U.S. Fish & Wildlife Service

Crested Floating-heart (*Nymphoides hydrophylla*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, December 2024
Revised, March 2025
Web Version, 9/23/2025

Organism Type: Flowering Plant
Overall Risk Assessment Category: High

Photo: Vengolis. Licensed under CC BY-SA 4.0. Available: https://commons.wikimedia.org/wiki/File:Nymphoides_hydrophylla_7929.jpg (December 2023).

1 Native Range and Status in the United States

Native Range

From Burks (2002):

"In Asia, *Nymphoides cristata* [synonym of *N. hydrophylla*] ranges from India (Clarke 1885) and Sri Lanka (Cramer 1981) to Taiwan (Kuo 1978) and northward into China as far as Jiangsu Province (Ho Ting-Nung and Ornduff 1995)."

Nymphoides hydrophylla is also known from Pakistan (Marwat et al. 2011 under synonym *N. cristata*).

Status in the United States

From Westbrooks et al. (2013):

"Free living populations of Crested floating heart were first observed in cypress swamps and water management canals in southeast Florida in the late 1990s. Within a few years, large canals and suburban lakes in the central and eastern parts of the state had become infested."

"Crested floating heart was first detected in a 20 acre cove near Eutaw Creek at the southeastern end of Lake Marion (Orangeburg County), South Carolina, in August, 2006. […] In 2009, it was estimated that about 2,000 surface acres of Lake Marion are infested with the plant. It has also been found in nearby Lake Moultrie, as well as the Santee River below the Lake Marion dam. Crested floating heart has also been detected in a golf course pond on Pawleys Island, South Carolina (Jack Whetstone, Clemson University, Georgetown, South Carolina. Personal Communication, May 19, 2010)."

Thayer and Pfingsten (2023) report nonindigenous occurrences of *Nymphoides hydrophylla* with establishment in Florida, Louisiana, Mississippi, North Carolina, South Carolina, and Texas.

From Harms and Nachtrieb (2019):

"Currently, *N. cristata* is widely distributed in Florida, and scattered populations occur in Texas, South Carolina, and North Carolina (Nault and Mikulyuk 2013)."

This species is in trade in the United States (e.g., Atlantic Aquariums 2023), although no estimates of trade volume are available.

Regulations

From Benjamin et al. (2021):

"*Nymphoides cristata*, more commonly known as crested floatingheart (CFH), is an invasive aquatic weed that was originally added to this list [Florida Exotic Pest Plant Council's 2019 List of Invasive Plant Species] in 2009 [FLEPPC 2009]. Furthermore, CFH was added to the Florida Department of Agriculture and Consumer Services (FDACS) Noxious Weed List in 2014 making CFH illegal to introduce, multiply, possess, move, or release (Gettys et al. 2017, FDACS 2020)."

Nymphoides hydrophylla is also regulated in South Carolina (SCDNR 2010 under synonym *Nymphoides cristata*) and Texas (TPDW 2022 under synonym *Nymphoides cristata*). 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 Burks (2002):

"The present distribution suggests that the scattered populations likely represent multiple introductions, quite possibly from dumping of cultivated plants."

From Westbrooks et al. (2013):

"Crested floating heart was first introduced to the U.S. as a water garden plant. Once established in a waterway, fragments of the plant are spread by wind, flowing water, boats, and trailers."

Remarks

The scientific name *Nymphoides cristata* has been recently synonymized with *Nymphoides hydrophylla*. Literature referencing both the accepted name, *N. hydrophylla*, and the synonym, *N. cristata*, was used in preparation of this report.

From Tippery et al. (2021):

"Morphological data from published accounts and from herbarium specimens largely fail to distinguish *N. cristata* and *N. hydrophylla*, and several authors already have considered these species to be synonymous (Sivarajan et al. 1989, Li et al. 2002). […] In fact, the ranges for all traits measured in this study were nearly identical between *N. cristata* and *N. hydrophylla*. […] Because we were unable to corroborate any substantial morphological differences between *N. cristata* and *N. hydrophylla*, we recommend continuing to regard these taxa as synonymous, with *N. hydrophylla* holding nomenclatural priority."

According to Harms et al. (2021), *Nymphoides hydrophylla* has been found to hybridize with at least one other *Nymphoides* species (*Nymphoides aquatica*).

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 Asteranae

Order Asterales
Family Menyanthaceae
Genus *Nymphoides*
Species *Nymphoides hydrophylla*

According to WFO (2023), *Nymphoides hydrophylla* (Lour.) Kuntze is the current accepted name for this species.

Size, Weight, and Age Range

From Gettys et al. (2017):

"Crested floatingheart […] produces floating cordate leaves on petioles that may be 2 m (6.56 ft) or more in length, depending on water depth."

Environment

From Willey and Langeland (2011):

"Crested floating heart is typically found rooted in the submersed sediments in shallow water (less than 2 feet deep to about 10 ft deep), depending on water clarity, with its leaves floating on the surface of the water."

Climate

From Willey and Langeland (2011):

"It grows best in tropical to subtropical climate zones […]."

From Burks (2002):

"In Asia, it occurs from 60° to 34° North latitude, […]."

Distribution Outside the United States

Native

From Burks (2002):

"In Asia, *Nymphoides cristata* ranges from India (Clarke 1885) and Sri Lanka (Cramer 1981) to Taiwan (Kuo 1978) and northward into China as far as Jiangsu Province (Ho Ting-Nung and Ornduff 1995)."

Nymphoides hydrophylla is also known from Pakistan (Marwat et al. 2011 under synonym *N. cristata*).

Introduced

No records of introduction outside the United States were found for *Nymphoides hydrophylla*.

From Burks (2002):

"It is not known to occur in Japan (Ohwi 1965). Nor has it been recorded elsewhere for the New World to my knowledge (e.g., VAST 1999, Gray Index 2000)."

Means of Introduction Outside the United States

No records of introduction of *Nymphoides hydrophylla* in the wild outside the United States were found.

Short Description

From Willey and Langeland (2011):

"Crested floating heart is a rooted, floating-leaved aquatic plant. It can be identified by the slender, tapered clusters of tuberous roots on the underside of its floating leaves. The flowers are unique to the species in that they bear an erect fold of tissue that runs down the length of the upper side of the petal."

From Gettys et al. (2017):

"Leaves are up to 25 cm (9.85 in) long and are bright green with a deep-red margin. The flowers of crested floatingheart measure approximately 2 cm across and have five white petals with a central ridge or crest."

Biology

From Willey and Langeland (2011):

"Sexual reproductive ability of crested floating heart in North America is suspected to be monoecious, but this is not known for sure (Burks 2002). Vegetative propagation is commonly observed in this plant, and vegetative reproduction occurs through numerous methods, including tubers, daughter plants […] rhizomes, and fragmentation."

Human Uses

From Mukhopadhyay et al. (2008):

"[…] *N. hydrophylla* has been reported to be grown for amenity purposes in many tropical waterbodies (Ghosh 2005)."

From Bhattacharjee et al. (2019):

"*Nymphoides hydrophylla* (NH) is […] traditionally used to treat fever, insect bites, different ulcers, and also to wash skin, where parasitic affection [sic] occurs."

From Ko et al. (2014):

"*Nymphoides hydrophylla* (NH), a lesser known aquatic vegetable, is a popular dish among the Hakka community in Taiwan."

Diseases

No information was found on diseases associated with *Nymphoides hydrophylla*.

Threat to Humans

No information was found on threats to humans from *Nymphoides hydrophylla*.

3 Impacts of Introductions

From Burks (2002):

"At all Florida sites, *Nymphoides cristata* has spread rapidly in shallow depths (to 2 m) to form mats of overlapping floating leaves […] that shade the water column nearly completely and impede water flow and aeration. Treatments with various forms and combinations of commonly used aquatic herbicides have not yielded long term success. Stands can be reduced to levels of minimum ecological impact but for no more than four months at a time; left untreated, a population can cover a 3.6 ha lake in three to four weeks (Glen Price, Collier County Storm Management, 2001, pers. comm.)."

From Gettys et al. (2017):

"It is clear that populations of crested floatingheart can cause a number of serious problems to humans and the ecosystem. The species interferes with navigation, recreation, flood control, and other water-based, anthropogenic activities throughout the southeastern United States and has grown to problematic levels in most areas in which it has become established (Westbrook [sic] and McCord 2010; Willey and Langeland 2011). Crested floatingheart is intensively managed to preserve or restore the function of invaded water bodies, and chemical control methods are being studied to optimize management of this species."

From Harms et al. (2021):

"We conducted a molecular study of internal transcribed spacer [ITS] sequences to determine whether hybridization has occurred between the North American macrophyte *Nymphoides aquatica* and the invasive *N. cristata* where their distributions overlap in the southeastern United States (US). A hybrid *N. aquatica* x *N. cristata* population was detected within Lake Moultrie, in South Carolina."

"However, we acknowledge the possibility that the *N. aquatica* ITS alleles found in our hybrids originated from hybrid *N. aquatica* x *N. cordata* hybrids. Further, whether *N. cristata* has hybridized with *N. cordata* in areas where these two species overlap is unknown, and warrants additional study."

"If hybridization between *N. cristata* and *N. aquatica* is common across their range of overlap, then there is the potential for large genetic diversity within hybrids, which may influence their phenotypic diversity, including their invasiveness and response to control methods."

Nymphoides hydrophylla (as *N. cristata*) is regulated in Florida (Benjamin et al. 2021), South Carolina (SCDNR 2010), and Texas (TPDW 2022). See section 1.

4 History of Invasiveness

The History of Invasiveness for *Nymphoides hydrophylla* is classified as High. This species has escaped ornamental cultivation and formed wild, established populations in the southern United States, most notably Florida. This species is available in trade in the United States. Documented harmful impacts of *N. hydrophylla* include ecosystem alteration and interference with human navigation and recreation. There is also evidence that *N. hydrophylla* has hybridized with native *Nymphoides* species in the southeastern United States.

5 Global Distribution

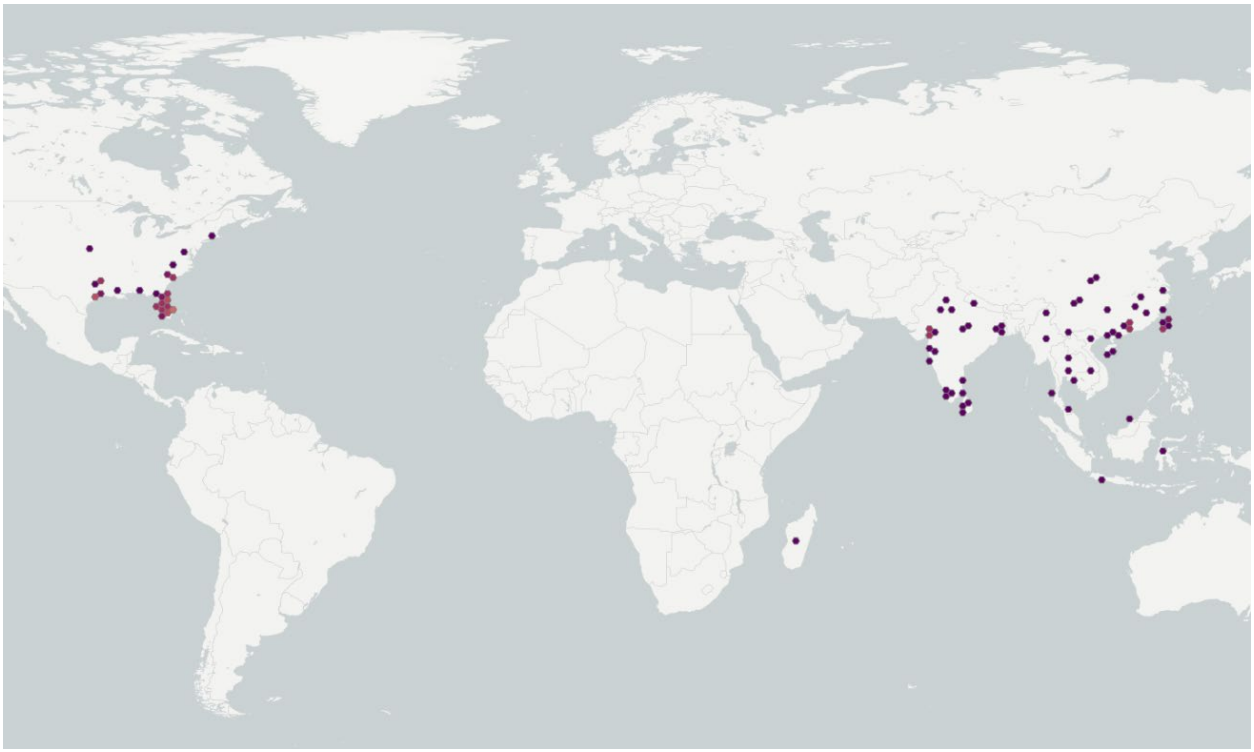

Figure 1. Reported global distribution of *Nymphoides hydrophylla*. Map from GBIF Secretariat (2023). Observations are reported from Brunei, China, India, Taipei, Sri Lanka, Thailand, Indonesia, Myanmar, Nepal, and the United States. A point in Madagascar was excluded from climate matching analysis because it could not be determined if it represents an established population. A point in Kansas was excluded because of incorrect coordinates. Points in New Hampshire and Connecticut were excluded because they represent cultivated specimens.

General collection locations for *Nymphoides hydrophylla* (under synonym *N. cristata*) in Pakistan were given in Marwat et al. (2011).

6 Distribution Within the United States

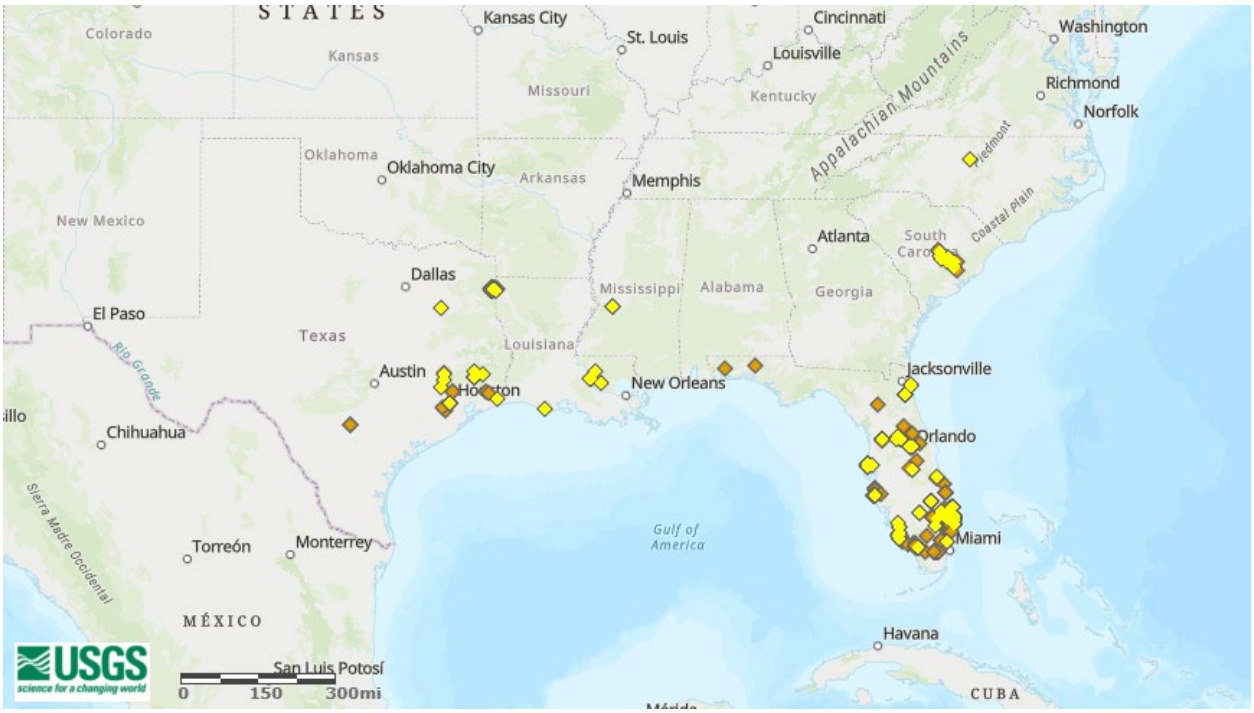

Figure 2. Reported distribution of *Nymphoides hydrophylla* in the United States. Map from USGS (2025). Observations are reported from North Carolina, South Carolina, Florida, Mississippi, Louisiana, and Texas. Points highlighted in yellow had a listed status of "established" and were used in the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate matching analysis for *Nymphoides hydrophylla* to the contiguous United States found areas of high match in the Southeast from eastern Texas to New Jersey. Areas of medium match generally extended from the Desert Southwest through the southern Great Lakes and into southern New England. Much of the Western United States and Northern Plains had low climate matches. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.410, 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 *Nymphoides hydrophylla* (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.

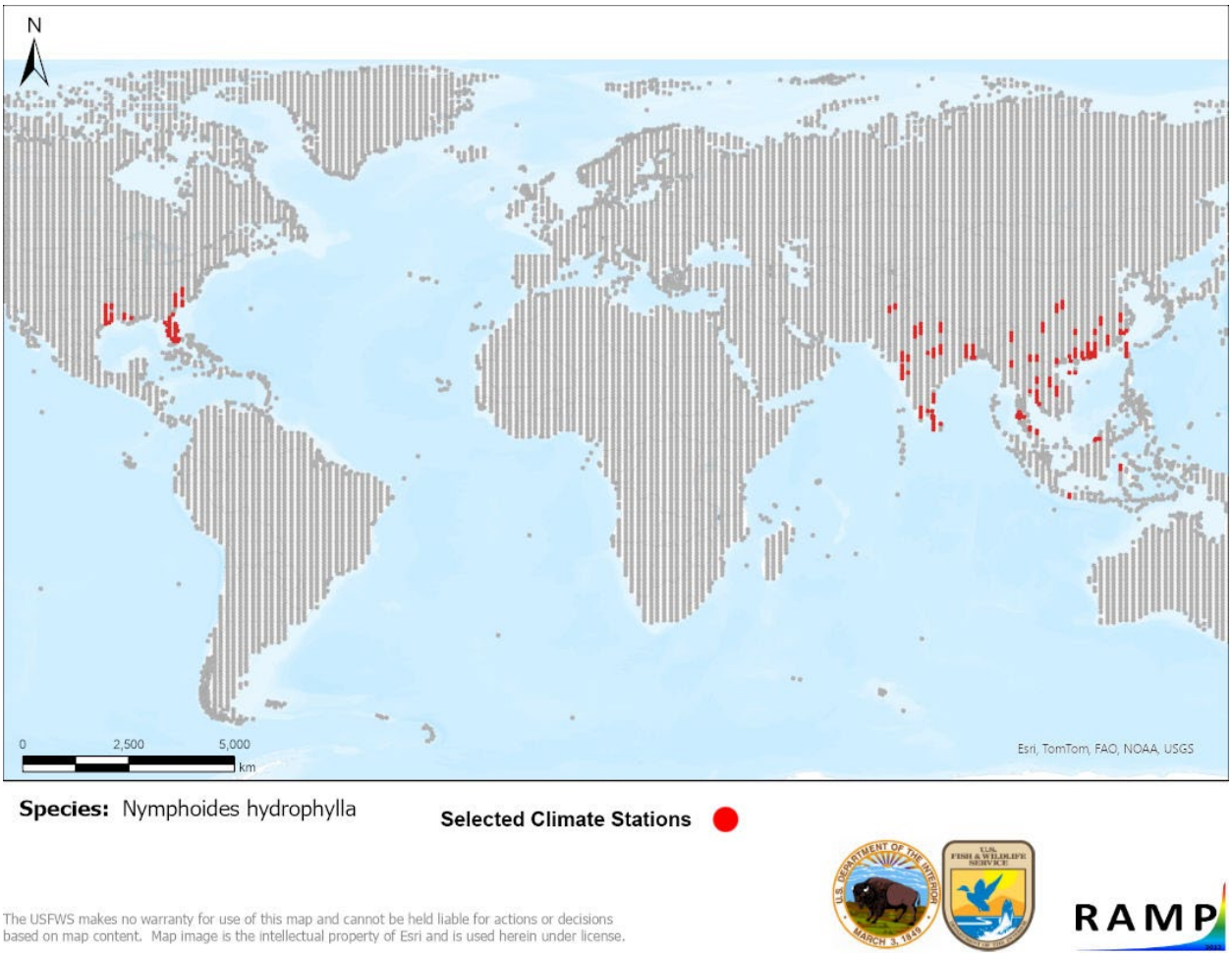

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in Asia and the United States selected as source locations (red; Brunei, China, India, Pakistan, Taipei, Sri Lanka, Thailand, Indonesia, Myanmar, Nepal, and the United States) and non-source locations (gray) for *Nymphoides hydrophylla* climate matching. Source locations from Marwat et al. (2011), GBIF Secretariat (2023), and USGS (2025). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

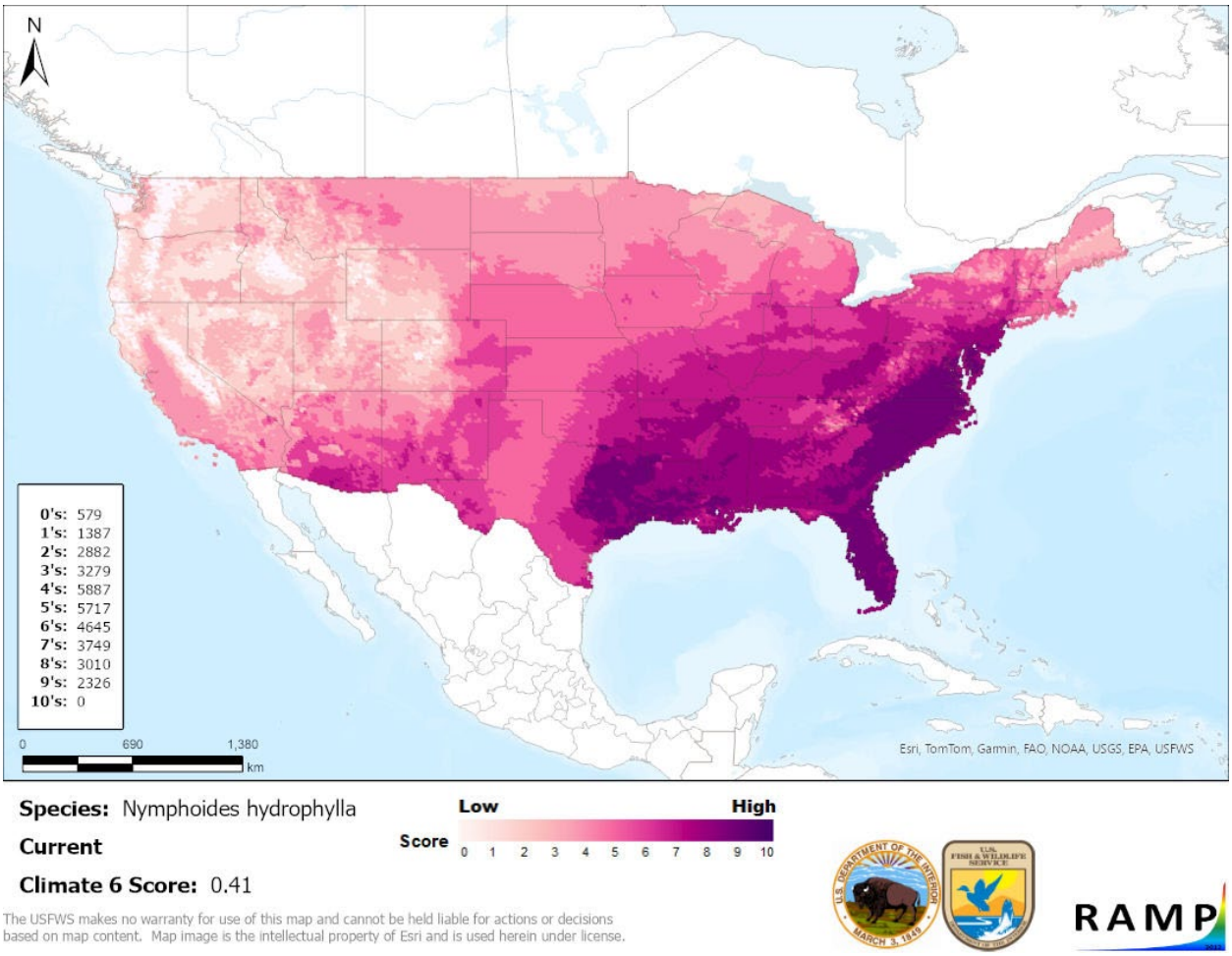

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Nymphoides hydrophylla* in the contiguous United States based on source locations reported by Marwat et al. (2011), GBIF Secretariat (2023), and USGS (2025). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The biology and ecology of *Nymphoides hydrophylla* are well-known. Clear, scientifically-credible information on negative impacts of introductions of this species has been documented by multiple sources. Its invasion history and potential has been well documented. The Certainty of Assessment for *Nymphoides hydrophylla* is classified as High.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Nymphoides hydrophylla, Crested Floating-heart, is an aquatic plant that is native to Asia, ranging from India and Pakistan to China. In its native range it is used for ornamental, medicinal, and food purposes. It was introduced to the United States as an ornamental pond plant. *N. hydrophylla* has been documented as established in Florida, Louisiana, Mississippi, North Carolina, South Carolina, and Texas. Where established, it forms dense mats which block

sunlight, impede water flow, and alter habitats. It may also hybridize with *Nymphoides* species native to the United States. The History of Invasiveness for *Nymphoides hydrophylla* is classified as High due to multiple documented negative impacts of its introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species. Areas of high climate match were found mainly in the eastern United States. The Certainty of Assessment for this ERSS is classified as High. The Overall Risk Assessment Category for *N. hydrophylla* 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: The scientific name *Nymphoides cristata* was recently synonymized with *N. hydrophylla*.**
- **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 Marwat et al. (2011), GBIF Secretariat (2023), and USGS (2025).

Under the future climate scenarios (figure A1), on average, high climate match for *Nymphoides hydrophylla* was projected to occur in the Appalachian Range, 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 Great Basin, Northern Pacific Coast, and Western Mountains regions. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.436 (model: MPI-ESM1-2-HR, SSP5, 2055) to a high of 0.630 (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 (0.410, 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 Colorado Plateau, Great Lakes, and Northeast saw a large increase in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, California, Great Basin, Northern Pacific Coast, Southern Plains, Southwest, 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, Mid-Atlantic, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, and Southwest saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

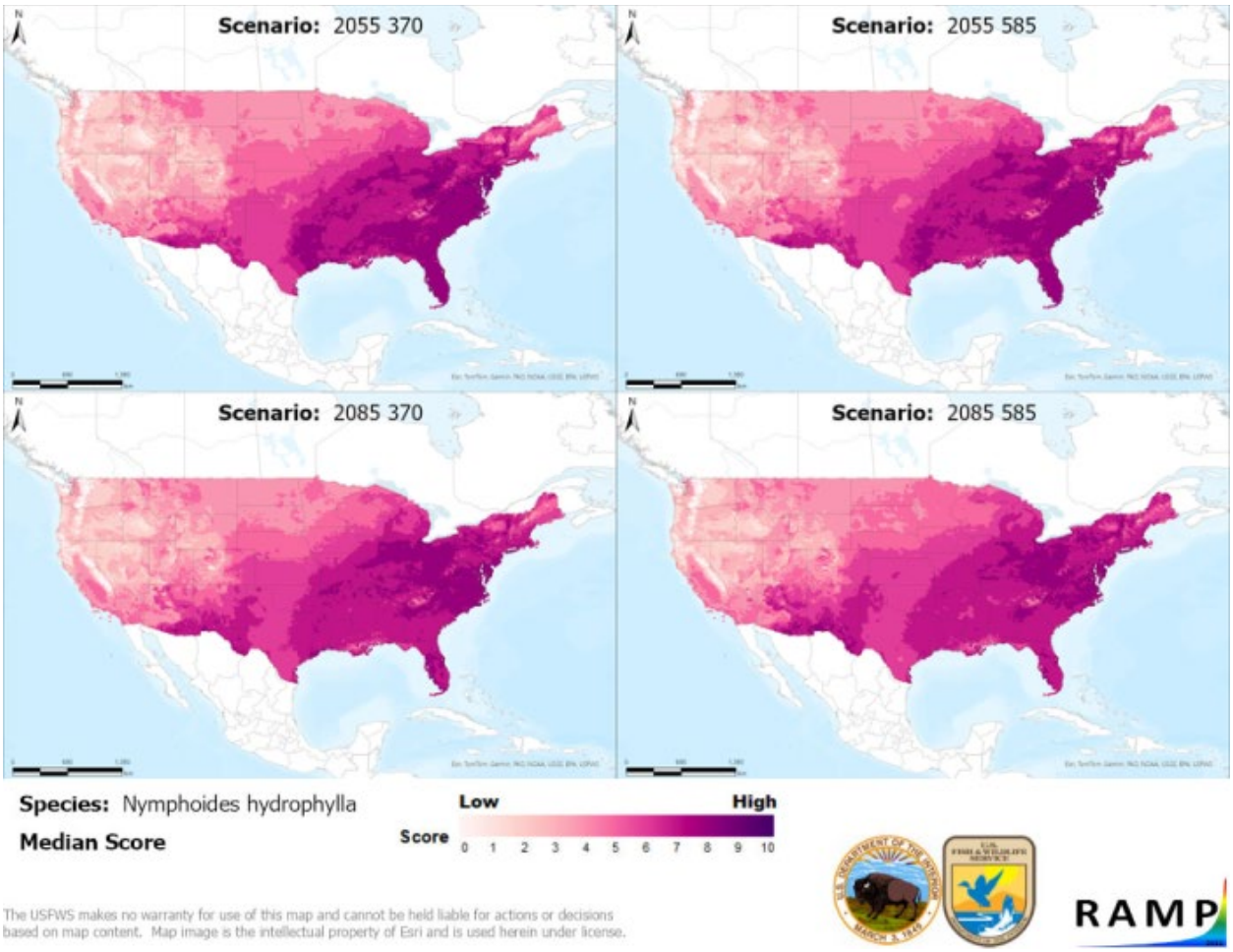

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Nymphoides hydrophylla* in the contiguous United States. Climate matching is based on source locations reported by Marwat et al. (2011), GBIF Secretariat (2023), and USGS (2025). 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.

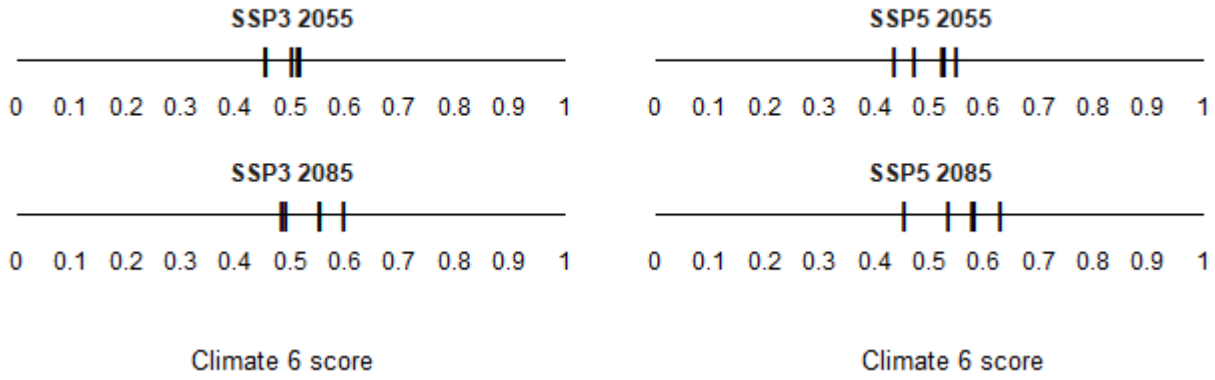

Figure A2. Comparison of projected future Climate 6 scores for *Nymphoides hydrophylla* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

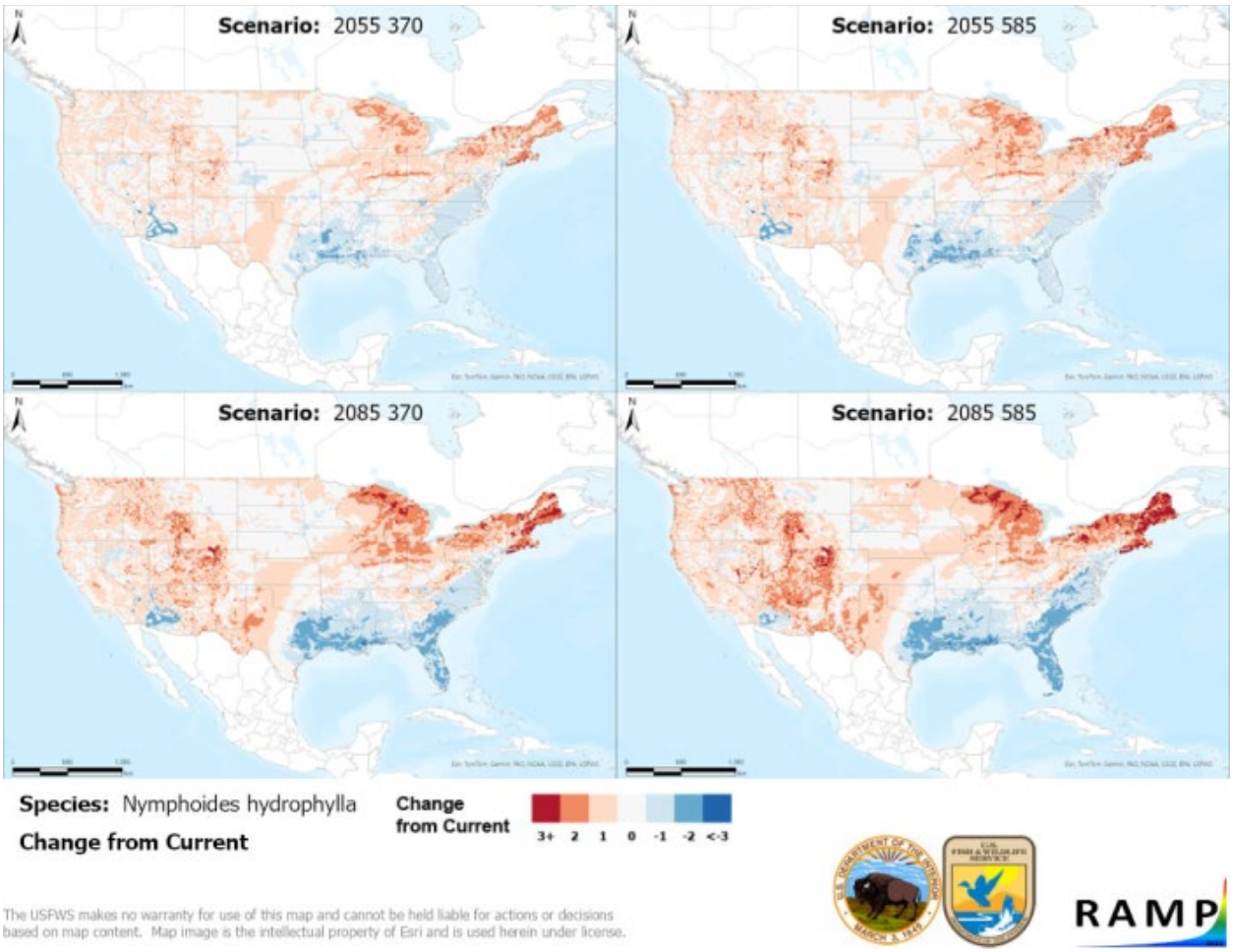

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Nymphoides hydrophylla* based on source locations reported by Marwat et al. (2011), GBIF Secretariat (2023), and USGS (2025). 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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