

# Indian Toothcup (*Rotala indica*)

## Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2023

Revised, March 2023

Web Version, 5/29/2024

Organism Type: Flowering Plant

Overall Risk Assessment Category: Uncertain



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<https://www.inaturalist.org/observations/147922629> (February 2023).

## 1 Native Range and Status in the United States

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### Native Range

From POWO (2023):

“Native to: Afghanistan, Assam [eastern India], Bangladesh, Cambodia, China North-Central, China South-Central, China Southeast, East Himalaya [Bhutan; Arunachal Pradesh, India], India, Iran, Japan, Jawa [Indonesia], Korea, Laos, Lesser Sunda Is. [Indonesia, Timor-Leste],

Malay[si]a, Myanmar, Nansei-shotō [Ryūkyū Islands, Japan], Nepal, Pakistan, Philippines, Sri Lanka, Sulawesi [Indonesia], Sumatera [Indonesia], Tadzhikistan, Taiwan, Thailand, Uzbekistan, Vietnam, West Himalaya [northern India, northern Pakistan]”

## Status in the United States

USGS (2023) reports *Rotala indica* as established in the following drainages in California (date range of observations given in parentheses): Butte Creek (1946-1994), Honcut Headwaters-Lower Feather (1994). USGS (2023) also reports this species as established in Louisiana in Mermentau Headwaters (1971-1984) and Mermentau (1986) drainages.

From Thieret (1972):

“During a recent visit to a rice field near Crowley [Louisiana] to collect aquatic plants for class use I noted an individual of a species that was quite unknown to me. Bringing the plant back to the laboratory, I soon identified it as *Rotala indica* (Willd.) Koehne, an Asiatic species previously recorded, in the conterminous United States, only from Butte County, California (H. L. Mason, [...] 1957). On a return visit to the Crowley site I found, after a thorough search, only four more individuals of *R. indica*; these were left in situ to provide a seed source that would, hopefully, help to keep the species a part of the field's flora. [...] Collection data are as follows: in rice field, Rice Experiment Station, 2.5 miles NE of Crowley, Acadia Parish, [...].”

*Rotala indica* is extensively available in trade in the United States (e.g., Buce Plant 2023; LiveAquaria 2023), although no precise estimates of trade volume are available.

## Regulations

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

## Means of Introductions within the United States

From eFloras (2023):

“*Rotala indica* probably was introduced into the flora area as a contaminant of imported rice seed stock.”

The majority of USGS (2023) records of *Rotala indica* in Louisiana are reported in proximity to rice fields.

## Remarks

No additional remarks.

## 2 Biology and Ecology

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### 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 *Rotala*  
Species *Rotala indica* (Willd.) Koehne

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

### Size, Weight, and Age Range

From Blanclaver et al. (2001):

“*Rotala indica*, of the family Lythraceae, is a dicotyledonous broadleaf annual weed (Morita 1997), that grows up to 40cm in height (Soerjani et al. 1987; Harada et al. 1997).”

From WFO (2023):

“Leaves [...] 5-13 mm long. 2-7 mm broad.”

### Environment

From Zhuang (2011):

“It is found in paddy fields and wetlands.”

From Les (2017):

“*Rotala indica* (Willd.) Koehne [...] grows submersed in shallow water (to 15 cm) or as an emergent on exposed substrates (often mud) in ditches, levees, marshes, rice fields, and wet prairies at elevations of up to 50 m (to 1000 m in its native range).”

### Climate

From POWO (2023):

“It [...] grows primarily in the seasonally dry tropical biome.”

From Blancaver et al. (2001):

“The weed is distributed from the tropical to the temperate regions of South-East Asia (Harada et al. 1997).”

## **Distribution Outside the United States**

### **Native**

From POWO (2023):

“Native to: Afghanistan, Assam [eastern India], Bangladesh, Cambodia, China North-Central, China South-Central, China Southeast, East Himalaya [Bhutan; Arunachal Pradesh, India], India, Iran, Japan, Jawa [Indonesia], Korea, Laos, Lesser Sunda Is. [Indonesia, Timor-Leste], Malay[si]a, Myanmar, Nansei-shotō [Ryukyu Islands, Japan], Nepal, Pakistan, Philippines, Sri Lanka, Sulawesi [Indonesia], Sumatera [Indonesia], Tadzhikistan, Taiwan, Thailand, Uzbekistan, Vietnam, West Himalaya [northern India, northern Pakistan]”

### **Introduced**

From Brunel (2009):

“The species is recorded as naturalized in Portugal and Italy.”

From Zhuang (2011):

“Introduced: Congo; Italy (Italy (mainland)); Spain (Spain (mainland));”

## **Means of Introduction Outside the United States**

From Zhuang (2011):

“It has been introduced in rice fields in Africa (Congo), Europe (Italy and Portugal) [...]”

## **Short Description**

From WFO (2023):

“Annual herb, erect, 10-19 cm tall, glabrous. Leaves obovate, obtuse, attenuate at the base, margin prominently cartilaginous, 5-13 mm long. 2-7 mm broad. Spikes axillary, in every axil, 4-9 mm long. Bracts leaf-like. Bracteoles subulate. Flowers 4-merous, 2-3 mm long. Hypanthium tubular-campanulate, membranous in fruit. Sepals 0.5-1 mm long, 1 mm broad, very acute. Petals minute, shorter than sepals. Ovary oblong. Capsule ± equaling the hypanthium, much shorter than the calyx. Seeds longer than broad.”

## Biology

From eFloras (2023):

“Flowering late spring-summer.”

From Blancaver et al. (2001):

“The species thrive well in open, wet grasslands, rice paddies, riverbanks and ditches. Propagation and dispersal is by seeds and plant fragments.”

## Human Uses

From Brunel (2009):

“*Rotala indica* (Lythraceae) originates from Asia and 10 000 plants were imported [to the European and Mediterranean Plant Protection Organization region] for aquarium use in 2007, mainly in the Netherlands and in France.”

*Rotala indica* is extensively available in trade in the United States (e.g., Buce Plant 2023; LiveAquaria 2023), although no precise estimates of trade volume are available.

## Diseases

No information was found on diseases associated with *Rotala indica*.

## Threat to Humans

From Blancaver et al. (2001):

“In Malaysia, it is classified as a rarely existing weed (Itoh 1991), but it is a common weed in Japan (Morita 1997), Indonesia (Soerjani et al. 1987) and in the Philippines (Pancho & Obien 1995). The Geographical Atlas of the World’s Worst Weeds (Holm et al. 1979) considers *R. indica* as a serious weed in Afghanistan, Japan, Korea, the Philippines and Taiwan; in Vietnam, it is a common weed. In Cambodia, Ceylon, China, Indonesia, Italy, Pakistan and Thailand, however, its rank of importance is not known.”

## 3 Impacts of Introductions

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From Les (2017):

“Information on the ecological impact of this species in North America is scarce.”

## 4 History of Invasiveness

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The History of Invasiveness for *Rotala indica* is classified as Data Deficient. Although established populations of *R. indica* have been documented outside of its native range, and it is considered a significant weed of cultivated rice within its native range, there was no specific information found on impacts of its introduction to new areas.

## 5 Global Distribution



**Figure 1.** Reported global distribution of *Rotala indica*. Map from GBIF Secretariat (2023). Observations are reported from North America, Europe, and Asia. Points reported in Egypt and New Zealand were excluded from climate matching analysis because no information could be found to corroborate the existence of established populations in those countries.

## 6 Distribution Within the United States



**Figure 2.** Reported distribution of *Rotala indica* in the United States. Map from USGS (2023). Observations are reported from California and Louisiana.

## 7 Climate Matching

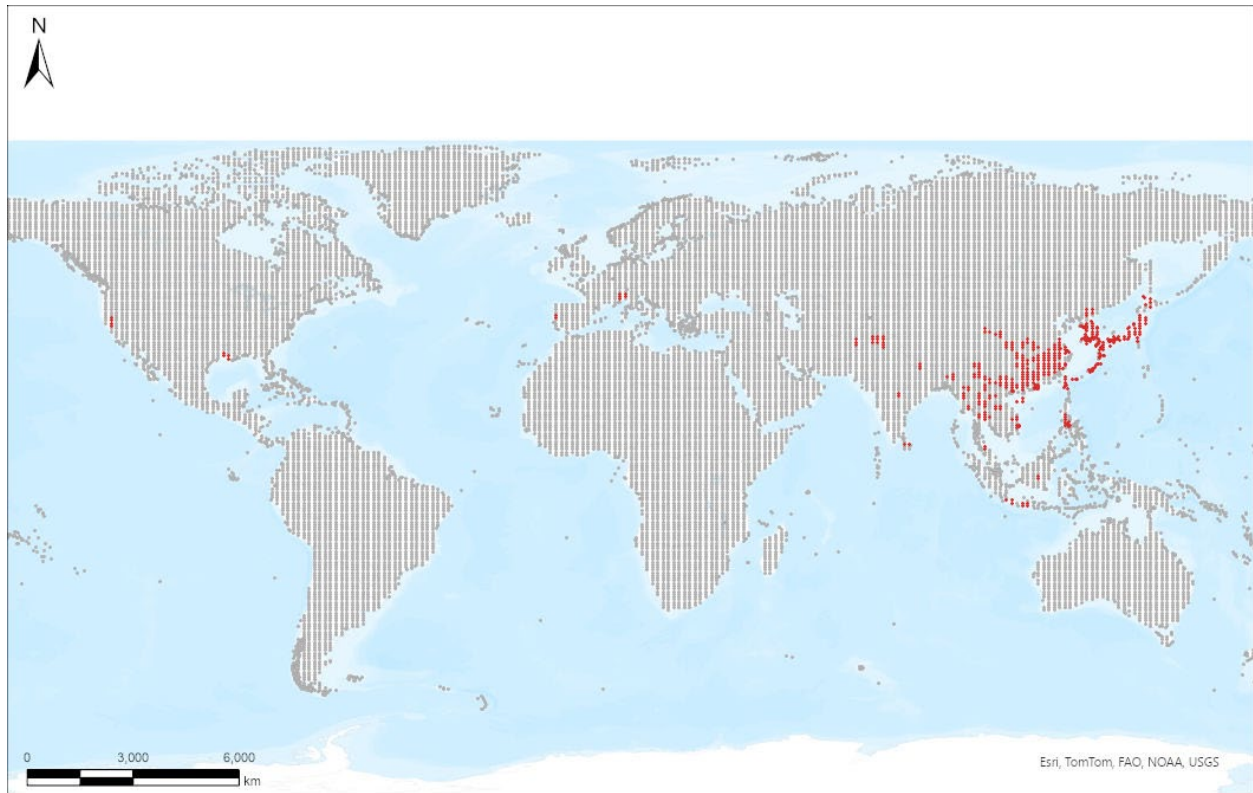
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### Summary of Climate Matching Analysis

The climate match for *Rotala indica* was high throughout much of the contiguous United States. The highest matches were found in California and Louisiana, where the species is currently established. The interior West and Pacific Northwest had areas of low to medium climate match. There were additional areas of medium match in the Upper Midwest, and in a band across the interior eastern and central States stretching from New England to eastern Texas. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.873, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores  $\geq 6$ )/(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 *Rotala indica* (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:** *Rotala indica*

**Selected Climate Stations** ●

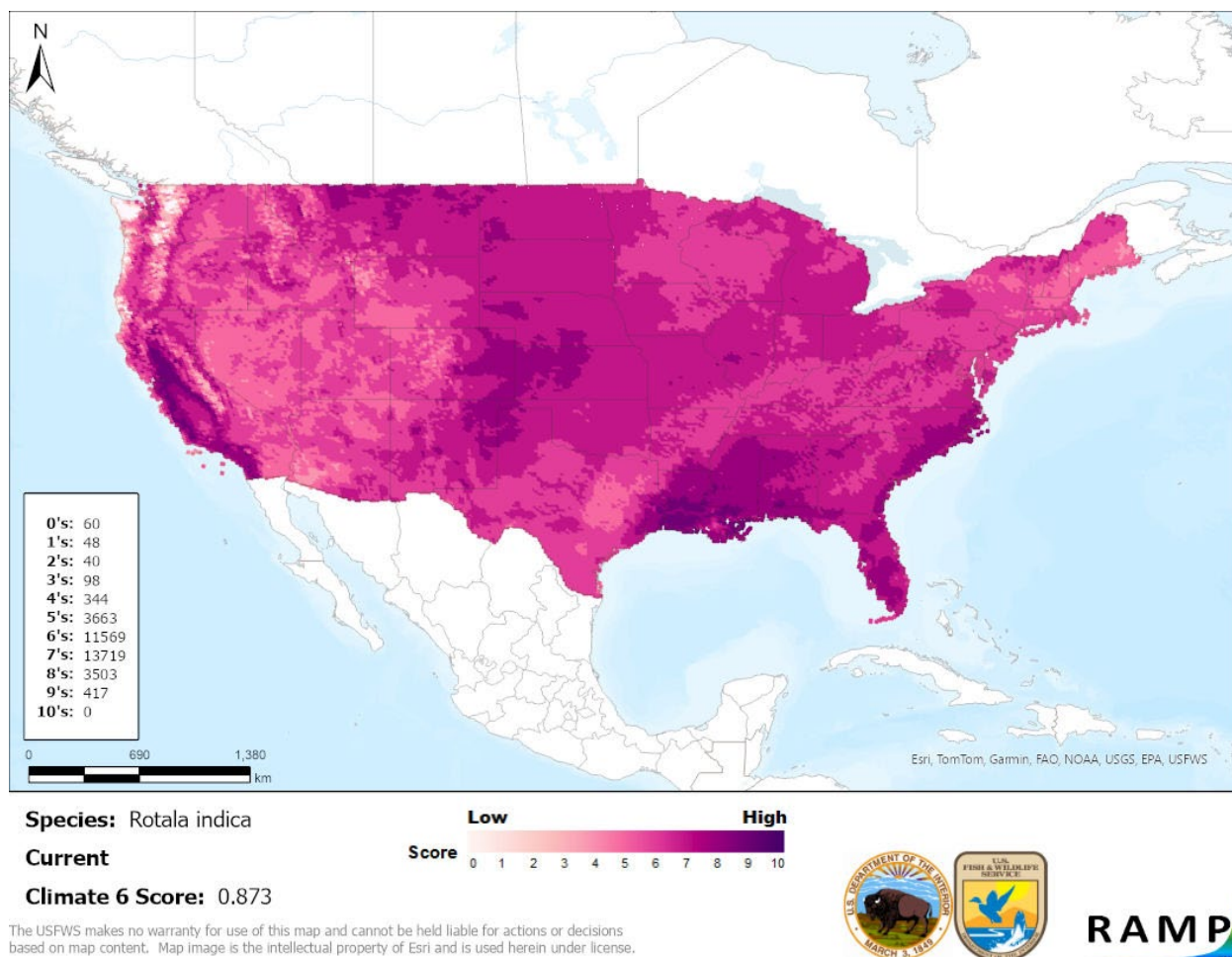


**RAMP**

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 in North America, Europe, and Asia selected as source locations (red; United States, Portugal, Italy, Indian subcontinent, East Asia, Southeast Asia) and non-source locations (gray) for *Rotala indica* climate matching. Source locations from GBIF Secretariat (2023). 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 *Rotala indica* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). 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 *Rotala indica* is classified as Low. Some information is available on the biology, ecology, and distribution of *R. indica*. It has been reported as a significant weed in rice cultivation. However, no information is available on actual agricultural or ecological impacts of its introduction to areas outside its native range.

## 9 Risk Assessment

### Summary of Risk to the Contiguous United States

*Rotala indica*, the Indian Toothcup, is a semiaquatic, annual flowering plant that is native to Asia. *R. indica* is found in wet habitats, including rice fields, where it is considered a weed within its native range. *R. indica* is widespread in the aquarium trade in Europe and the United States. It has been introduced to California and Louisiana, most likely in rice seed. The History of Invasiveness for *Rotala indica* is classified as Data Deficient due to a lack of information

regarding impacts of introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species. Most areas of the contiguous United States showed medium to high climate match. The Certainty of Assessment for this ERSS is classified as Low due to the lack of information regarding impacts of its introduction, despite its status as an agricultural weed in rice cultivation within the native range. The Overall Risk Assessment Category for *Rotala indica* 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

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

Blancaver ME, Itoh K, Usui K. 2001. Resistance of *Rotala indica* Koehne var. *uliginosa* Koehne to sulfonylurea herbicides. *Weed Biology and Management* 1:209–215.

Brunel S. 2009. Pathway analysis: aquatic plants imported in 10 EPPO countries. *EPPO Bulletin* 39(2):201–213.

Buce Plant. 2023. *Rotala indica* aquarium plant. Available: <https://buceplant.com/products/rotala-indica> (February 2023).

eFloras. 2023. *Rotala indica*. Flora of North America. Available: [http://www.efloras.org/florataxon.aspx?flora\\_id=1&taxon\\_id=200014664](http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=200014664) (February 2023)

GBIF Secretariat. 2023. GBIF backbone taxonomy: *Rotala indica* (Willd.) Koehne. Copenhagen: Global Biodiversity Information Facility. Available: <https://www.gbif.org/species/3188674> (February 2023).

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- Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.
- Thieret JW. 1972. *Rotala indica* (Lythraceae) in Louisiana. SIDA, Contributions to Botany 5:45.
- [USFWS] U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an “Ecological Risk Screening Summary.” Version 3.
- [USGS] U.S. Geological Survey. 2023. *Rotala indica* (Willd.) Koehne. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=240#> (February 2023).
- [WFO] World Flora Online. 2023. World Flora Online – a project of the World Flora Online Consortium. Available: <http://www.worldfloraonline.org> (February 2023).
- Zhuang X. 2011. *Rotala indica*. The IUCN Red List of Threatened Species 2010. Available: <https://www.iucnredlist.org/species/168735/6530815> (February 2023).

## 11 Literature Cited in Quoted Material

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**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.**

- Harada J, Shibayama H, Morita H. 1997. Weeds in the tropics. Tokyo: AICAF.
- Holm LR, Pancho VV, Herberger JP, Plucknett DL. 1979. A geographical atlas of world's weeds. New York: John Wiley.
- Itoh K. 1991. Life cycles of Ricefield weeds and their management in Malaysia. Tsukuba, Japan: Tropical Agriculture Research Center.
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- Pancho JV, Obien SR. 1995. Manual of ricefield weeds in the Philippines. Muñoz, Nueva Ecija, Philippines: Philippines Rice Research Institute.
- Soerjani M, Kostermans AJGH, Tjitrosoepomo G. 1987. Weeds of rice in Indonesia. Jakarta: Bali Pustaka.

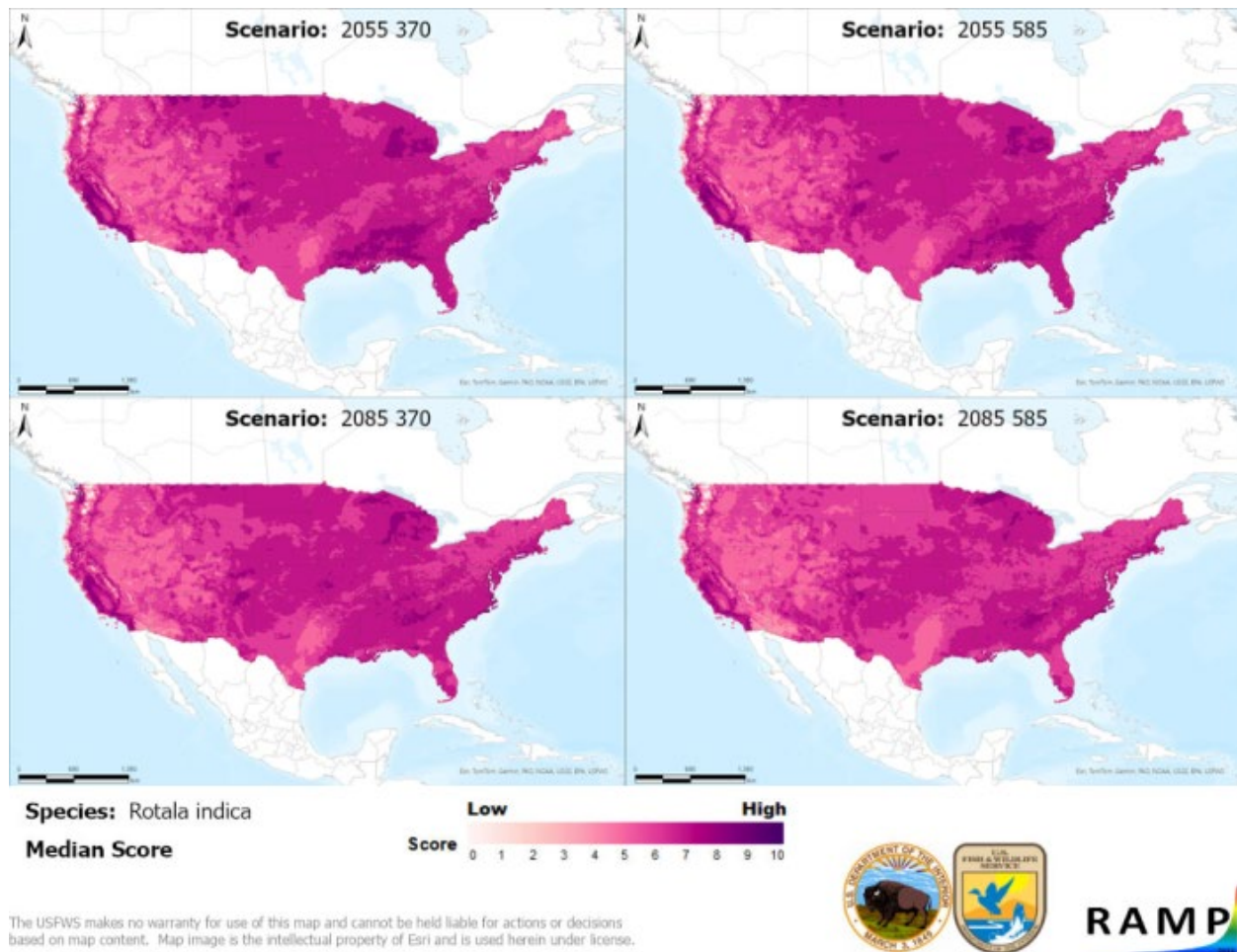
# Appendix

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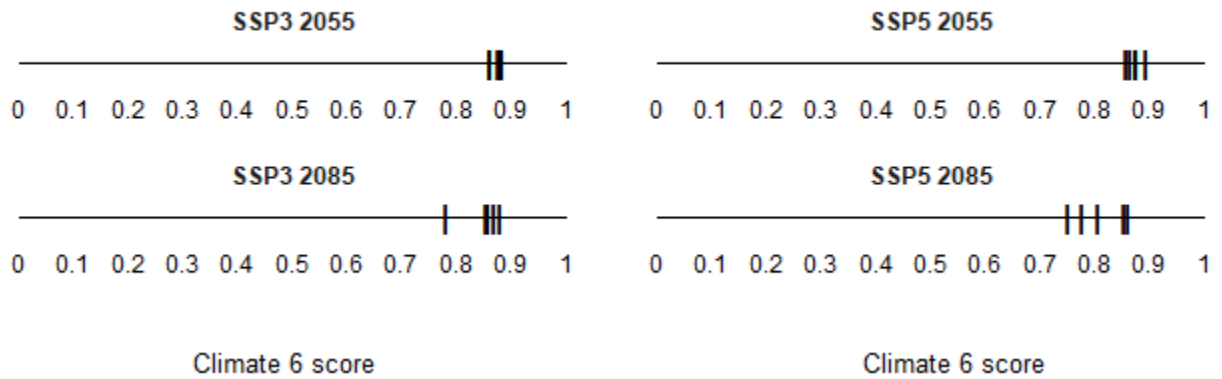
## Summary of Future Climate Matching Analysis

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).

Under the future climate scenarios (figure A1), on average, high climate match for *Rotala indica* was projected to occur in California. In some scenarios, areas of high match also appeared in the Southeast, Great Lakes region, northern Montana, and along the western edge of the Great Plains. Areas of medium to low climate match were found in the northern Pacific coast, interior West, and eastern Texas under all future climate scenarios. In general, the areas of high climate match became smaller with time and from SSP3 to SSP5. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.750 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.890 (model: IPSL-CM6A-LR, 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 scenarios. The Climate 6 score for the current climate match (0.873, figure 4) falls within the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085, the most extreme climate change scenario. Under one or more time step and climate scenarios, areas within the Great Lakes, Northeast, Northern Pacific Coast, and Western Mountains saw a moderate increase in the climate match relative to current conditions. No large increases were observed regardless of time step and climate scenarios. Under one or more time step and climate scenarios, areas within the currently established range of *R. indica* in northern California saw a large decrease in the climate match relative to current conditions. Additionally, areas of the Gulf Coast, Northern Plains, interior Southeast, and Southern Plains saw a moderate decrease in the climate match relative to current conditions. Additional, very small areas of large or moderate change may be visible on the maps (figure A3). In general, the changes in climate match became more extreme with time and from SSP3 to SSP5.

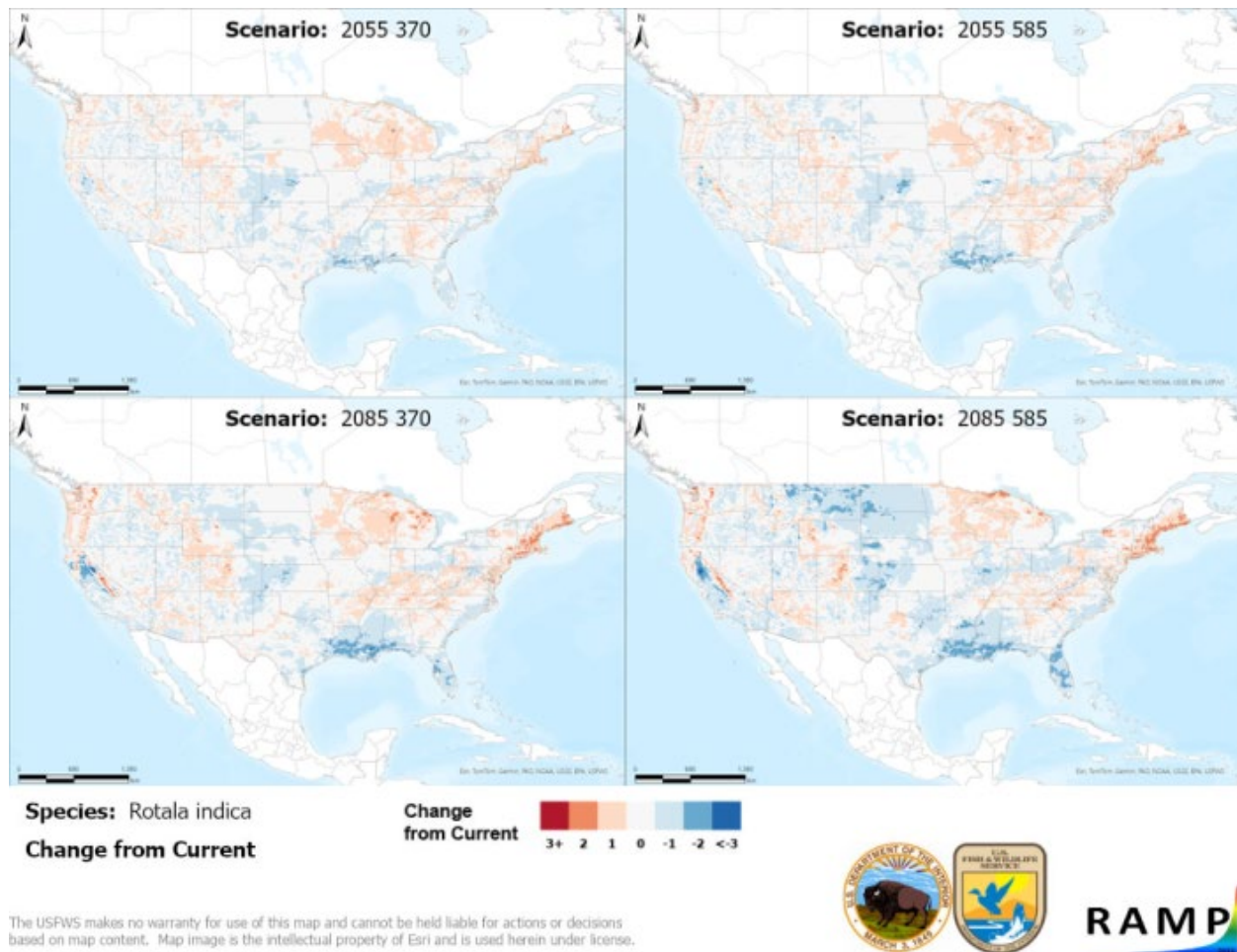


**Figure A1.** Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Rotala indica* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared 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 *Rotala indica* 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 *Rotala indica* based on source locations reported by GBIF Secretariat (2023). 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. 2023. GBIF backbone taxonomy: *Rotala indica* (Willd.) Koehne. Copenhagen: Global Biodiversity Information Facility. Available: <https://www.gbif.org/species/3188674> (February 2023).
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