

Grand Redstem (*Ammannia robusta*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2023

Revised, May 2023

Web Version, 3/29/2024

Organism Type: Flowering Plant

Overall Risk Assessment Category: Uncertain



Photo: Betty Nellums. Licensed under CC BY-NC-SA 3.0. Available:
<http://www.worldfloraonline.org/image/127306> (March 2023).

1 Native Range and Status in the United States

Native Range

According to Maiz-Tome (2016), *Ammannia robusta* is native to Canada (British Columbia, Ontario), Mexico, and the United States (Arizona, Arkansas, California, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, North Dakota, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Utah, Washington, Wisconsin, Wyoming).

From Salive (2020):

“[*Ammannia robusta*] occurs most abundantly north of Mexico from North Dakota and Western Minnesota south to Oklahoma, extending sporadically into Texas, Northern Arkansas and Tennessee (Kartesz 2015). It also ranges into the west where it is unevenly distributed from Colorado to California becoming rare in the northwest from Wyoming to British Columbia. Additional populations are found in the Great Lakes region from Wisconsin east to Southern Ontario and south to Southern Ohio (Kartesz 2015) [...]”

From Douglas (1999):

“*Ammannia robusta* ranges from south-central British Columbia south through Nebraska, Minnesota and Ohio to most of the extreme southern U.S.A. and Mexico. It also occurs in tropical Central America (Hitchcock and Cronquist 1961; Douglas et al. 1990, Hickman 1993). In British Columbia, it is restricted to the Osoyoos Lake area.”

Status in the United States

Maiz-Tome (2016) lists *Ammannia robusta* as native to the following States: Arizona, Arkansas, California, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, North Dakota, Ohio, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Utah, Washington, Wisconsin, and Wyoming.

From Salive (2020):

“*A. robusta* has been introduced to Hawaii [...] as a contaminant of rice (Les 2017).”

According to Graham (1985), there have been several collections of *A. robusta* in Guam and Saipan (Northern Mariana Islands) in the western Pacific.

Records were found of *Ammannia robusta* for sale in a native plant nursery’s 2022 catalog (Taylor Creek Nurseries 2022). However, this species is no longer listed for sale. No other records were found that would suggest this species to currently be available for trade in the United States.

Regulations

No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From Salive (2020):

“*A. robusta* has been introduced to Hawaii [...] as a contaminant of rice (Les 2017).”

Remarks

NatureServe (2023) lists the conservation status of *Ammannia robusta* as Vulnerable (S3) in Arizona, Imperiled (S2) in Colorado, Montana, and Wisconsin, and Critically Imperiled (S1) in Washington and Wyoming.

From Salive (2020):

“*Ammannia robusta* has legal status federally under Canada’s *Species at Risk Act*, and provincially under Ontario’s *Endangered Species Act, 2007* (ESA).”

From Douglas (1999):

“*Ammannia robusta* is easily mistaken for its close relative, also a member of Lythraceae, *Rotala ramosior*, which grows in the same habitat. Close examination of the plants will reveal that the leaves of *A. robusta* are sessile and clasping at the base, while those of *R. ramosior* gradually taper to a distinct petiole. In addition, *A. robusta* has at least some leaf axils with two or more, usually three to five flowers. *R. ramosior*, rarely has more than a single flower per leaf axil.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Rosanae
Order Myrtales
Family Lythraceae
Genus *Ammannia*
Species *Ammannia robusta* Heer & Regel

According to WFO (2023), *Ammannia robusta* is the current valid name for this species.

Size, Weight, and Age Range

From Salive (2020):

“*Ammannia robusta* is a glabrous, decumbent to erect, simple or branched summer annual ranging from 15 to 100 cm in height (Graham 1985; McClintock 1993; Douglas et al. 1999) [...]”

Environment

From Salive (2020):

“[...] *A. robusta* has been reported to develop extensive populations in fresh water to depths of 0.5 m (Graham 1985). However, it is unclear if plants established under these conditions or if water levels rose after plant establishment.”

“It is reported that seed germination of *A. robusta* takes place on warm (30 to 45°C) muddy or alluvial substrates, however there are no germination studies supporting this claim (Scarlet *Ammannia* Recovery Team 2008; Environment Canada 2015).”

“Although little is known, it appears that *A. robusta* as well as other *Ammannia* species are most often found in habitats with a pH ranging from 6.0 to 7.3 (Les 2017).”

Climate

From POWO (2023):

“[...] grows primarily in the subtropical biome.”

From Salive (2020):

“Species of *Ammannia* that occur in temperate regions tend to be found in damp to wet habitats (Booi et al. 2003). In British Columbia, Canada, the species is found in the southern Okanagan Valley, in the Osoyoos Lake area, which is characterized as a habitat with a semi-arid steppe climate, with cold winters, hot and dry summers, a relatively low annual rainfall (300 mm), and short growing seasons (Environment Canada 2015). In Ontario, *A. robusta* is found in the southernmost part of the province in Essex County. Relative to the rest of the province, this area has the mildest climate due to an influx of hot humid air from the south resulting in little frost penetration into the ground during the winter (Environment Canada 2015).”

Distribution Outside the United States

Native

Part of the native range for this species is within the United States, see section 1 for a complete description of the native range.

According to Maiz-Tome (2016), *Ammannia robusta* is native to Canada (British Columbia, Ontario) and Mexico.

From Salive (2020):

“[...] rare in the northwest [...] to British Columbia. Additional populations are found in the Great Lakes region [...] east to Southern Ontario [...] (Kartesz 2015) [...].”

From Douglas (1999):

“*Ammannia robusta* ranges from south-central British Columbia south [to] Mexico. It also occurs in tropical Central America (Hitchcock and Cronquist 1961; Douglas et al. 1990, Hickman 1993). In British Columbia, it is restricted to the Osoyoos Lake area.”

According to Smithsonian Institution (2007), *Ammannia robusta* is native in the West Indies and Lesser Antilles (Martinique; but see Distribution Outside the United States: Introduced).

Introduced

POWO (2023) lists *Ammannia robusta* as introduced into northeastern Argentina, southern Brazil, the Mariana Islands, Spain, and the southern Lesser Antilles. No information is provided on establishment status.

Singh et al. (2016) lists *Ammannia robusta* as a weed at two experimental sites (Taraori and Madhuban) in Haryana, India, but establishment status is unclear.

From Salive (2020):

“*A. robusta* has been introduced to [...] Philippines, and the South Pacific [...] (Les 2017).”

MNHN and OFB editors (2023) report *Ammannia robusta* as introduced to France and Martinique (but see Distribution Outside the United States: Native).

Valdés (2012) reports *Ammannia robusta* as naturalized in France and Italy, casual in Spain, and reported in error for Portugal. Sanz-Elorza et al. (2006) and Aymerich and Sáez (2019) confirm naturalization (establishment) in northeastern Spain.

Means of Introduction Outside the United States

From Salive (2020):

“*A. robusta* has been introduced to [...] Philippines, and the South Pacific as a contaminant of rice (Les 2017).”

Short Description

From Douglas (1999):

“*Ammannia robusta* has oblong to oblong-lanceolate, glabrous, opposite, entire leaves which are cordate-clasping at the base and 2-8 cm long. Flowers are three to five, rarely one, in the leaf axils, the hypanthium is globose to campanulate, the stamens and style are exerted beyond the hypanthium, and the petals are deep rose-purple, approximately 3-5 mm long. The fruits are glabrous, globose, usually 4-valved, and 3-5 mm long.”

Biology

From Douglas (1999):

“*Ammannia* is predominantly an autogamous genus, although out-crossing occurs. For example, plants of *A. robusta* have amphidiploid origin, or result from hybridization (Graham 1979). [...] *Ammannia robusta* is pollinated by skippers and small bees; these animals seek nectar produced by the thickened glandular area surrounding the base of the ovary (Graham 1985). Plants emerge in summer sometime between late June and July, depending on year-to-year fluctuations. In one instance, plants had not yet emerged in early August.”

From Salive (2020):

“Euliss and Harris (1987) examined the feeding habits of northern pintails and green-winged teal and concluded that mature capsules of *A. robusta* are consumed by waterfowl after observing them in their esophagus contents. Additionally, ducks have been known to eat *A. robusta* fruits (Culver and Lemly 2013).”

Human Uses

Records were found of *Ammannia robusta* for sale in a native plant nursery’s 2022 catalog (Taylor Creek Nurseries 2022). However, this species is no longer listed for sale. No other records were found that would suggest this species to currently be available for trade in the United States.

According to Salive (2020), *A. robusta* is used as a food source by northern pintails, green-winged teal, and other game species.

Diseases

No information was found on diseases associated with *Ammannia robusta*.

Threat to Humans

Norsworthy et al. (2013) list *Ammannia robusta* in their “Ranking of the most problematic weeds of Arkansas and Mississippi rice and the importance of these weeds.”

3 Impacts of Introductions

No information available on impacts of reported introductions.

4 History of Invasiveness

The History of Invasiveness for *Ammannia robusta* is classified as Data Deficient. *A. robusta* is classified as a weed species in rice cultivation. This species has been reported as introduced outside of its native range, but no information is available on impacts of its introduction. It does not appear to currently be in trade. However, there is evidence of this species likely being sold in the past. The only regulations on *A. robusta* are those related to its status as an endangered species in Canada.

5 Global Distribution



Figure 1. Reported global distribution of *Ammannia robusta*. Map from GBIF Secretariat (2022). Observations are reported from Argentina, Belize, Brazil, Canada (British Columbia and Ontario), France, Guatemala, Martinique, Mexico, Spain, and the United States.

Reported occurrences in Argentina, Brazil, and southwestern Spain could not be confirmed to represent established populations and were therefore excluded from the climate match analysis.

No georeferenced occurrences were available for established *A. robusta* in Italy.

6 Distribution Within the United States

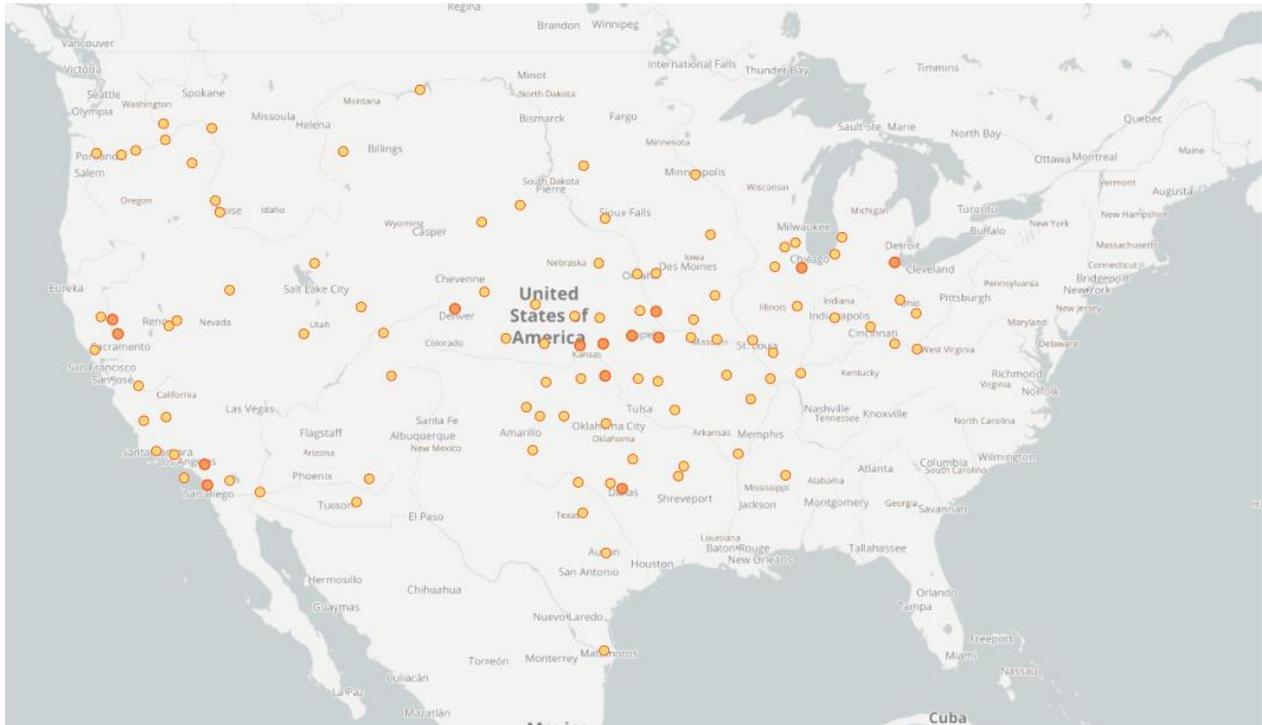


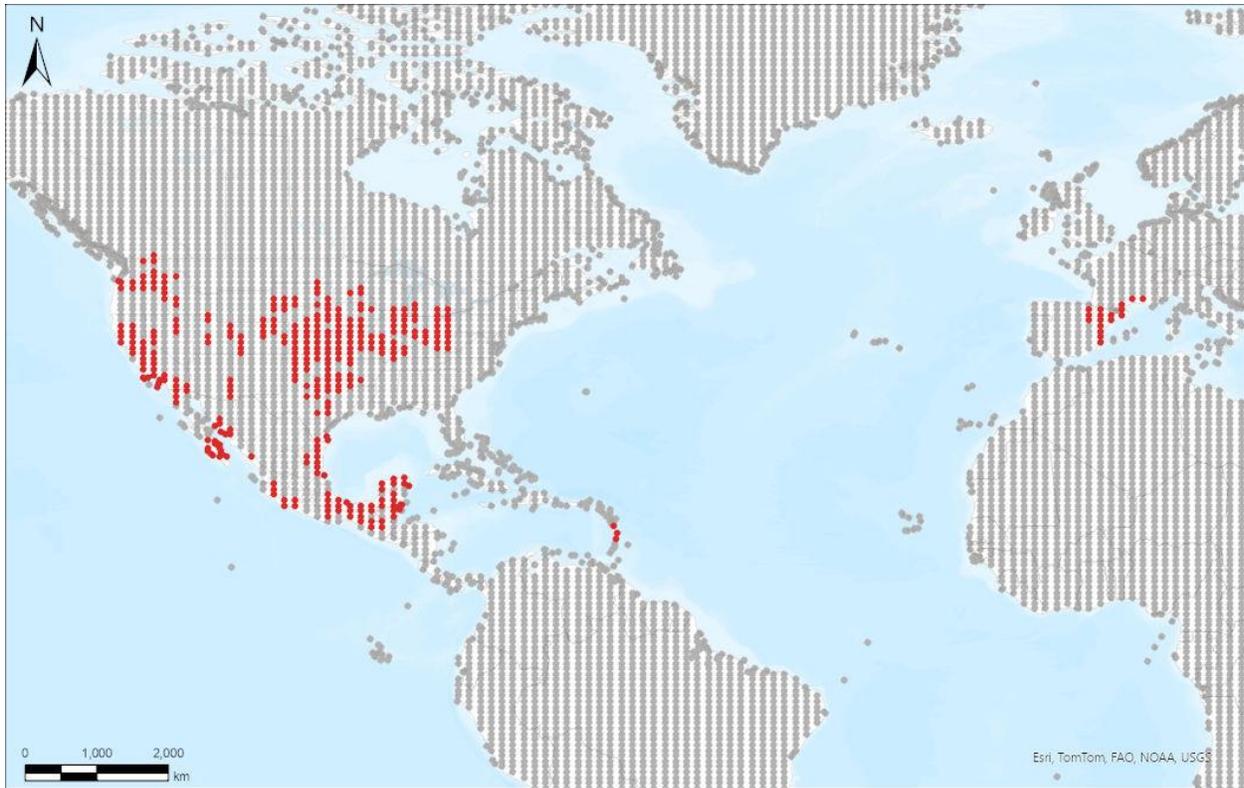
Figure 2. Reported distribution of *Ammannia robusta* in the United States. Map from GBIF-US (2023). Observations are reported from a wide area of the western and central contiguous United States with majority of occurrences emanating from California, Kansas, Missouri, Oklahoma, and Arkansas.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Ammannia robusta* was uniformly high across much of the central United States. In the western United States, the climate match was mostly high, with some small, isolated areas of medium-low match in the Pacific Northwest. In the eastern and southeastern United States, the Climate match was medium to medium-high, with small, scattered areas of low match. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.988, indicating that Yes, there is establishment concern for this species outside its native range. 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 *Ammannia robusta* (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.



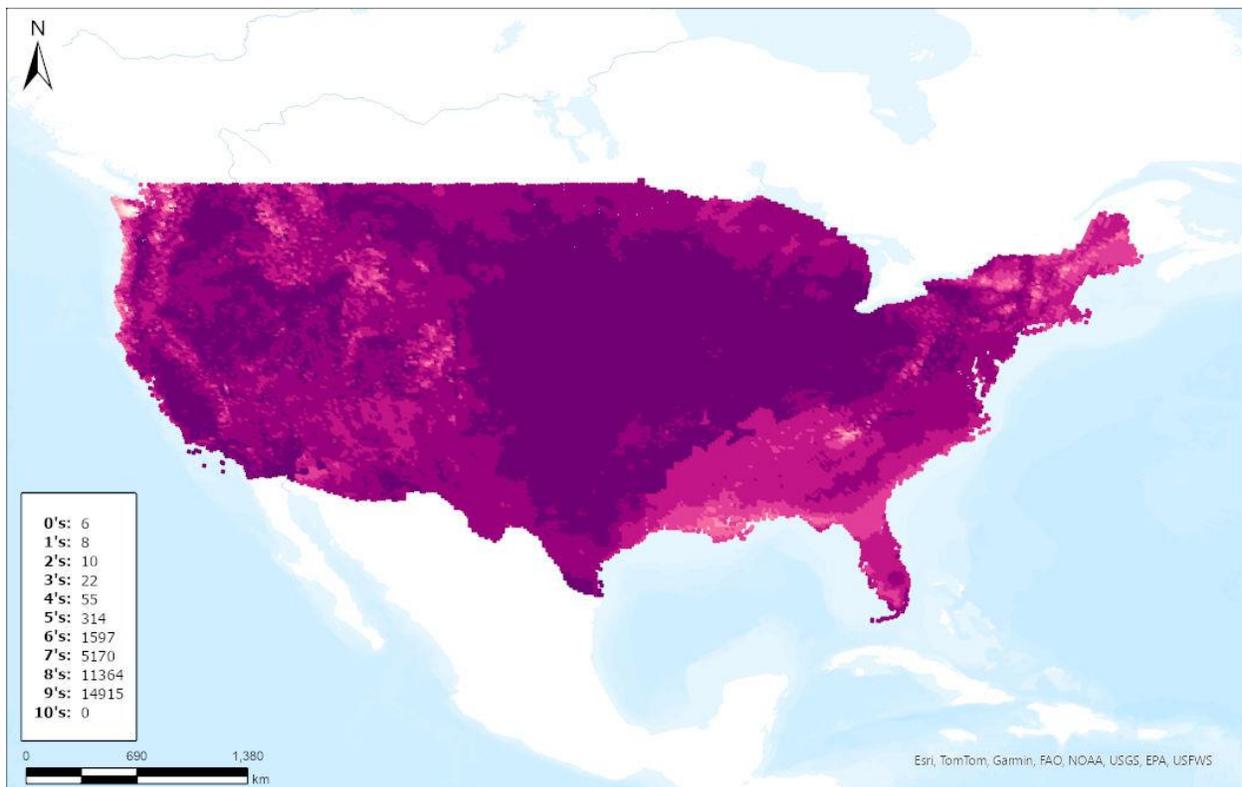
Species: *Ammannia robusta*

Selected Climate Stations ●



The USFWS makes no warranty for use of this map and cannot be held liable for actions or decisions based on map content. Map image is the intellectual property of Esri and is used herein under license.

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations selected as source locations (red; Canada, United States, Mexico, Belize, Guatemala, Martinique, France, Spain) and non-source locations (gray) for *Ammannia robusta* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.



Species: *Ammannia robusta*

Current

Climate 6 Score: 0.988



The USFWS makes no warranty for use of this map and cannot be held liable for actions or decisions based on map content. Map image is the intellectual property of Esri and is used herein under license.

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Ammannia robusta* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). 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 *Ammannia robusta* is classified as Low. Although this species has been reported as introduced outside of its native range, no impacts of its introduction have been documented. Further information is needed to adequately assess the risk this species poses to environments in the contiguous United States outside of its native range.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Ammannia robusta, Grand Redstem, is a flowering wetland plant that is native to a wide area ranging from southern Canada to Central America. This species is native to a large portion of the contiguous United States, and it has been reported as introduced to Hawaii through rice seed contamination, although no further information on current status or impact is available for Hawaii. Outside of the United States, *A. robusta* has been documented as introduced to Spain,

France, Italy, India, Argentina, Brazil, the Philippines, multiple Pacific Islands, and the Caribbean. *A. robusta* has been named a problematic weed in the rice industry in Arkansas and Mississippi, where it is a native species. However, no documentation is available on impacts or lack thereof outside the native range. The History of Invasiveness for *A. robusta* is classified as Data Deficient due to this lack of documentation of impacts from the introduced range. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range, with nearly all of the contiguous United States exhibiting a medium or high climate match. The Certainty of Assessment for this ERSS is classified as Low due to lack of information from which to assess its invasive potential. The Overall Risk Assessment Category for *A. robusta* in the contiguous United States is Uncertain.

Assessment Elements

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

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.

Aymerich P, Sáez L. 2019. Checklist of the vascular alien flora of Catalonia (northeastern Iberian Peninsula, Spain). *Mediterranean Botany* 40:215–242.

Douglas GW. 1999. Status of scarlet ammannia in British Columbia. Victoria, British Columbia: Ministry of Environment, Lands and Parks Wildlife Branch and Resources Inventory Branch. Wildlife Bulletin B-93.

GBIF Secretariat. 2022. GBIF backbone taxonomy: *Ammannia robusta* Heer ex Regel. Copenhagen: Global Biodiversity Information Facility. Available: <https://www.gbif.org/species/3188708> (March 2023).

GBIF-US. 2023. Species occurrences: *Ammannia robusta*. Available: <https://doi.org/10.15468/dl.tajq3f> (March 2023).

Graham SA. 1985. A revision of *Ammannia* (Lythraceae) in the western hemisphere. Arnold Arboretum of Harvard University. *Journal of the Arnold Arboretum* 66(4):395–420.

[ITIS] Integrated Taxonomic Information System. 2023. *Ammannia robusta* Heer & Regel. Reston, Virginia: Integrated Taxonomic Information System. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=182101#null (March 2023).

Maiz-Tome L. 2016. *Ammannia robusta*. The IUCN Red List of Threatened Species 2016. Available: <https://www.iucnredlist.org/species/64263777/67728508> (March 2023).

- [MNHN and OFB editors] Muséum national d'histoire naturelle and L'Office français de la biodiversité editors. 2023. Sheet of *Ammannia robusta* Heer & Regel, 1842. Inventaire national du patrimoine naturel (INPN). Available: https://inpn.mnhn.fr/espece/cd_nom/160299 (March 2023).
- NatureServe. 2023. NatureServe Explorer: an online encyclopedia of life. Arlington, Virginia: NatureServe. Available: <http://explorer.natureserve.org> (March 2023).
- Norsworthy JK, Bond J, Scott RC. 2013. Weed management practices and needs in Arkansas and Mississippi rice. *Weed Technology* 27(3):623–630.
- [POWO] Plants of the World Online. 2023. *Ammannia robusta* Heer & Regel. Plants of the World Online. London: Royal Botanic Gardens, Kew. Available: <https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:552767-1> (March 2023).
- Salive K. 2020. Assessing threats and mitigation for scarlet ammannia (*Ammannia robusta*) in Southwestern Ontario. Master's thesis. Waterloo, Ontario: Wilfrid Laurier University.
- Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.
- Sanz-Elorza M, Dana ED, Sobrino E. 2006. Invasibility of an inland area in NE Spain by alien plants. *Acta Oecologica* 29:114–122.
- Singh V, Jat ML, Ganie ZA, Chauhan BS, Gupta RK. 2016. Herbicide options for effective weed management in dry direct-seeded rice under scented rice-wheat rotation of western Indo-Gangetic Plains. *Crop Protection* 81:168–176.
- Smithsonian Institution. 2007. Catalogue of the seed plants of the West Indies. Available: <https://naturalhistory2.si.edu/botany/WestIndies/query.cfm> (March 2023).
- Taylor Creek Nurseries. 2022. 2022 Wholesale Catalog. Available: https://www.taylorcreeknurseries.com/wp-content/uploads/2022/01/TCRN-2022-Catalog_digital.pdf (March 2023).
- U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an “Ecological Risk Screening Summary.” Version 3.
- Valdés B. 2012. *Ammannia*. In Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity. Available: https://europlusmed.org/cdm_dataportal/taxon/1f85c7cc-08e3-4d30-b763-fc3542fb88cd (March 2024).
- [WFO] World Flora Online. 2023. World Flora Online – a project of the World Flora Online Consortium. Available: <http://www.worldfloraonline.org> (March 2023).

11 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

- Booi M, Punt W, Hoen PP. 2003. The northwest European pollen flora, 68 Lythraceae. Review of Palaeobotany and Palynology 123:163–180.
- Culver D, Lemly J. 2013. Field guide to Colorado's wetland plants: Identification, ecology and conservation. Colorado Natural Heritage Program.
- Douglas GW, Straley DB, Meidinger D. 1990. The vascular plants of British Columbia Parts 1-4. Victoria, British Columbia: Ministry of Forests, Forest Sciences Research Branch. Special Report Series 1-4.
- Environment Canada. 2015. Recovery strategy for the scarlet ammannia (*Ammannia robusta*) in Canada. *Species at Risk Act Recovery Strategy Series*. Ottawa: Environment Canada.
- Euliss NH, Harris SW. 1987. Feeding ecology of northern pintails and green-winged teal wintering in California. *Journal of Wildlife Management* 724-732.
- Graham SA. 1979. The origin of *Ammannia x robusta* Rottboell. *Taxon* 28:169–178.
- Hickman JC. 1993. The Jepson manual: higher plants of California. Berkeley: University of California Press.
- Hitchcock CL, Cronquist A. 1961. Vascular plants of the Pacific Northwest. Part 3: Saxifragaceae to Ericaceae. Seattle: University of Washington Press.
- Kartesz JT. 2015. The Biota of North America Program (BONAP). North American Plant Atlas. Version 1.0.
- Les DH. 2017. Aquatic dicotyledons of North America: ecology, life-history, and systematics. Boca Raton, Florida: CRC Press.
- McClintock E. 1993. Lythraceae. The Jepson manual: higher plants of California. Berkeley: University of California Press.
- NatureServe. 2014. NatureServe Explorer: an online encyclopedia of life. Arlington, Virginia: NatureServe. Available: <http://explorer.natureserve.org> (July 2014).
- Scarlet Ammannia Recovery Team. 2008. Recovery strategy for scarlet ammannia (*Ammannia robusta*) in British Columbia and Ontario. Victoria, British Columbia and Ontario, Canada: British Columbia Ministry of Environment and Ontario Ministry of Natural Resources.

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 (2022).

Under the future climate scenarios (figure A1), on average, high climate match for *Ammannia robusta* was projected to occur across the contiguous United States except along the Gulf Coast, inland Southeast, and along the northern Pacific Coast, where the climate match was medium to low across all scenarios. The highest matches occurred in the Great Lakes and Northern Plains regions, particularly at the 2055 time step. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.888 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.985 (model: GFDL-ESM4, SSP3, 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 (0.988, 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 most time step and climate scenario combinations, small areas of southwestern Arizona and northeastern Michigan saw moderate increases in the climate match relative to current conditions. No large increases were observed regardless of time step and climate scenarios. In the 2085 time step, scattered areas in California and along the southern edge of the Ohio River basin saw a large decrease in the climate match relative to current conditions. In the most extreme scenario, SSP5 2085, additional areas in the Northern Plains and the Colorado Plateau were projected to have a large decrease in climate match relative to current conditions. Areas of moderate decrease in climate match were also widespread under this most extreme scenario.

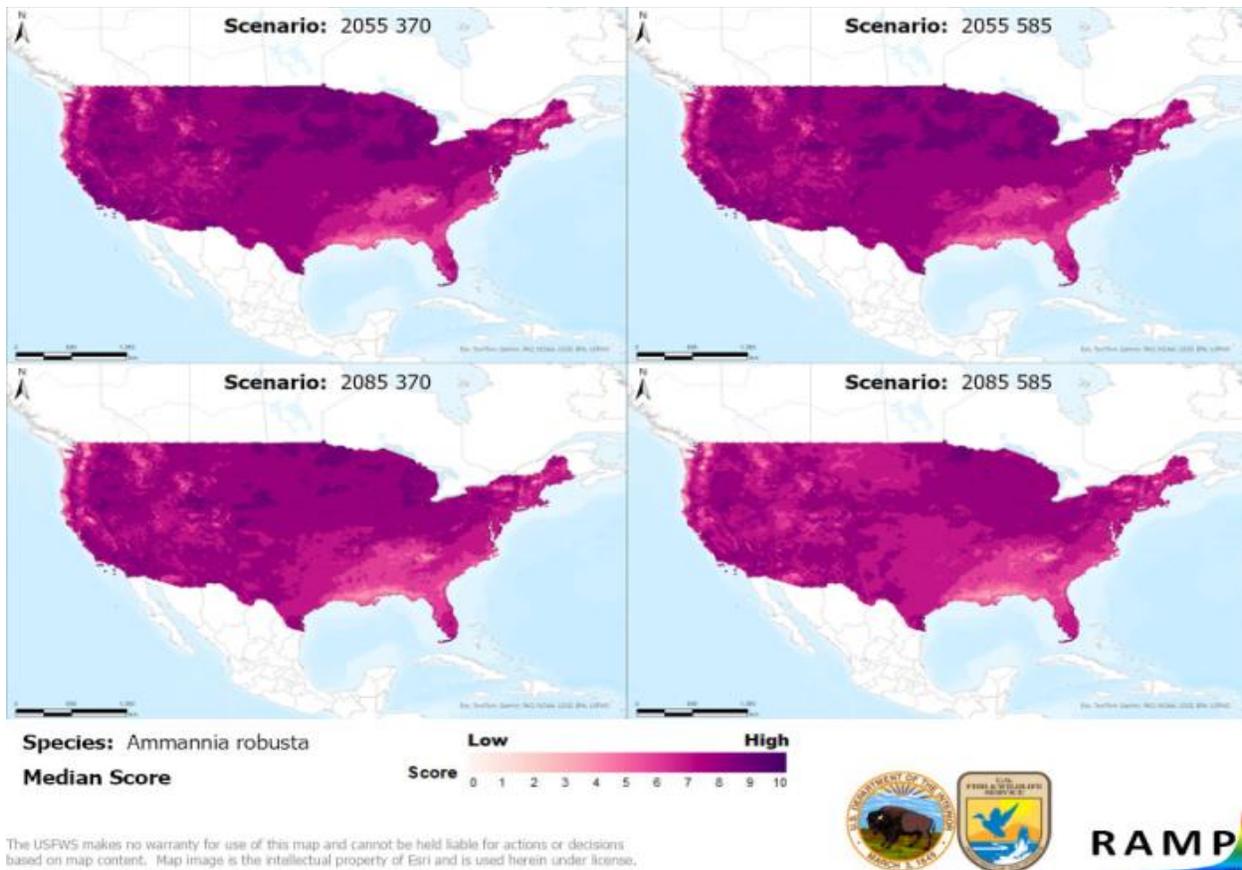


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Ammannia robusta* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2022). Shared Socioeconomic 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.

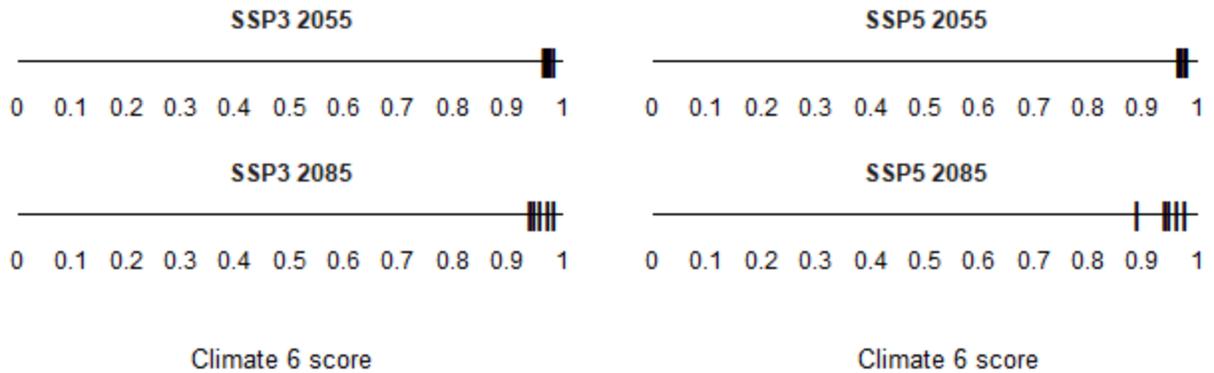
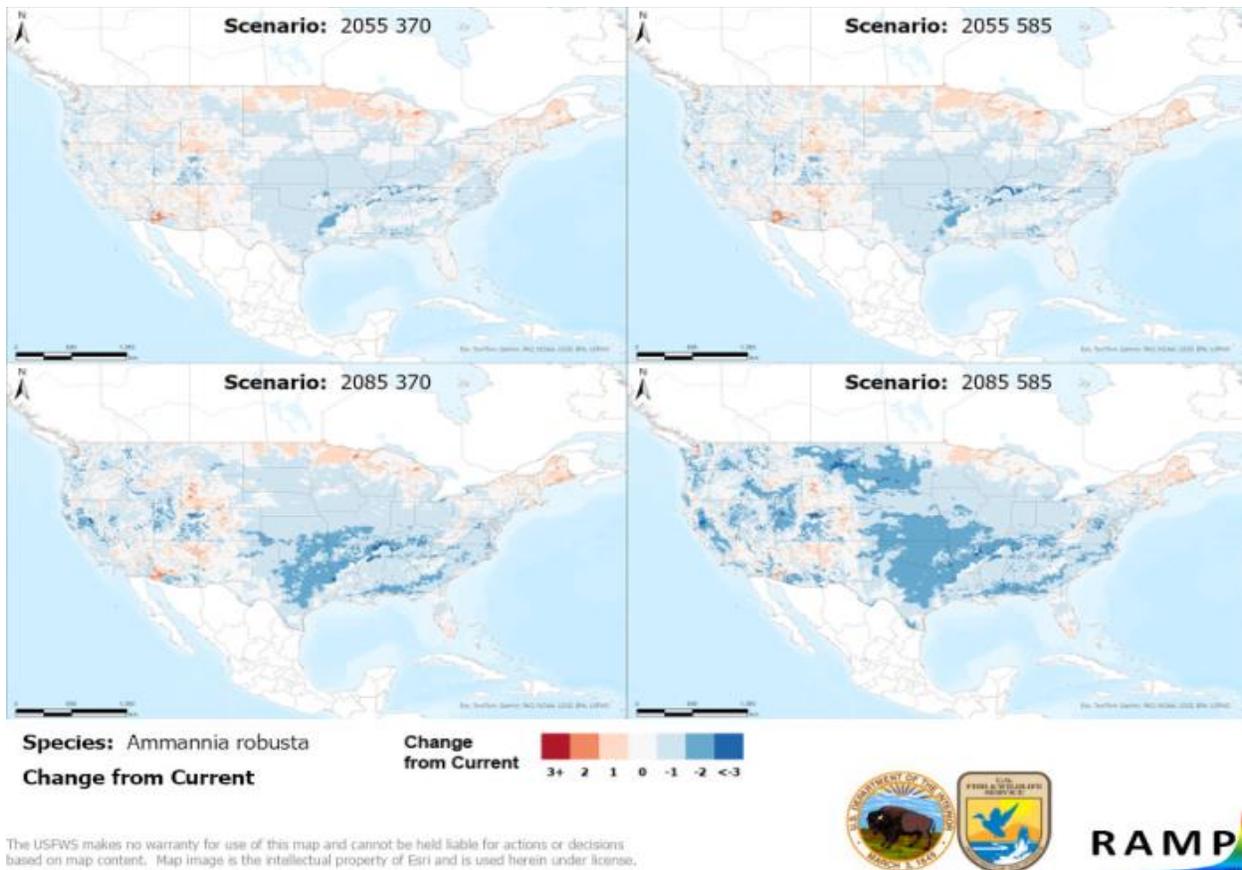


Figure A2. Comparison of projected future Climate 6 scores for *Ammannia robusta* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 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.



The USFWS makes no warranty for use of this map and cannot be held liable for actions or decisions based on map content. Map image is the intellectual property of Esri and is used herein under license.

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 *Ammannia robusta* based on source locations reported by GBIF Secretariat (2022). 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.

Literature Cited

- GBIF Secretariat. 2022. GBIF backbone taxonomy: *Ammannia robusta* Heer ex Regel. Copenhagen: Global Biodiversity Information Facility. Available: <https://www.gbif.org/species/3188708> (March 2023).
- [IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
- Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: <https://doi.org/10.16904/envodat.228.v2.1>.
- Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.
- Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.