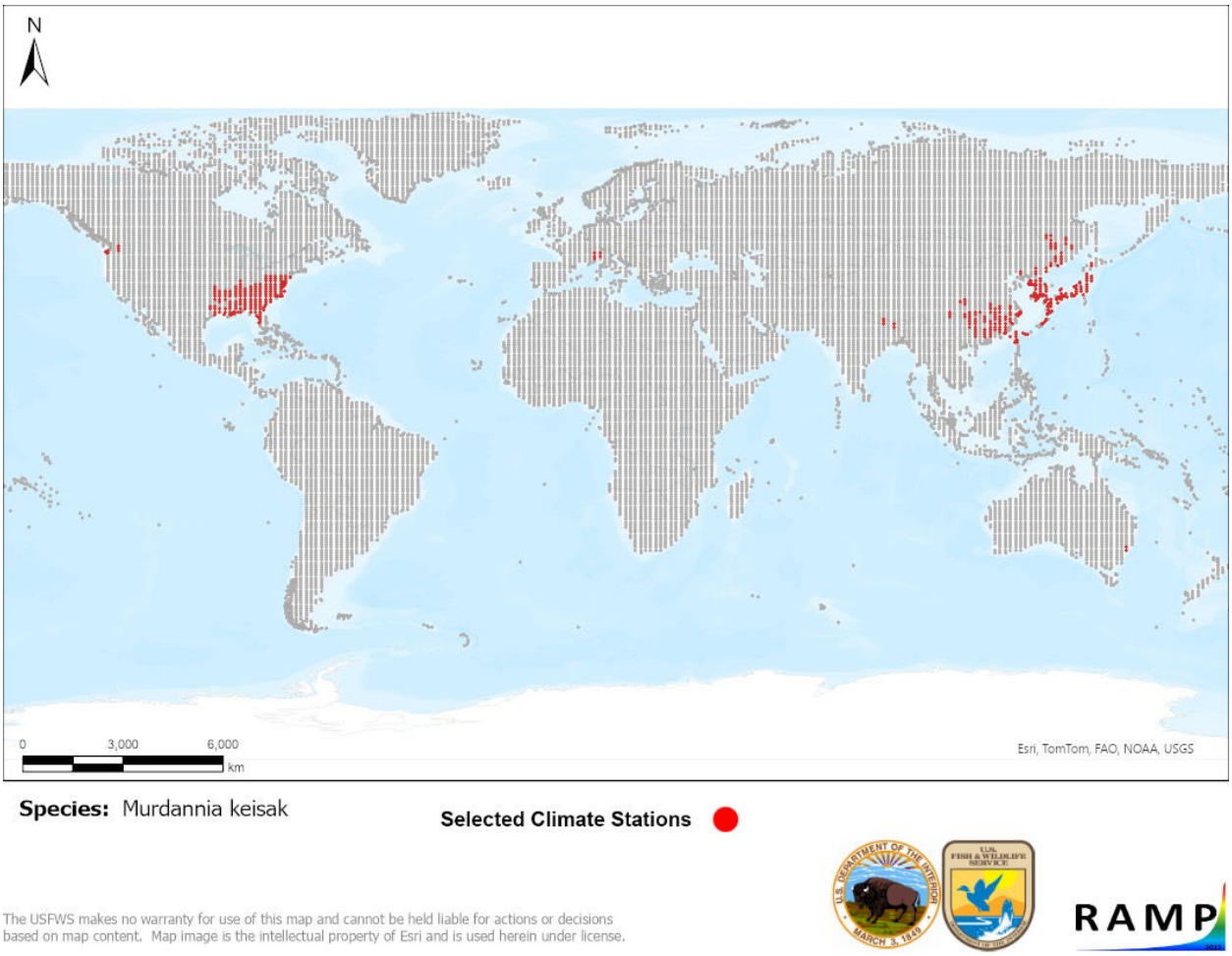


Figure 3. RAMP (Sanders et al. 2023) source map showing global weather stations selected as source locations (red; United States, Italy, Nepal, India, China, Taiwan, Russia, Japan, North Korea, South Korea, Australia) and non-source locations (gray) for *Murdannia keisak* climate matching. Source locations from GBIF Secretariat (2023) and Chowdhury et al. (2015). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

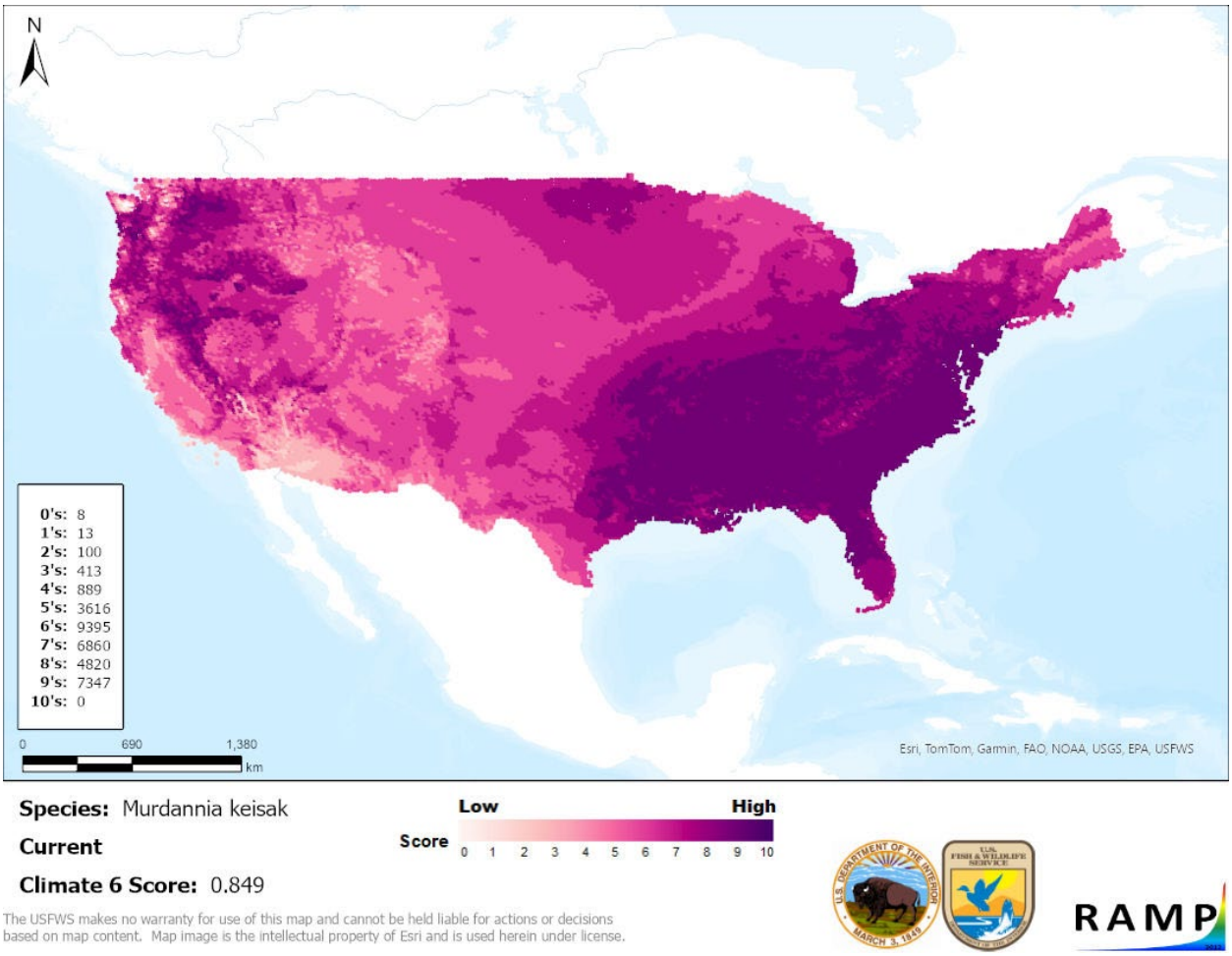


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Murdannia keisak* in the contiguous United States based on source locations reported by GBIF Secretariat (2023) and Chowdhury et al. (2015). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Murdannia keisak* is classified as Medium. There is sufficient information available on the distribution, biology, and ecology of the species. There is also widespread agreement in the literature that *Murdannia keisak* has negative impacts on native flora where introduced, but relatively few data were found to confirm the severity of these impacts.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Murdannia keisak, marsh dewflower, is a flowering plant that is native to eastern Asia. It grows in damp soils around wetlands and streams and forms thick mats that can exclude other vegetation. The plant was most likely introduced into the United States as a contaminant of rice and was first documented in the 1930s in a rice paddy in South Carolina. *M. keisak* has been

shown to outcompete native vegetation and has spread across the eastern portion of the country, as well as in Washington and Oregon. Three U.S. States regulate *M. keisak* as a prohibited, invasive, or quarantine species. The History of Invasiveness for *M. keisak* is classified as High. The climate matching analysis for the contiguous United States indicates establishment concern for this species. The highest climate matches were found where this species is currently established in the Southeast, Mid-Atlantic, and Pacific Northwest regions. The Certainty of Assessment for this ERSS is classified as Medium due to few scientific studies with data to support claims of the negative impacts of introduction of the species. The Overall Risk Assessment Category for *Murdannia keisak* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see section 4): High**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (see section 8): Medium**
- **Remarks, Important additional information: None**
- **Overall Risk Assessment Category: High**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2023) and Chowdhury et al. (2015).

Under the future climate scenarios (figure A1), on average, high climate match for *Murdannia keisak* was projected to occur throughout the eastern third of the contiguous United States. In the western United States, high climate matches were also found along the eastern edge of the Cascade and Sierra mountain ranges under all scenarios. At the 2085 time step, the high climate matches shifted northward in the eastern United States, leaving Florida and the Gulf Coast with medium-high match. Low climate matches were found for the Southwest and much of California under all scenarios. Under the most extreme scenario, SSP5 in 2085, areas of low match also appeared scattered through the western Great Plains. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.551 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.811 (model: MPI-ESM1-2-HR, SSP5, 2055). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future climate scenarios. The Climate 6 score for the current climate match (0.849, figure 4) falls above the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085 (figure A3). Under all time step and climate scenarios, areas within the Colorado Plateau, Western Mountains, Great Lakes, and Northeast had areas of moderate increase in the climate match relative to current conditions. At the 2085 time step, there were large increases in the climate match relative to current conditions in northern Colorado, and at the 2085 time step for SSP5, there were large increases relative to current conditions in northeastern Minnesota. Areas within California, the Great Basin, and Western Mountains saw a decrease in the climate match relative to current conditions under all scenarios. The decrease in climate match for these regions was moderate to large at the 2085 time step. Additionally, areas within the Appalachian Range, Colorado Plateau, Gulf Coast, Mid-Atlantic, Northern Pacific Coast, Northern Plains, Southeast, Southern Plains, and Southwest saw a moderate decrease in the climate match relative to current conditions. The change in climate match was more extreme, whether increasing or decreasing, at time step 2085 than at time step 2055.

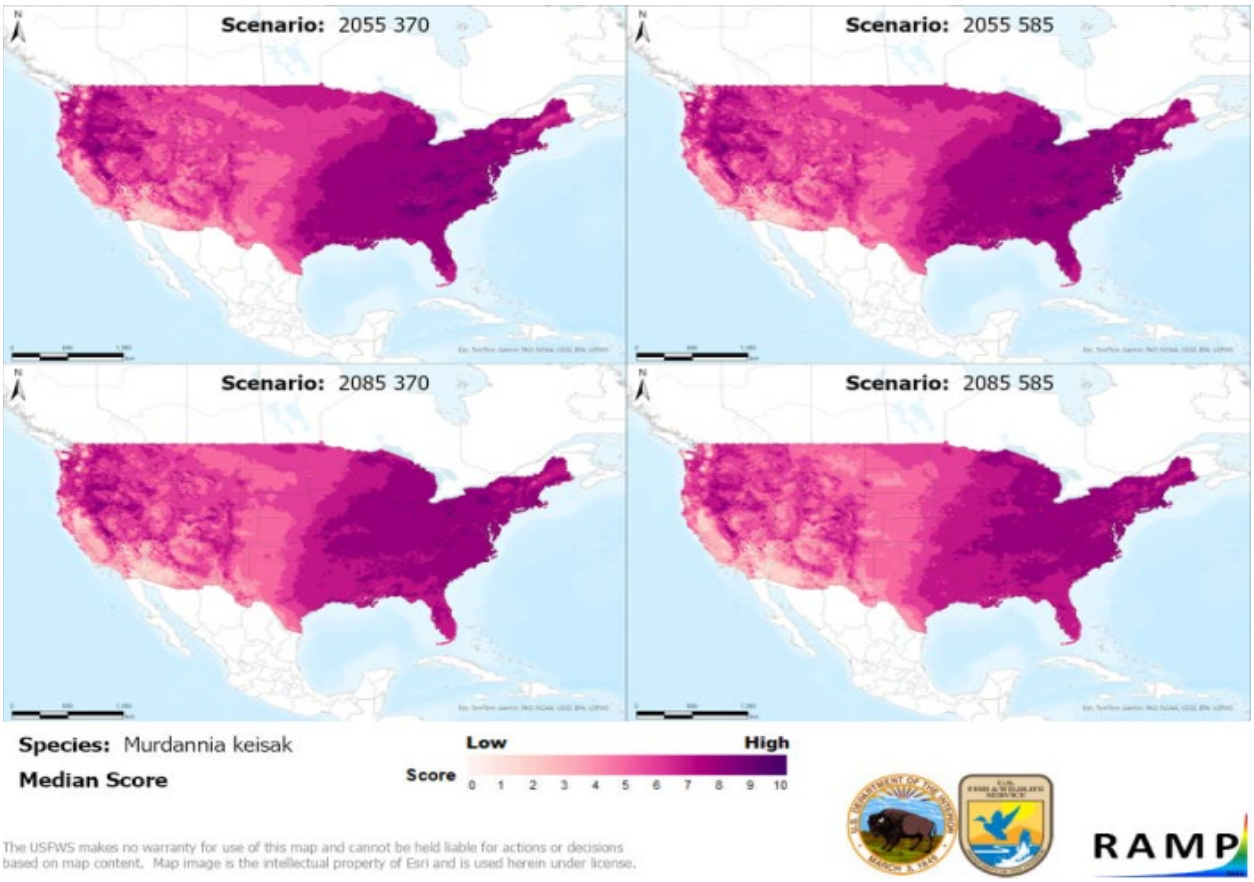

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Murdannia keisak* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023) and Chowdhury et al. (2015). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

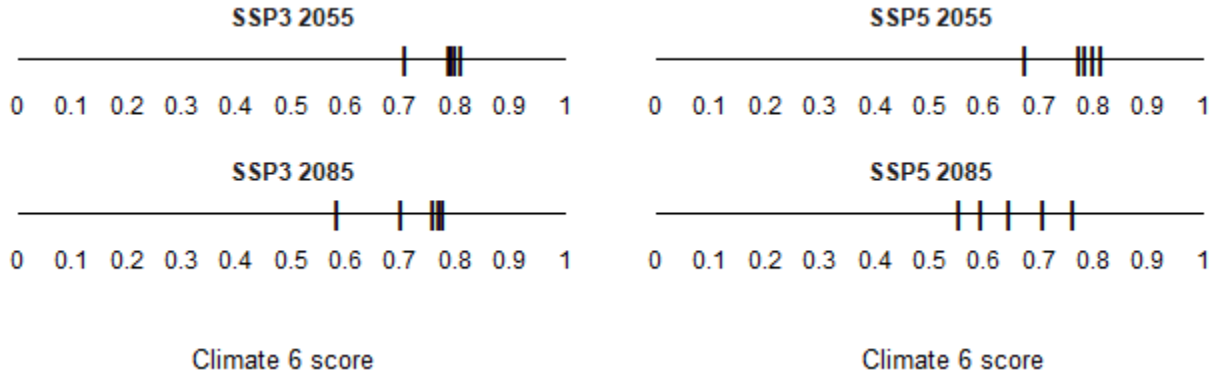

Figure A2. Comparison of projected future Climate 6 scores for *Murdannia keisak* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

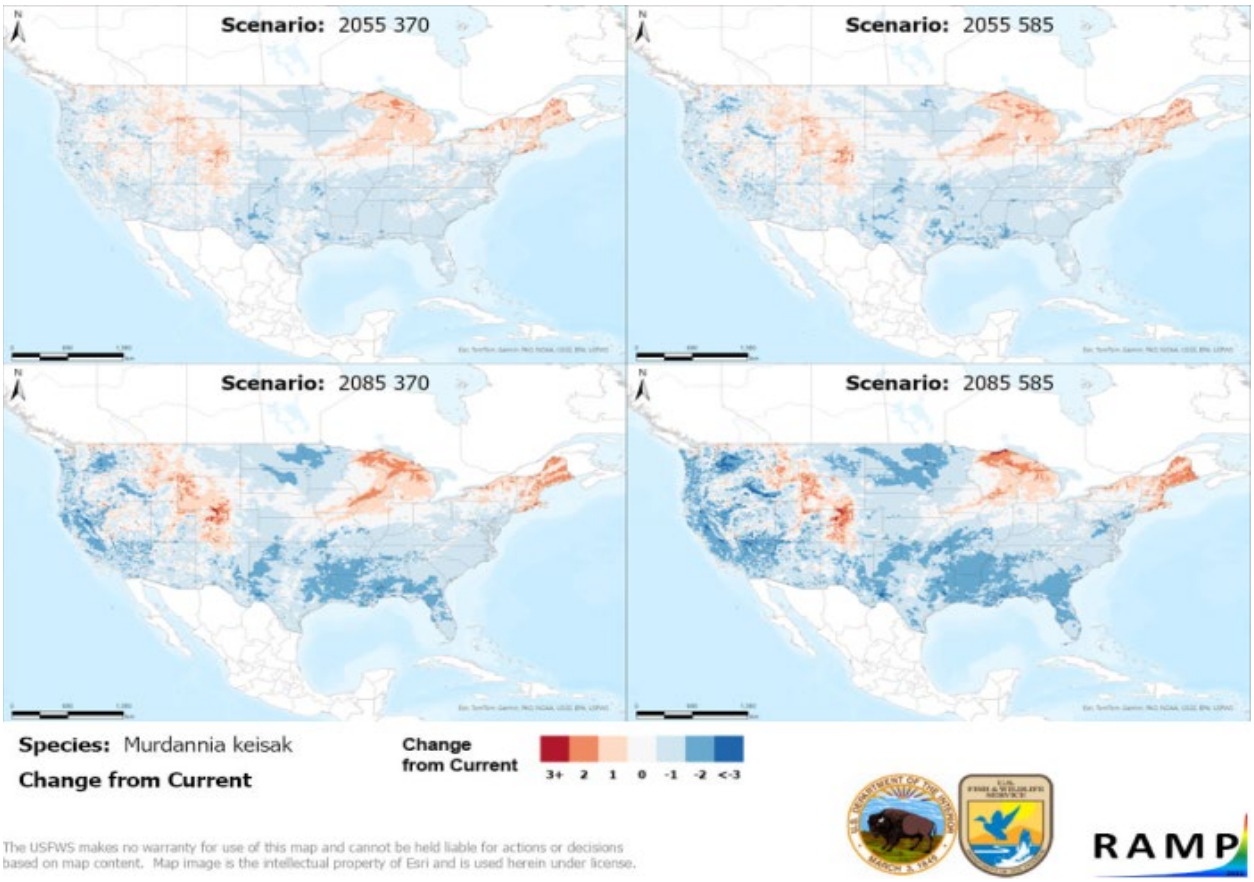

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Murdannia keisak* based on source locations reported by GBIF Secretariat (2023) and Chowdhury et al. (2015). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

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