Indian Swampweed (*Hygrophila polysperma*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2024
Revised, April 2024
Web Version, 2/18/2026

Organism Type: Flowering Plant
Overall Risk Assessment Category: High

Photo: Krzysztof Ziarnek, Kenraiz. Licensed under CC BY-NC 4.0 DEED. Available: https://commons.wikimedia.org/wiki/File:Hygrophila_polysperma_kz02.jpg (April 2024).

1 Native Range and Status in the United States

Native Range

From Thayer et al. (2026a):

"Native Range: India, Malaysia, Bangladesh, Bhutan, Nepal, Cambodia, Laos, Myanmar, Thailand, and Vietnam (Angerstein and Lemke 1994, Nault and Mikulyuk 2009)."

From Gupta (2011):

“Bangladesh; Bhutan; Cambodia; China (Guangdong, Guangxi, Yunnan); India; Lao People's Democratic Republic; Myanmar; Nepal; Pakistan; Thailand; Viet Nam”

Status in the United States

From Thayer et al. (2026a):

“Established in Alabama, Florida, Kentucky, Mississippi, South Carolina, and Texas. Extirpated in Virginia due to freezing temperatures in the 1970s (Nault and Mikulyuk 2009).”

Thayer et al. (2026a) report additional observations of *Hygrophila polysperma* in Ohio with no information on establishment.

From Gettys (2024):

“Angerstein and Lemke (1994) reported naturalized populations of East Indian hygrophila in the San Marcos and Comal rivers in Texas (USA), where the species had likely been present since the late 1960s but had been misidentified for many years.”

Hygrophila polysperma is in live trade within the United States.

From Thayer et al. (2026a):

“Surveys conducted by Rixon et al. (2005) found that *H. polysperma* was available for purchase in 25% of the pet and aquarium stores surveyed near Lakes Erie and Ontario. Maki and Galatowitsch (2004) had evidence that *H. polysperma* is available for purchase from vendors across the U.S. with delivery service to Minnesota. In addition, it is sometimes sold under the incorrect name of *Alternanthera sessilis*.”

From Gettys (2024):

“East Indian hygrophila is widely sold as an aquarium plant and a number of cultivars are available in addition to the wild type. Kay and Hoyle (2001) conducted an internet search using the scientific names of 12 common aquatic weeds sold by the aquarium industry and reported that East Indian hygrophila was the most commonly found commercial plant, with 30 of the first 100 hits coming from commercial sources.”

“East Indian hygrophila is readily available to purchase from numerous aquatic nurseries and hobbyists on the internet. Despite being a Federal Noxious Weed in the United States, the wild-type and numerous cultivars are available online.”

Regulations

Hygrophila polysperma is listed on the Federal Noxious Weed List (U.S. Department of Agriculture 2016).

Hygrophila polysperma is regulated in California (CDFA 2021), Florida (FDACS 2010), Illinois (Illinois DNR 2015), Indiana (Indiana DNR 2022), Louisiana (LDWF 2022), Massachusetts (MDAR 2023), Minnesota (MDA 2023), New Hampshire (NHDES 2022), North Carolina (North Carolina DEQ 2023), Ohio (ODA 2023), Oklahoma (ODWC 2023), South Carolina (SCDNR 2010), West Virginia (WVDA 2023), and Wisconsin (Wisconsin DNR 2022). Please refer back to state agency regulatory documents for details on the regulations, including restrictions on activities involving this species. While effort was made to find all applicable regulations, this list may not be comprehensive. Notably, it does not include regulations that do not explicitly name this species or its genus or family, for example, when omitted from a list of authorized species with blanket regulation for all unnamed species.

Means of Introductions within the United States

From Thayer et al. (2026a):

"*Hygrophila polysperma* was first introduced into Florida via the aquarium industry in the 1950s (Cuda and Sutton 2000). It was cultivated in Ohio at the end of WWII by an aquarium dealer (Reams 1953), but there is no indication that this species is still cultivated there."

From Gettys (2024):

"East Indian hygrophila reproduces primarily by vegetative fragments. The brittle stems break easily and can result from currents, wind, and mechanical disruption (e.g. watercraft, mechanical weed control activity, etc.) and are transported via water. Seeds may be transported by currents but their importance for dispersal of the species is unclear."

"Fragments of East Indian hygrophila could be transported by animals such as birds that visit areas where this species is present."

"Accidental introductions of East Indian hygrophila could occur from fragments hitchhiking on contaminated equipment (e.g. watercraft in submersed areas, mowers along banks and shorelines)."

Remarks

This ERSS was previously published in August 2018. Revisions were completed to incorporate new information and conform to updated standards.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2024):

Kingdom Plantae
  Subkingdom Viridiplantae
    Infrakingdom Streptophyta
      Superdivision Embryophyta

Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Asteranae
Order Lamiales
Family Acanthaceae
Genus *Hygrophila*
Species *Hygrophila polysperma* (Roxb.) T. Anderson

According to WFO (2024), *Hygrophila polysperma* is the current valid name for this species.

The following synonyms of *Hygrophila polysperma* from WFO (2024) were used to search for information for this report: *Justicia polysperma, Hemiadelphis polysperma*.

Size, Weight, and Age Range

From Thayer et al. (2026a):

"Stems 6 feet or longer (Ramey 2001)."

From Gettys (2024):

"Leaves are up to 8 cm in length, 2 cm in width, and broader at the tip than at the base."

Environment

From Gupta (2011):

"Freshwater"

From Thayer et al. (2026a):

"This species can grow in water at depths up to 3 m and on stream banks as an emersed plant (Nault and Mikulyuk 2009). *Hygrophila polysperma* can inhabit habitats with a variety of environmental conditions. It favors warmer waters of 18-30°C but can tolerate water temperatures as low as 4°C (Kasselmann 1995, Ramey 2001, Rixon et al. 2005, US EPA 2008). It grows in waters with pH of 6.5-7.8 (Spencer and Bowes 1985, Doyle et al. 2003) and water hardness of 30-140 ppm (Nault and Mikulyuk 2009). This species has low light saturation and compensation points, so it is capable of photosynthesizing in low light levels (Doyle et al. 2003). […] This species can draw CO_2 from both the water and atmosphere (Doyle et al. 2003)."

Climate

From Gupta (2011):

"*Hygrophila polysperma* is native to temperate and tropical Asia […]"

From Tanaka and Kobokun (2022):

“The establishment of *H. polysperma* in the Ashikaga [Japan] population indicates that it can overwinter at least by vegetative reproduction, even in areas where the [air] temperatures fall below freezing during the winter.”

Distribution Outside the United States

Native

From Thayer et al. (2026a):

“Native Range: India, Malaysia, Bangladesh, Bhutan, Nepal, Cambodia, Laos, Myanmar, Thailand, and Vietnam (Angerstein and Lemke 1994, Nault and Mikulyuk 2009).”

From Gupta (2011):

“Bangladesh; Bhutan; Cambodia; China (Guangdong, Guangxi, Yunnan); India; Lao People's Democratic Republic; Myanmar; Nepal; Pakistan; Thailand; Viet Nam”

Introduced

From Tanaka and Kobokun (2022):

“In Japan, its establishment was first confirmed in Kochi Prefecture, western Japan, in 2010 (Yamanouchi, 2019). We found *H. polysperma* in a small stream of Ashikaga City, Tochigi Prefecture (36°18′47.7″N, 139°30′49.6″E), in 2021, and this is the first record in Eastern Japan.”

From Gettys (2024):

“East Indian hygrophila occurs in the Tweed River on the North Coast of New South Wales [Australia], […]. The species is also present in southeast Queensland (NSW Government Department of Primary Industries, 2023). East Indian hygrophila is present in thermally heated waters (which are not typical of natural conditions) in Austria, Germany, Hungary and Poland, but has not become established in any natural environments within the Euro-Mediterranean region (EPPO, 2017).”

From Thayer et al. (2026b):

“*Hygrophila polysperma* has spread extensively in […] parts of Mexico.”

According to Champion and Clayton (2000), *H. polysperma* is present in New Zealand.

From Hussner (2014):

“Macrophyte mappings of a 37 km stretch of the thermally abnormal Erft River [Germany] in 2003, 2005, 2007, 2011 and 2013 documented the presence of nine alien ([…], *Hygrophila polysperma*, […]) in addition to 15 native species.”

Means of Introduction Outside the United States

From Gettys (2024):

"East Indian hygrophila occurs in the Tweed River on the North Coast of New South Wales [Australia], where it was introduced by the aquarium trade."

"East Indian hygrophila reproduces primarily by vegetative fragments. The brittle stems break easily and can result from currents, wind, and mechanical disruption (e.g. watercraft, mechanical weed control activity, etc.) and are transported via water. Seeds may be transported by currents but their importance for dispersal of the species is unclear."

"Fragments of East Indian hygrophila could be transported by animals such as birds that visit areas where this species is present."

"Accidental introductions of East Indian hygrophila could occur from fragments hitchhiking on contaminated equipment (e.g. watercraft in submersed areas, mowers along banks and shorelines)."

Short Description

From Gettys (2024):

"East Indian hygrophila is a herbaceous perennial plant that inhabits aquatic, wetland and marshy areas. The species has square stems and is amphibious. Emergent plants growing along banks are up to 20 cm in height, whereas submersed plants can reach 3 m in length and may produce aerial growth that emerges up to 5 cm above the surface of the water. Emergent growth may be covered with fine, short hairs, but submersed growth is usually smooth. Submersed leaves tend to be larger than emergent leaves, but the leaves of both forms are similar in shape (Sutton,1995; Langeland and Craddock Burks, 1998; Gettys and Enloe, 2022)."

"Leaves are up to 8 cm in length, 2 cm in width, and broader at the tip than at the base. They are attached in an opposite arrangement and are sessile (lacking petioles), with a collar of fine hairs at the node where the leaf base attaches to the stem (Langeland and Craddock Burks, 1998). The stems and leaves of East Indian hygrophila may have cystoliths – calcium carbonate deposits in epidermal cell walls that present as raised lines or dots (Sutton, 1995)."

"The small (to 8 mm), sessile, zygomorphic flowers are pale blue to light purple in colour and are bilabiate with five lobes. Solitary flowers are borne individually in the upper leaf axils on emergent growth from fall through spring (late October to late February in south Florida, USA). East Indian hygrophila fruits, which are produced in winter and late spring (December through March in south Florida, USA) are narrow, 2-cm-long capsules that split along their length to free the many tiny, round seeds contained within (Sutton, 1995; Langeland and Craddock Burks, 1998)."

Biology

From Thayer et al. (2026a):

"*Hygrophila polysperma* is a wetland plant that can occur as a submerged or an emersed plant. […] *Hygrophila polysperma* exhibits low seasonality and can maintain shoot biomass year round (Spencer and Bowes 1985). Growth rate is dependent on water temperature and daylight (Nault and Mikulyuk 2009), and can increase dramatically in the presence of nutrient inputs (Sutton and Dingler 2000)."

"In North America, *H. polysperma* has a specific life cycle, starting with a rooted stage in hydro-soil in dense stands of shoots, some with large leaves reaching up to the canopy, and some emergent ones with smaller leaves. Shoots on moist banks are very small, and resemble the submerged form after banks are flooded. Shoots begin elongating in March as the water temperature rises, then they reach the surface in late spring. In summer, they break off into mats and float away, and take root as soon as they come into contact with soil. The whole shoot of the plant breaks off near the root crown in August and forms very dense floating mats, which can sink piece by piece, or all at once to form a new colony; new shoots regrow from the roots, and they grow slowly in winter (Hall et al. 2003)."

From Gettys (2024):

"East Indian hygrophila (*Hygrophila polysperma*) is an amphibious plant that occurs under submersed conditions and as a terrestrial plant in littoral and water-adjacent zones."

Human Uses

From Gupta (2011):

"The roots are anthelmintic [antiparasitic] and its pastes are given to kill abdominal insects. It is a very common aquarium plant because of its fast growing habit."

From Thayer et al. (2026a):

"In India, *H. polysperma* seeds are used as a medicine (Spencer and Bowes 1985)."

Diseases

According to Poelen et al (2014), *Hygrophila polysperma* is host to the following fungi: *Cercospora hygrophilae*, *Cercospora apii*, *Puccinia cacao*.

Mukherjee et al. (2012) list the following nematodes as parasites of *Hygrophila polysperma*: *Meloidogyne graminicola* Golden & Birchfield, *Helicotylenchus* sp. Steiner, *Meloidogyne incognita* Chitwood, *Rotylenchulus reniformis* Linford & Oliveira, *Hirschmanniella oryzae* Luc & Goodey, *Criconemoides* sp. Taylor, *Tylenchorhynchus mashhoodi* Siddiqi & Basir, *Hoplolaimus indicus* Sher, *Paratrichodorus* sp. Siddiqi, *Trichodorus* sp. Cobb, *Tylenchorhynchus* sp. Cobb, *Hemicycliophora* sp. de Man, *Mesocriconema* sp. Andrassy,

Meloidogyne sp. Goeldi, *Hemicriconemoides* sp. Chitwood & Birchfield, *Pratylenchus* sp. Filipjev, and *Hoplolaimus* sp. Daday.

Threat to Humans

From Gettys (2024):

"East Indian hygrophila infestations are unlikely to directly impact human health. In general, however, dense surface mats that result from invasive submersed weeds can create stagnant surface-water habitats that support breeding mosquitoes, which may transmit pathogens to humans and other animals (Cuda, 2020)."

"[…] Sutton (1996) reported that East Indian hygrophila treated with fluridone [sic] was controlled for 20 months in flowing water [Florida], but the cost was nearly $67,000 USD ($34,580 USD in 1996) per hectare."

3 Impacts of Introductions

From Schmitz and Nall (1984):

"In Coral Springs [Florida], over 100 acres of drainage canals are heavily infested with *H. polysperma* causing problems with their pump intake screens […]."

From Cuda and Sutton (2020):

"Hygrophila [*Hygrophila polysperma*] forms dense stands that occupy the entire water column and easily fragments, clogging irrigation and flood-control systems (Schmitz and Nall 1984, Sutton 1995) and interfering with navigation (Woolfe 1995)."

From Thayer et al. (2026a):

"*Hygrophila polysperma* forms dense monocultures that exclude native plants and is a superior competitor because of its low requirements for light and rapid growth (Spencer and Bowes 1985). It shades out native submerged plants and can displace native plants when it occupies the entire water column (Vandiver 1980; Owens et al. 2001; Ramey 2001). When *H. polysperma* was grown with *Ludwigia repens*, *L. repens* exhibited slower growth rates compared to when grown alone, suggesting that *H. polysperma* has superior competitive abilities (Doyle et al. 2003). *Hygrophila polysperma* has spread into areas formerly dominated by *Hydrilla verticillata* (Cuda and Sutton 2000)."

From Gettys (2024):

"[…] Sutton (1996) reported that East Indian hygrophila treated with fluridone [sic] was controlled for 20 months in flowing water [Florida], but the cost was nearly $67,000 USD ($34,580 USD in 1996) per hectare."

“East Indian hygrophila reduces biodiversity by outcompeting other submersed plants and forming monocultures. Once established, the species can expand its population size very rapidly; in fact, Vandiver (1980) reported that an infestation of East Indian hygrophila in East Lake Tohopekaliga (Osceola County, FL, USA) increased its size from 0.1 acre to 10 acres in a single year. There is no evidence of hybridization between East Indian hygrophila and its Florida native Gulf swampweed (*Hygrophila costata*).”

“East Indian hygrophila can negatively affect ‘ecotourism’ activities, such as recreational fishing, by damaging fish habitat and reducing catch rates. The long, brittle stems of the species can become tangled around outboard motor propellors, causing boats and other watercraft to become inoperable. Areas near waters that are invaded by East Indian hygrophila or other submersed weeds can be impacted as well. Infested waters are often unattractive and the aesthetic value associated with waterfront property can be greatly reduced. As a result, resorts, campgrounds and recreational areas near weed-infested waters hold less appeal for tourists and other visitors. In addition, people paying a premium to live on waterfront property (even if the water is a man-made retention pond or reservoir) may become frustrated if the aquatic system near their property is unsightly and property values are likely to be reduced.”

Hygrophila polysperma is listed on the Federal Noxious Weed List (U.S. Department of Agriculture 2016) and currently regulated in the following States: California, Florida, Illinois, Indiana, Louisiana, Massachusetts, Minnesota, New Hampshire, North Carolina, Ohio, Oklahoma South Carolina, West Virginia, and Wisconsin. See section 1.

4 History of Invasiveness

Hygrophila polysperma has been introduced outside its native range and become established in the southeastern United States, Australia, New Zealand, Mexico, Japan, and Europe. Nonnative established populations have been associated with displacement and reduced growth rate of native aquatic vegetation species. It has also caused problems with water flow control structures and navigation, with management of the species incurring a high economic cost. In addition, there is a high volume of this species in the aquarium industry throughout many countries including the United States, despite being listed as a federal noxious weed. The History of Invasiveness for *Hygrophila polysperma* is classified as High.

5 Global Distribution

Figure 1. Reported global distribution of *Hygrophila polysperma*. Map from GBIF Secretariat (2023). Observations are reported from Australia, China, Germany, India, Laos, Mexico, Myanmar, Nepal, New Zealand, Pakistan, Sweden, Taiwan, Thailand, United States, and Vietnam. Some observations in the United States (California, North Carolina, Georgia; see also section 6) and Sweden do not represent established populations and were therefore excluded from climate matching analysis. The observation in Germany is from thermally regulated waters and was not used in the climate matching analysis.

Hygrophila polysperma observations representing established populations in Japan were reported by Tanaka and Kobokun (2022) and were used in the climate match analysis.

6 Distribution Within the United States

Figure 2. Reported distribution of *Hygrophila polysperma* in the United States. Map from Thayer et al. (2026a). Observations are reported from Alabama, Florida, Mississippi, Ohio, South Carolina, Texas, and Virginia. Observations in Ohio and Virginia do not represent established populations and were not used in the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Hygrophila polysperma* to the contiguous United States was high across portions of the South and Southeast from western Texas to southeastern Virginia. Areas of low climate match were found in the West, Northern Plains, and Northeast. Much of the upper Mississippi and lower Missouri River basins, along the southern Great Lakes region, had medium climate matches. Overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.506, 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 *Hygrophila polysperma* (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.

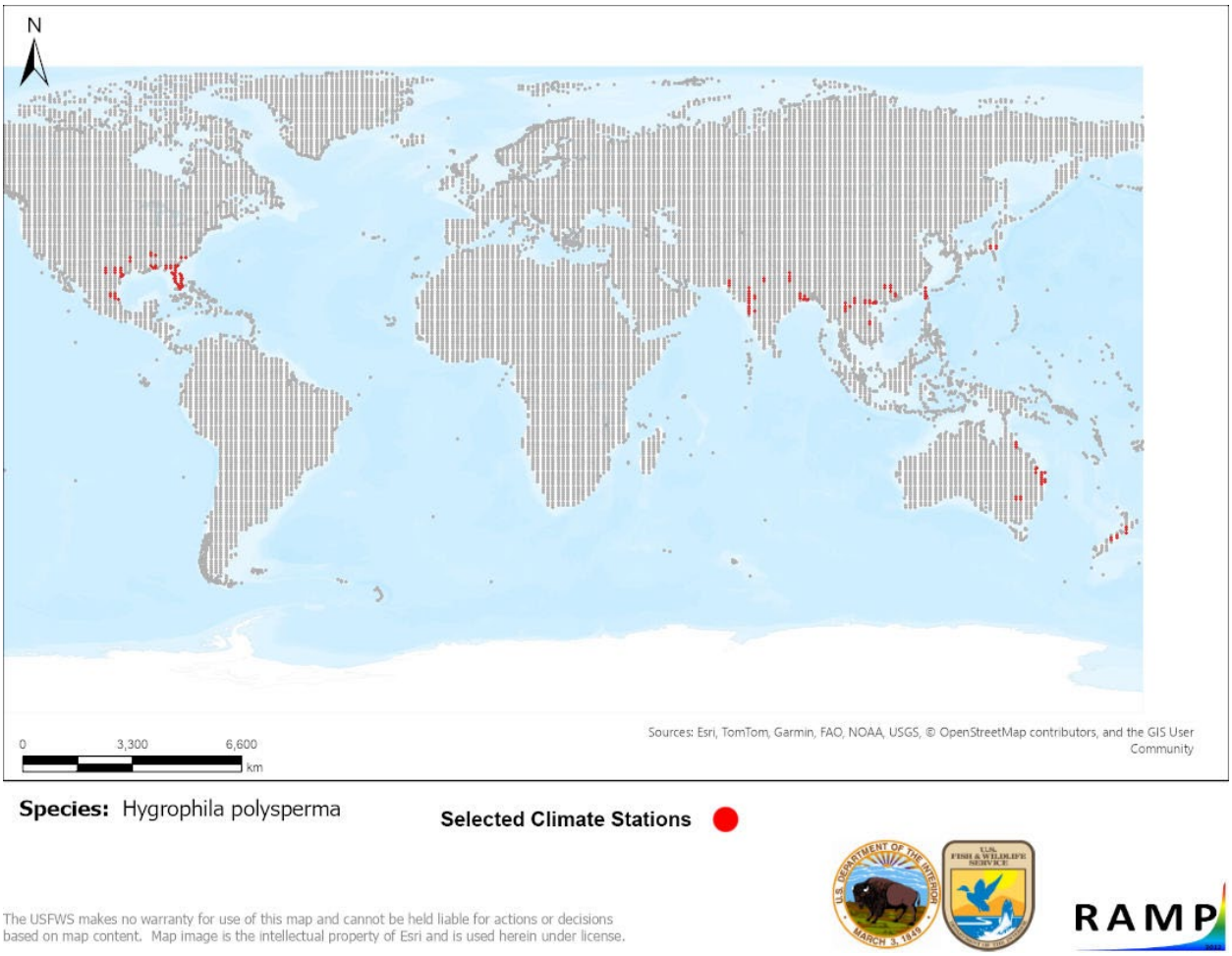

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations around the globe selected as source locations (red; Australia, Bangladesh, China, India, Japan, Laos, Mexico, Myanmar, Nepal, New Zealand, Pakistan, Taiwan, Thailand, Vietnam, United States) and non-source locations (gray) for *Hygrophila polysperma* climate matching. Source locations from Tanaka and Kobokun (2022) and 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.

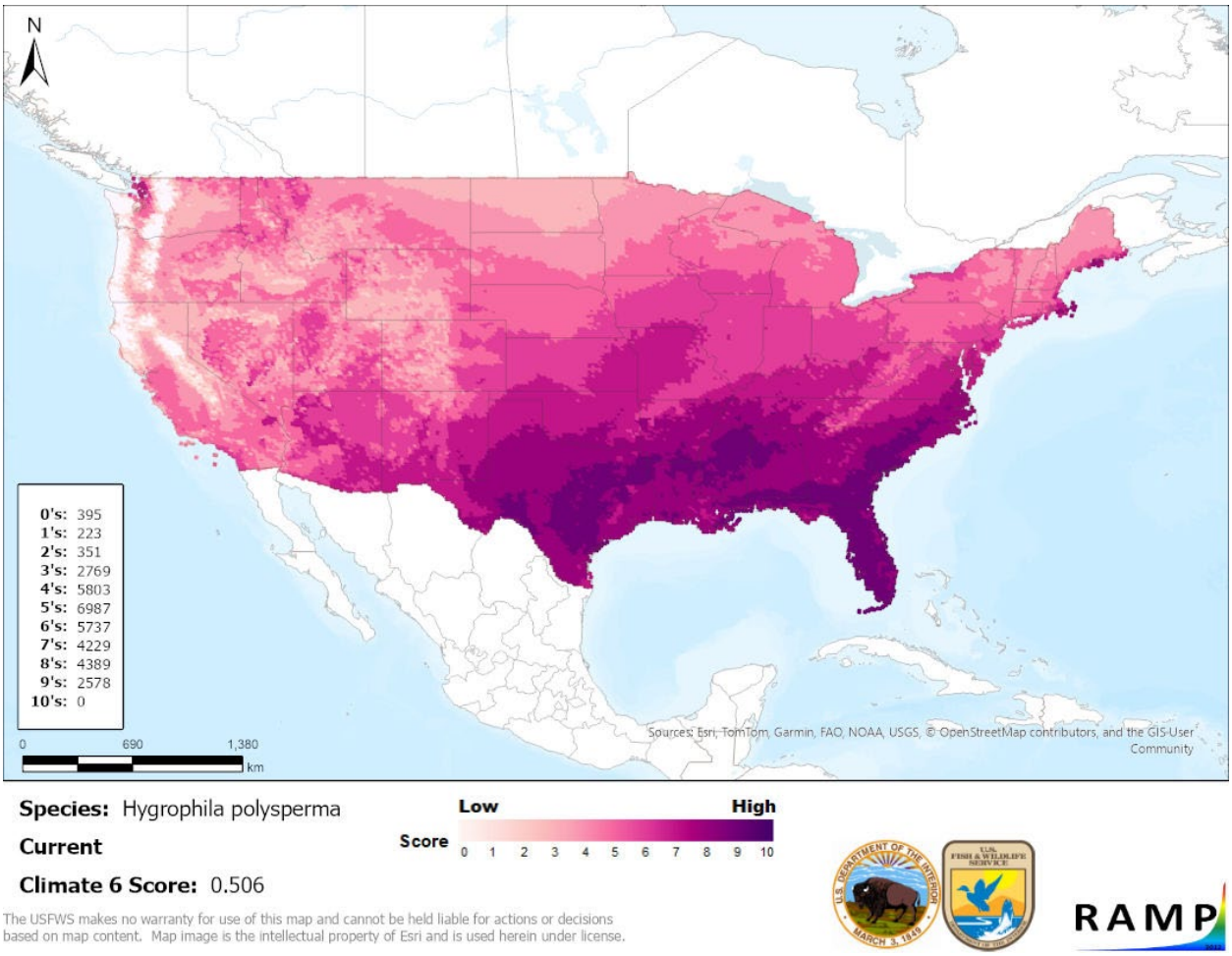

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Hygrophila polysperma* in the contiguous United States based on source locations reported by Tanaka and Kobokun (2022) and GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Hygrophila polysperma* is classified as High. There is extensive evidence for the non-native establishment of *Hygrophila polysperma*, as well as several peer reviewed papers documenting negative impacts. However, the climate matching analysis may underrepresent where the species could become established, because *H. polysperma* can establish in thermally regulated waters which are not reflected in the climate matching analysis.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Hygrophila polysperma, Indian Swampweed, is an amphibious plant native to southeast Asia. *H. polysperma* is a popular species in the aquarium trade, which has likely led to the introduction and spread of this species globally. *H. polysperma* is listed as a Federal Noxious Weed and regulated in at least 14 U.S. States. *H. polysperma* has been introduced to and become

established in the United States. It has also been introduced and become established in Australia, Europe, and Japan. Establishment in Europe has occurred only in thermally regulated waters. *H. polysperma* outcompetes, displaces, and reduces growth in native aquatic plants by forming dense monocultures. These dense populations negatively impact recreational areas and water control structures, and in turn have become an economic burden. The History of Invasiveness for *Hygrophila polysperma* is classified as High due to well documented nonnative establishment and negative impacts. The climate matching analysis for the contiguous United States indicates establishment concern for this species. The highest areas of climate match for *Hygrophila polysperma* in the contiguous United States were found in the south and southeast from Texas to Virginia. The Certainty of Assessment for this ERSS is classified as High due to evidence of nonnative establishment, as well as several peer-reviewed sources documenting negative impacts. The Overall Risk Assessment Category for *Hygrophila polysperma* 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): High**
- **Remarks, Important additional information: *Hygrophila polysperma* is listed on the Federal Noxious Weed List. Can establish in thermally regulated waters.**
- **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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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.

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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 Tanaka and Kobokun (2022) and GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Hygrophila polysperma* was projected to occur in the Appalachian Range, Gulf Coast, Mid-Atlantic, Southeast, Southern Atlantic Coast, and Southern Florida regions of the contiguous United States. Areas of low climate match were projected to occur in the Northern Pacific Coast region. Areas of medium and high match tended to expand and move northward between time steps 2055 and 2085. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.549 (model: MPI-ESM1-2-HR, SSP5, 2085) to a high of 0.739 (model: UKESM1-0-LL, SSP5, 2085). 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 (0.506, figure 4) falls below 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 Northeast saw a large increase in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Colorado Plateau, Great Basin, Great Lakes, Mid-Atlantic, Northern Plains, and Western Mountains saw a moderate increase in the climate match relative to current conditions. Under one or more time step and climate scenarios, areas within the Gulf Coast and Southeast saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Southern Atlantic Coast, Southern Florida, Southern Plains, and Southwest 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). The magnitude of change from current conditions was more pronounced in time step 2085 than in time step 2055 under both scenarios, SSP3 and SSP5. The areas of moderate and large changes also had a larger geographic extent under SSP5 than SSP3 in the 2085 time step.

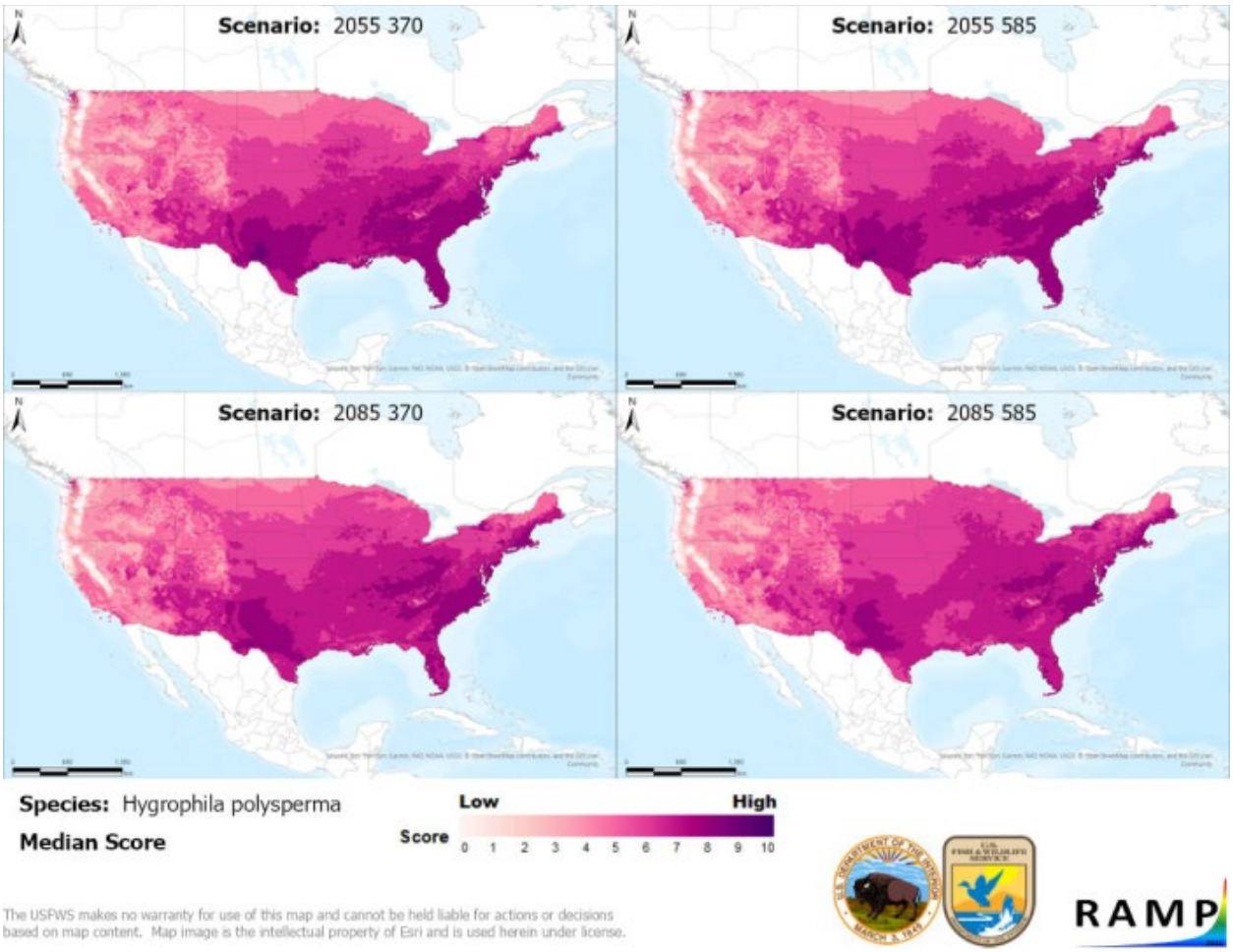

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Hygrophila polysperma* in the contiguous United States. Climate matching is based on source locations reported by Tanaka and Kobokun (2022) and 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.

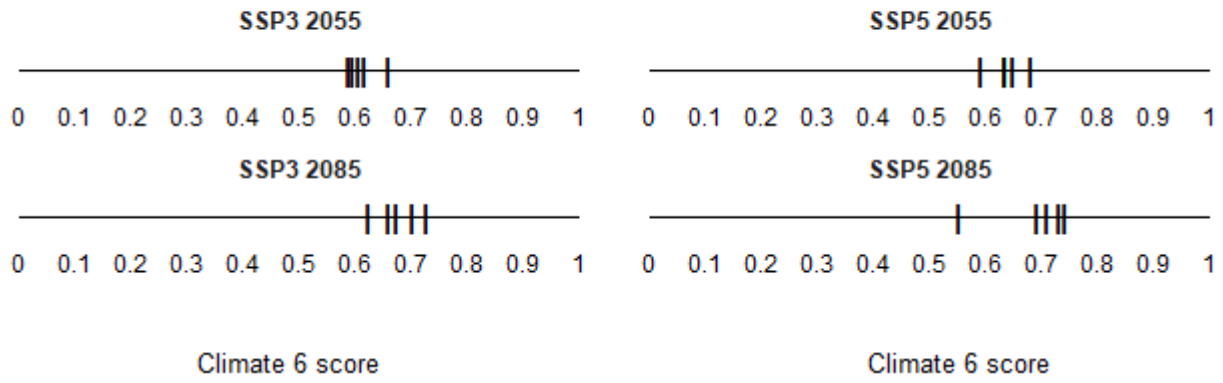

Figure A2. Comparison of projected future Climate 6 scores for *Hygrophila polysperma* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

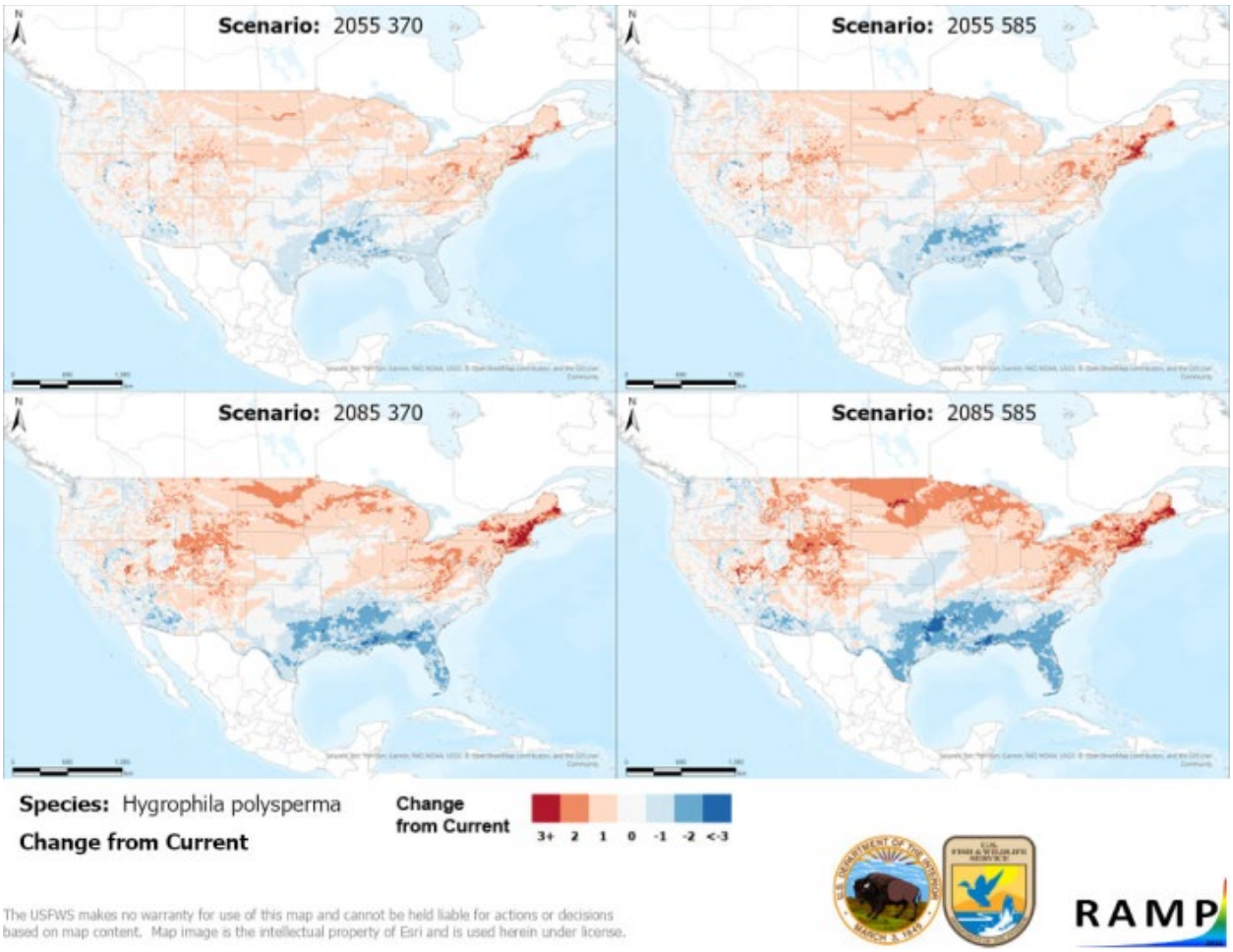

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Hygrophila polysperma* based on source locations reported by Tanaka and Kobokun (2022) and 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.

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