U.S. Fish & Wildlife Service

Floating Primrose-willow (*Ludwigia peploides*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2023
Revised, July 2023
Web Version, 3/13/2025

Organism Type: Flowering Plant
Overall Risk Assessment Category: High

Photo: Deaver Herbarium (Northern Arizona University) Licensed Under: CC BY-NC. Available: https://cals.arizona.edu/yavapaiplants/imageviewer.php?genus=Ludwigia&species=peploides&imagenum=0 (January 2023).

1 Native Range and Status in the United States

Native Range

From Reddy et al. (2021a):

"The taxa's [*Ludwigia* spp.] amphitropical and disjunct distribution from the South American native range (Raven 1963a,b) and recent phylogenetic results (Liu et al. 2017) have now provided convincing support for recognition of the South American origin for the entire sect. *Jussiaea*, including all *Ludwigia peploides* taxa in the United States."

"[…] molecular data now ascribe the origin [of *Ludwigia peploides* subsp. *glabrescens*] to South America."

From Grewell et al. (2016):

"*L. peploides* (Kunth) Raven subsp. *peploides* is found in Argentina, Paraguay, and Brazil where it is native."

"*Ludwigia peploides* (Kunth) Raven subsp. *montevidensis* (Spreng.) Raven is known to southern South America (Argentina, Uruguay, and southern Brazil) where it is native."

Status in the United States

From Reddy et al. (2021b):

"In the USA, four *Ludwigia* section *Jussiaea* taxa have naturalized in aquatic systems of the South Atlantic, Gulf, and/or Pacific coastal states [Grewell et al. 2016]: [including] *Ludwigia peploides* (Kunth) P. H. Raven subsp. *peploides*; *Ludwigia peploides* (Kunth) P. H. Raven subsp. *montevidensis* (Spreng.) P. H. Raven […]"

From Reddy et al. (2021a):

"In the United States, *L. peploides* subsp. *montevidensis* is naturalized in California, Oregon, Washington, Louisiana, and Oklahoma […]; *L. peploides* subsp. *peploides* is found in the western and southern United States […] (Wagner and Hoch 2005, Hoch and Grewell 2012, Grewell et al. 2016a). *Ludwigia peploides* subsp. *glabrescens* is distributed in eastern and midwestern wetlands and, although now considered exotic, it is not invasive in parts of its naturalized range."

From Grewell et al. (2016):

"In the western U.S., *L. peploides* was the first [*Ludwigia* species] to arrive. The earliest herbarium specimens were collected from 1863-1893 from scattered sites in northern California. During the 20th century, they spread into the San Joaquin Valley and southern California. Although invasive populations are being managed in Portland, *Ludwigia peploides* is still rare in Oregon, with only a few confirmed records. There is a single disjunct record of *L. peploides* in Washington from invasion of a wetland restoration site near Seattle."

"It [*L. peploides* subsp. *peploides*] is also found in the western U.S. from California to Texas where it was long thought to be native; however, the existence of hybrids between other subspecies and molecular evidence from naturalized California specimens suggest a South American origin (Okada et al. unpublished data). […] *Ludwigia peploides* (Kunth) Raven subsp. *glabrescens* (Kuntze) Raven occurs disjuntly [sic] in the U.S. […] and has long been considered native in the eastern, southeastern, and western U.S. including Texas where its range overlaps with *L. p.* subsp. *peploides*. However, […] its disjunct presence in the U.S. may be a naturalized occurrence."

"[*L. peploides* subsp. *montevidensis*] is widely recognized as introduced in disjunct, naturalized populations found in California, Louisiana, Oregon, […]"

From the New York State Department of Environmental Conservation (2022):

"The Long Island Invasive Species Management Area (LIISMA) […] ranks *Ludwigia peploides* as a Tier 2: Emerging Invasive Species on Long Island. Tier 2 invasive species are defined as just starting to become established in localized portions of Long Island, relying on early detection and rapid response efforts for successful control."

From Sturla (2017):

"Floating Primrose Willow is now a significant invasive weed in central Arizona waterways."

From Estes and Thorp (1974):

"Three subspecies occur in the United States: *L. peploides* ssp. *montevidensis* (Sprengel) Raven is introduced and of limited distribution; *L. peploides* ssp.*peploides* is distributed through the Central Valley of California to Oregon; and *L. peploides* ssp. *glabrenscens* (O. Kuntze) Raven is situated in the southeastern United States, west to Texas and Oklahoma."

According to USGS (2023), *Ludwigia peploides* is considered established in the following states: Arkansas, California, Delaware, Florida, Georgia, Indiana, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, and West Virginia. The subspecies *Ludwigia peploides* ssp. *montevidensis* is considered established in the following states: California, New York, Oregon, Texas.

From DiTomaso et al. (2013):

"*L. peploides* is sometimes sold as an aquarium or pond ornamental."

From Grewell et al. (2016):

"Unfortunately, aquatic water primroses and primrose-willows are still sold as decorative plant species for water gardens and aquaria."

Regulations

Ludwigia peploides is regulated in Delaware (Delaware Code 2022; subsp. *glabrescens*), New York (NYDEC 2022a), Oregon (Oregon Department of Agriculture 2022), and Washington (Washington State Noxious Weed Control Board 2021). A 'creeping water primrose' is regulated in Nebraska, no scientific name was given (Nebraska Game and Parks Commission 2023). 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.

From Reddy et al. (2021a):

"[…] listed as a *plant pest* in California."

Means of Introductions within the United States

From Mikulyuk (2009):

"Release from ornamental plantings of *L. peploides* is likely primarily responsible for the introduction of the species in its adventive range. *L. peploides* has been historically valued as an ornamental […]"

Remarks

According to Mikulyuk (2009), common names for *Ludwigia peploides* include: California water primrose, creeping water primrose, creeping water primrose, floating primrose, floating primrose willow, floating primrose willow, floating water primrose, and marsh purslane.

From Washington State Noxious Weed Control Board (2023):

"May Be Confused With**:** Water primrose, *Ludwigia hexapetala*, a Class B noxious weed in Washington, looks very similar, and they can be very difficult to tell apart, even for experts."

This species has three recognized subspecies (WFO 2022; *L. peploides* subsp. *glabrescens*, *L. peploides* subsp. *montevidensis*, and *L. peploides* subsp. *stipulacea*) and a fourth subspecies name (*L. peploides* subsp. *peploides*) that has been synonymized with the parent species with large amounts of information using the various names. Information for all subspecies was included in this document. Some information may be contradictory due to the number of subspecies and differences between them.

According to WFO (2022), this plant is native to multiple locations across the world, such as the Americas, Australia, and East Asia. Several sources also indicate at least one subspecies was considered native to areas of the United States (e.g., Spyreas et al. 2017; POWO 2023; USDA 2023). However, agency reports and peer-reviewed articles such as Grewell et al. (2016) and Reddy et al. (2021a, b) contradict those claims by stating that molecular and genetic testing show the plant originates from South and Central America.

From Grewell et al. (2016):

"It [*L. peploides* subsp. *peploides*] is also found in the western U.S. from California to Texas where it was long thought to be native; however, the existence of hybrids between other subspecies and molecular evidence from naturalized California specimens suggest a South American origin (Okada et al. unpublished data) […] *Ludwigia peploides* (Kunth) Raven subsp. *glabrescens* (Kuntze) Raven occurs disjunctly [sic] in the U.S. and Eastern Asia and has long been considered native in the eastern, southeastern, and western U.S. including Texas where its range overlaps with *L. p*. subsp. *peploides*. However, we have observed *L. p*. subsp. *glabrescens* in Argentina, purchased live specimens from internet sellers, and suspected its disjunct presence in the U.S. may be a naturalized occurrence […]"

From Reddy et al. (2021a):

"However, in several taxonomic treatments, some long-established *Ludwigia* taxa were thought to be native to the United States. For example, native status was attributed to *L. peploides* subsp. *peploides* in California (Hickman 1993). The taxa's amphitropical and disjunct distribution from the South American native range (Raven 1963a,b) and recent phylogenetic results (Liu et al. 2017) have now provided convincing support for recognition of the South American origin for the entire sect. *Jussiaea*, including all *Ludwigia peploides* taxa in the United States. […] In addition, creeping water primrose [*Ludwigia peploides* (Kunth) P. H. Raven subsp. *glabrescens* (Kuntze) P. H. Raven] has long been considered native in the eastern to midwestern United States, but it has been observed in South America, and molecular data now ascribe the origin to South America."

From Mikulyuk (2009):

"*L. peploides* is native to South and Central America, […] as well as perhaps Australia (McGregor et al., 1996; USDA-ARS, 1997). A number of sources indicate that *L. peploides* is 'likely' to be native to Australia, but there is some disagreement regarding its nativity to Australia (CEH, 2007)."

From EPPO (2011a):

"In France, *Ludwigia grandiflora* and *L. peploides* are no longer imported because sale and introduction in natural areas has been forbidden by law since 2007 (Ministère de l'écologie et du développement durable, 2007). In Belgium, there is a Royal Decree at the federal level under construction to prohibit the import and export of *L. grandiflora* and *L. peploides* and regional decrees to prohibit the sale, distribution and release into the wild of both species (Branquart, pers. comm. 2011). In Switzerland, there is a federal decree prohibiting the trade of *L. grandiflora* and *L. peploides* (Swiss Confederation, 2008). As of 2011-01-01, the signatories of the Dutch Code of conduct should stop selling *Ludwigia grandiflora* and *L. peploides* (Anon, 2010)."

From Jo et al. (2024):

"It is also included in Portugal's national invasive species list, where its possession, breeding, and trade are prohibited [Invasoras.pt 2023]. In the UK, under Schedule 9 of the Wildlife and Countryside Act 1981, it is illegal to plant this species in the wild in England and Wales [GB Non-Native Species Secretariat 2023]. In New Zealand, it is classified as an "Unwanted Organism" under the Biosecurity Act 1993, and permission must be obtained for its movement, trade, and release [Grewell et al. 2016]."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophyta
Class Magnoliopsida
Superorder Rosanae
Order Myrtales
Family Onagraceae
Genus *Ludwigia*
Species *Ludwigia peploides* (Kunth) P.H. Raven
Direct Children:
Subspecies *Ludwigia peploides ssp. glabrescens*
Subspecies *Ludwigia peploides ssp. montevidensis*
Subspecies *Ludwigia peploides ssp. peploides*

According to WFO (2022), *Ludwigia peploides* is the current valid name for this species.

Size, Weight, and Age Range

From Sturla (2017):

"Floating Primrose Willow may be floating, matted or creeping, stems prostrate or erect and may branch out 9 feet more or less."

"**Leaves:** Green, bright green and shiny; leaves up to 4 inches or so, leaf shape oblong or round, glabrous or with pubescence above."

Environment

From Washington State Noxious Weed Control Board (2023):

"Floating water-primrose grows along freshwater shorelines and sprawls across the water's surface. It typically inhabits margins of lakes, ponds, ditches and streams. It can tolerate water depths up to around 10 feet."

From Grewell et al. (2016):

"[…] *L. peploides* are most often found from 0.6 m (2 feet) above standing water to 1 m (3.3 feet) deep, but they tolerate depths up to 3 m (9.8 feet) and are also found at greater distances from standing water (Lambert et al. 2010)."

"Differences in environmental tolerances among subspecies are unknown, but the three diploid taxa [*L. peploides* subspecies] are predicted to be ecologically more similar to each other than to the polyploid invaders."

From EPPO (2011a):

"*Ludwigia peploides* is also found […] colonizing brackish waters (Mesleard & Perennou, 1996)."

Climate

According to Mikulyuk (2009), *Ludwigia peploides* prefers a warm temperate climate that can range from wet all year or with a dry summer, with warm average temps > 10°C and cold average temps > 0°C. *Ludwigia peploides* can tolerate a tropical monsoon climate, a tropical wet and dry savanna climate, a steppe climate, and a continental climate with wet or dry seasons. It has a latitude range of 49°N to 40°S.

Distribution Outside the United States

Native

From Reddy et al. (2021a):

"The taxa's [*Ludwigia* spp.] amphitropical and disjunct distribution from the South American native range (Raven 1963a,b) and recent phylogenetic results (Liu et al. 2017) have now provided convincing support for recognition of the South American origin for the entire sect. *Jussiaea*, including all *Ludwigia peploides* taxa in the United States."

"[…] molecular data now ascribe the origin [of *Ludwigia peploides* subsp. *glabrescens*] to South America."

From Grewell et al. (2016):

"*L. peploides* (Kunth) Raven subsp. *peploides* is found in Argentina, Paraguay, and Brazil where it is native."

"*Ludwigia peploides* (Kunth) Raven subsp. *montevidensis* (Spreng.) Raven is known to southern South America (Argentina, Uruguay, and southern Brazil) where it is native."

Introduced

From Grewell et al. (2016):

"Specimens document the taxa [*L. peploides* ssp. *peploides*] in Nicaragua and Australia where is has been introduced."

"It [*L. peploides* ssp. *montevidensis*] is widely recognized as introduced in disjunct, naturalized populations found in […] Cuba, Belgium, France, Italy, the Netherlands, Portugal, Spain, Switzerland, the United Kingdom (UK), Australia, and New Zealand."

From Zotos et al. (2006):

"*Ludwigia peploides* (Kunth) Raven subsp. *montevidensis* (Spreng) Raven […] was introduced and established in eastern Australia and New Zealand and locally naturalized in west Europe. This taxon is herein reported as a new alien taxon for Greece and the Balkans."

According to the New Zealand Plant Conservation Network (2023), *Ludwigia peploides* was naturalized in 1933 on the North Island of New Zealand.

From EPPO (2011a):

"*Ludwigia peploides* has already established in several EPPO countries (Belgium, France, Italy, Greece, the Netherlands, Spain, Turkey, and the UK)."

"In Turkey, the first outbreak of *L. peploides* has been recorded in 1998 near Antalya, and there is no evidence of spread to new sites, either locally or anywhere else in the country (Güner et al., 2000)."

From EPPO (2011b):

"According to Verloove & Gullon (2008), *Ludwigia peploides* has been recorded to be well naturalized at various localities along river El Llobregat in the province of Barcelona [Spain], and it also recorded in La Selva del mar [sic] in the Province of Gerona [sic; Spain]"

"*L. peploides* was first observed in Belgium in 1995 (Branquart et al., 2010), and has established isolated populations in Flanders."

From Jo et al. (2024):

"*L. peploides* have spread into natural ecosystems [in South Korea] through rivers, and their distribution is gradually expanding in Suwon, Hwaseong, and Busan [Kim et al. 2019]."

From POWO (2023):

"Introduced into:
Belgium, Cook Is., Fiji, France, Greece, Portugal, Romania, Society Is. [French Polynesia], Spain, Tadzhikistan, Tubuai Is. [French Polynesia]"

Means of Introduction Outside the United States

From Zotos et al. (2006):

"Portions of the plant have been recorded as being carried on the plumage of birds (Salanom, 1999) for several miles between bodies of water. This, together with the transfer of plant material by boats, are the main methods by which this taxon is thought to have spread throughout north-western Europe over the last 30 years."

From Grewell et al. (2016):

"In the 20th century*, Ludwigia peploides* was introduced as an ornamental plant in southern France, and it has since spread northwest to the Loire River […]"

From Mikulyuk (2009):

"*L. peploides* has been historically valued as an ornamental; ornamental plantings likely explain its introduction to Europe (Ruaux et al., 2009) […] *L. peploides* was introduced from the Americas to Montpellier in France in the 1830s, likely as a result of ornamental plantings."

Short Description

From Swearingen and Bargeron (2016):

"*Ludwigia peploides* is a perennial herbaceous plant of wetlands whose sprawling stems usually grow flat along mud or the surface of the water."

"Leaves are alternately arranged and vary in shape and size, from lanceolate to ovate. They range from 0.5-4 in. (1.27-10.2 cm) long. Leaves are hairless and have smooth margins. Leaf petioles range from 1-1.5 in. (2.5-3.8 cm) long."

"*L. peploides* has solitary flowers are held on stems arising from the upper leaf axils. Stems can be floating or lying on the ground. Flowers have five bright notched yellow petals, 0.4-0.6 in. (1-1.5 cm) long."

From Grewell et al. (2016):

"The flowers of *L. peploides* are smaller than those of the polyploid species and usually have 10 stamens. […] and fruit capsules can be ~ 10-30 mm (0.4-1.2 inches) long. Sepals are persistent on capsules after petal drop. […] Bracteoles (or "bractlets") near the base or up to the middle of the ovary are usually dark green, deltoid-squamate, and 0.5-1 mm (0.02-0.04 inches) long. […] The buoyant shoots of plants float on the water or on stolons root from nodes as they creep across wet soil."

Biology

From Lower Hudson PRISM (2009):

"Floating primrose willow reproduces both vegetatively, via stem fragments, and sexually, via prodigious production of seed. Stem fragments are buoyant and easily dispersed by water or, potentially even longer distances by waterfowl."

From Mikulyuk (2009):

"*L. peploides* is an emergent and floating herbaceous perennial macrophyte […] *L. peploides* (including all subspecies) is a diploid species with chromosomes numbering 16 (2n). Zardini et al. (1991) report that nearly all species in sect. *Oligospermum* can hybridize and produce vigorous offspring. The species has demonstrated a high degree of phenotypic plasticity."

From EPPO (2011a):

"*Ludwigia grandiflora* and *L. peploides* are outcrossing plants, pollinated by insects, with germination requiring cold stratification."

From Grewell et al. (2016):

"*Ludwigia peploides* plants are self-compatible, and pollinating bees are frequent visitors."

"In France, *L. peploides* is self-compatible and produced many seed capsules and seeds; […] High seed output of 10,000 seeds/m^2 is reported for *L. peploides* and *L. hexapetala* from the Loire River, France (Dandelot 2004)."

"In general, water primroses have high growth rates. […] Rejmánková (1992) demonstrated that *L. peploides* from California could regenerate 67% or its biomass within 45 days after 95% of it was experimentally cut and removed."

Human Uses

From Harms and Grodowitz (2012):

"The species is a popular aquarium plant and has beneficial uses, including food for waterfowl (Whitley et al., 1999) and invertebrates (Harms and Grodowitz, 2009), and in aquatic-restoration projects (Dick et al., 2004)."

From Mikulyuk (2009):

"*L. peploides* has been historically valued as an ornamental […]"

"There has been some study regarding the use of this plant in the treatment of wastewater. It is capable of producing large amounts of biomass in the presence of elevated nitrogen levels (Rejmánková, 1992). However, it may be less adept at removing dissolved phosphorus, as an Australian study reports it had negative growth in all phosphorus concentrations investigated (Wen and Recknagel, 2002) […] Water garden enthusiasts may have an aesthetic appreciation of this species […] Little information is available regarding other beneficial social uses of the plant […] Due to the plant's phenotypic plasticity, it could possibly be used in the reclamation of severely impacted ecosystems."

From Smida et al. (2018):

"The extract [of *Ludwigia peploides*] displays antioxidant and anti-acne effects as well as inhibition potential of B16 melanoma cells proliferation."

Diseases

No information was found on diseases associated with *Ludwigia peploides*.

Threat to Humans

No information was found on threats to humans from *Ludwigia peploides*.

3 Impacts of Introductions

Many impacts are reported under '*Ludwigia* ssp.' due the difficulty of distinguishing between the species. The information presented below is attributed to *Ludwigia peploides* but may not cover the full extent of impacts due to other impacts being reported at the genus level.

From Mikulyuk (2009):

"This species has an allelopathic effect that impacts water quality throughout the year. When the plant is at nuisance levels, the effects on dissolved oxygen, sulphide, phosphate, and pH levels can lead to impoverished flora by decreasing seedling survival of vulnerable native taxa (Dandelot et al., 2008). Its tendency to grow in thick mats also contributes to physical alteration of the environment, making it unsuitable for sensitive species […] When invasive, this species causes declines in biodiversity (EPPO, 2004) through shading, competitive exclusion, and chemical allelopathic alteration of the growing environment. Due to the species' allelopathic activity, it poses a severe threat to vulnerable native flora (Dandelot et al., 2005). Additionally the plant provides little in terms of suitable habitat. The dense surface matting excludes the growth of native species, shades out submersed aquatic vegetation, and is inhospitable for fish and invertebrates."

From Branquart et al. (2010):

“Water primroses are highly detrimental to the environment in Western Europe. They quickly develop and make very thick monospecific floating carpets at the surface of water bodies. They alter the physico-chemical quality of water (reduction of light and dissolved oxygen) and possess an allelopathic activity that influences the water quality throughout the year and reduces the germination and survival rates of other plant species.”

From Harms and Grodowitz (2012):

“Despite its benefits, floating primrose-willow can become problematic in [areas formerly considered the native range but now included in the introduced range, see Remarks] (Barrett and Seaman, 1980; Whitley et al., 1999), spreading by vegetative growth to form dense stands that create habitat for mosquitoes and anoxic conditions in water (Anderson, 2003), restricting access to water along shorelines, and threatening rare species of plants with extinction (Dandelot et al., 2005).”

From California Invasive Plant Council (2023:

“*Ludwigia peploides* (creeping water-primrose) is a perennial aquatic plant (family Onagraceae) that forms very dense, virtually impenetrable mats which restrict fishing and boat access. It also out competes native aquatic plants.”

From Grewell et al. (2016):

“The European and Mediterranean Plant Protection Organization (EPPO) risk analysis for *L. peploides* and *L. grandiflora* report that these species interfere with agricultural production, ecosystem services, and human use of water bodies. These impacts include deterioration of dams and other water management infrastructure, loss of recreation areas, increase in flood risk due to reductions of channel carrying capacity, and high economic consequences incurred for control of the weeds (EPPO 2011[c], 2011[d]).”

“*L. peploides* is reported as a weed in rice fields in Argentina, Australia, California, Chile, and Columbia [sic].”

From NYDEC (2022b):

“Thick growth within ditches and culverts can drastically alter habitats by impeding the movement of water and displacing native plant species.”

“*Ludwigia peploides* produces dense mats of vegetation that can sprawl along shorelines and grow within slow-moving channels, impeding access and navigation within waterbodies. These mats prohibit swimming, boating, and fishing in infested areas of the river.”

From Swearingen and Bargeron (2016):

"*L. peploides* forms dense, fast-growing, floating mats that can displace native aquatic plants, wetland grasses, lower dissolved oxygen and pH of the water, reduce water quality for wildlife and increase sedimentation."

Ludwigia peploides is regulated in California, Delaware, New York, Oregon, and Washington. See section 1.

4 History of Invasiveness

The History of Invasiveness for *Ludwigia peploides* is classified as High. While historically there was some debate on the native range of *Ludwigia peploides* and its subspecies within the United States, it is now considered introduced in the United States. It has also been introduced to and spread throughout Central Europe. Large mats of the species can impede water flows, shade out and out compete native species, impact water quality, and flood regimes. It can also impede recreational use of waterways.

5 Global Distribution

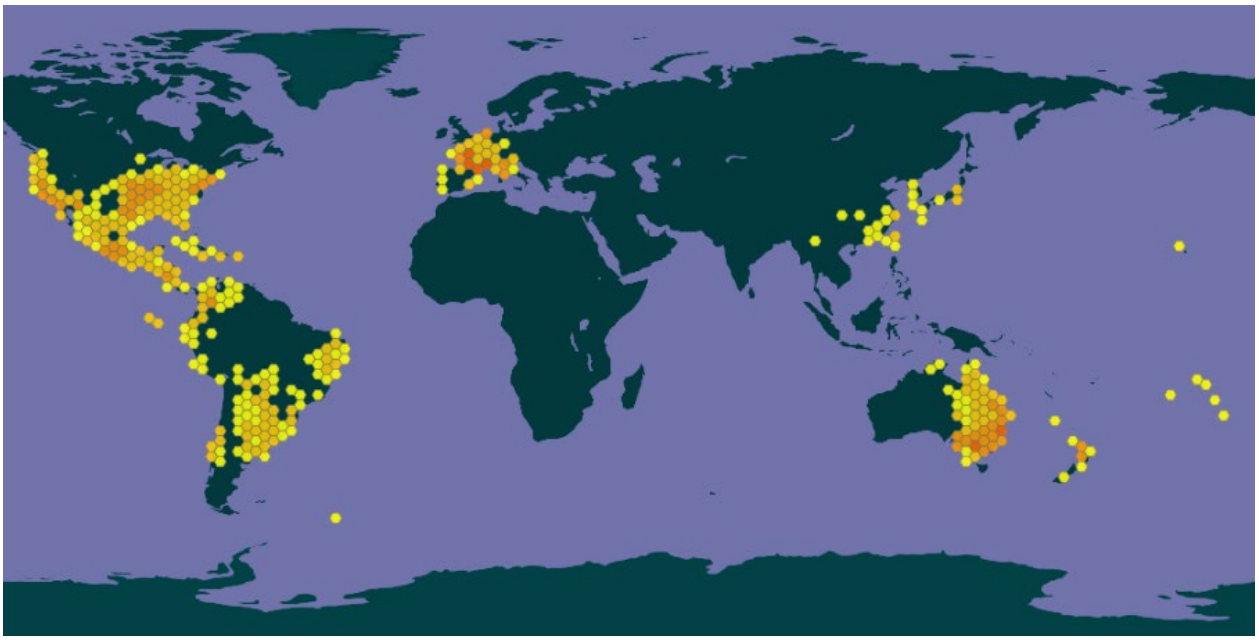

Figure 1. Reported global distribution of *Ludwigia peploides*. Map from GBIF (2022). Observations are reported from the North America, Central America, South America, Central and Western Europe, Japan, China, Taiwan, Australia, French Polynesian Islands, Cook Islands, and New Zealand. The occurrence reported in the southern Atlantic Ocean was not used to select source points for the climate matching analysis because the coordinates do not match the verbal description of the occurrence location. Points in central and southwestern China were not used because no confirmation was found of populations in these areas.

6 Distribution Within the United States

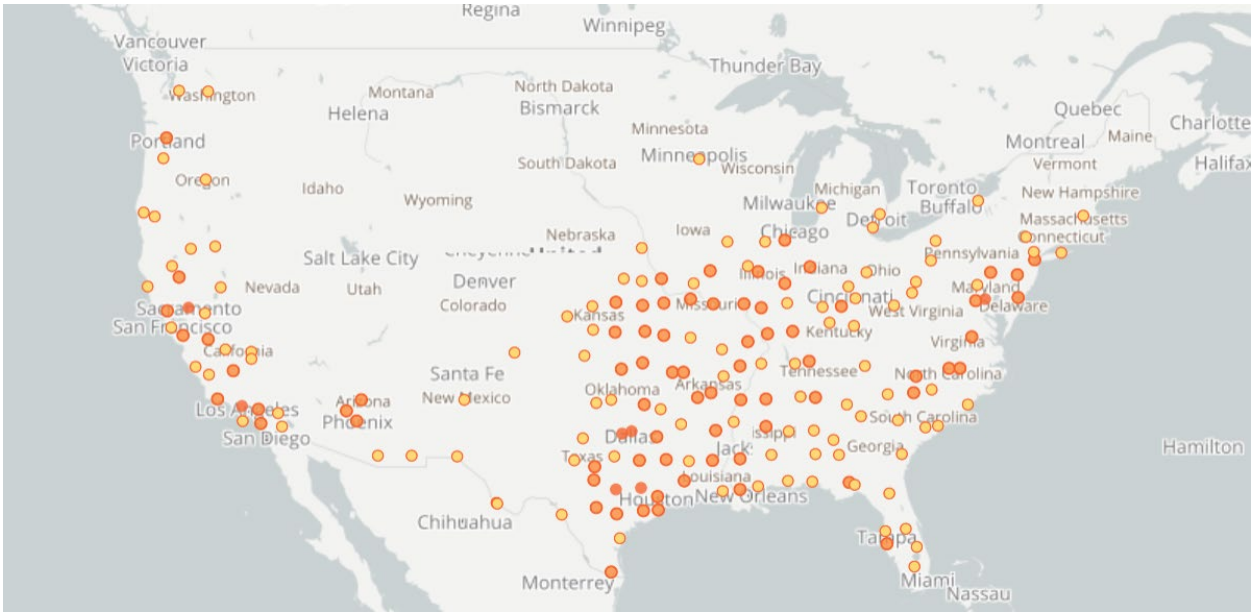

Figure 2. Reported distribution of *Ludwigia peploides* in the United States. Map from GBIF-US (2023). Observations are reported from the East and West Coasts, southern and eastern Midwest, southwest and the Gulf region. Point in Minnesota does not represent an established population and was not used in the climate matching analysis.

Figure 3. Reported distribution of *Ludwigia peploides* in Puerto Rico. Map from GBIF-US (2023). Observations are reported throughout the main island.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match analysis indicated high climate matches throughout most of the contiguous United States. There were areas of medium match in the Colorado Plateau, Western Mountains, Great Basin, and in patches along the northern Pacific Coast. There were no areas of low match. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.985, 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 *Ludwigia peploides* (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.

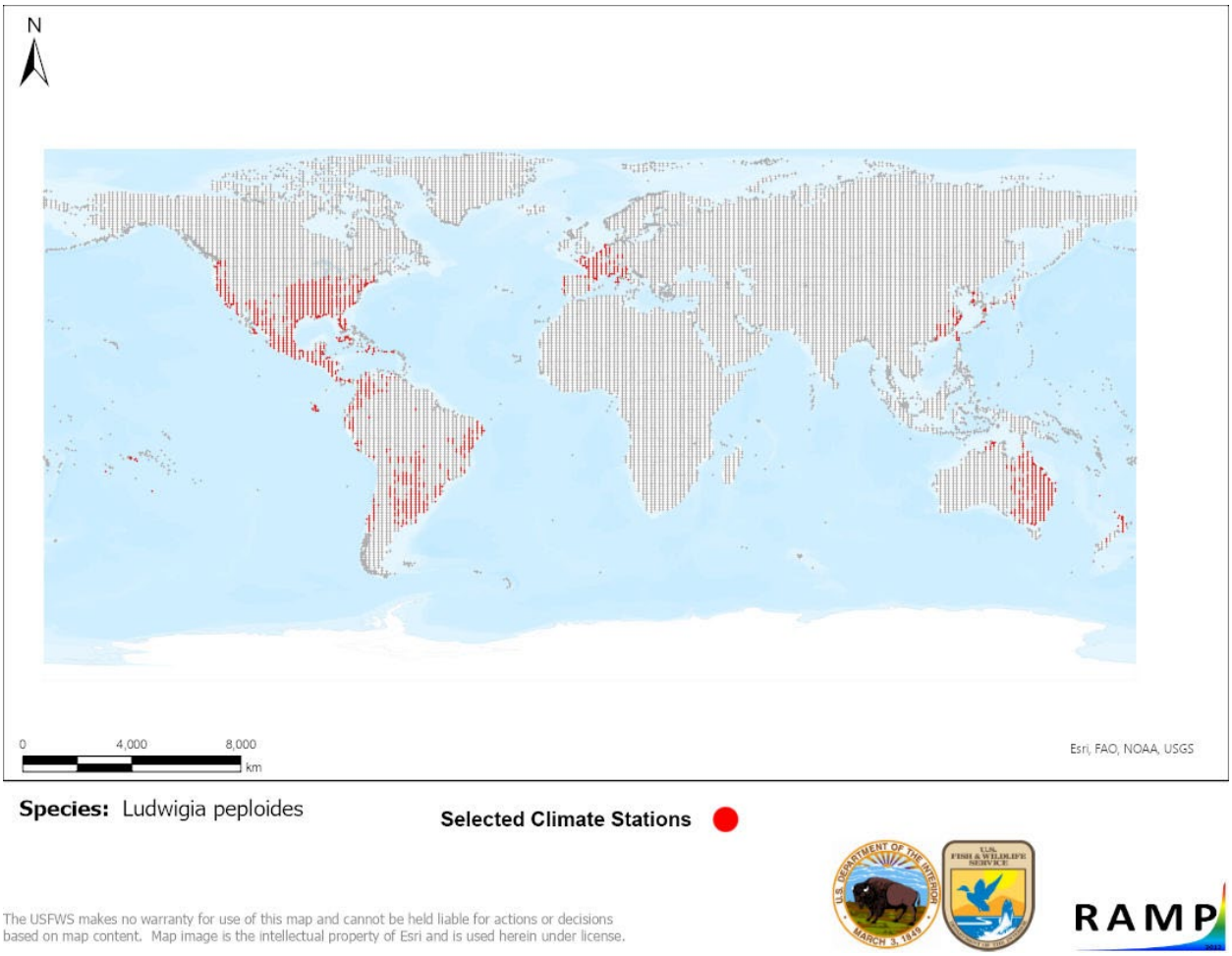

Figure 4. RAMP (Sanders et al. 2023) source map showing weather stations across the world selected as source locations (red; United States, Central America, Northwestern, Eastern and Southern South America, Western Europe, Japan, South Korea, China, Australia, and New Zealand) and non-source locations (gray) for *Ludwigia peploides* 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.

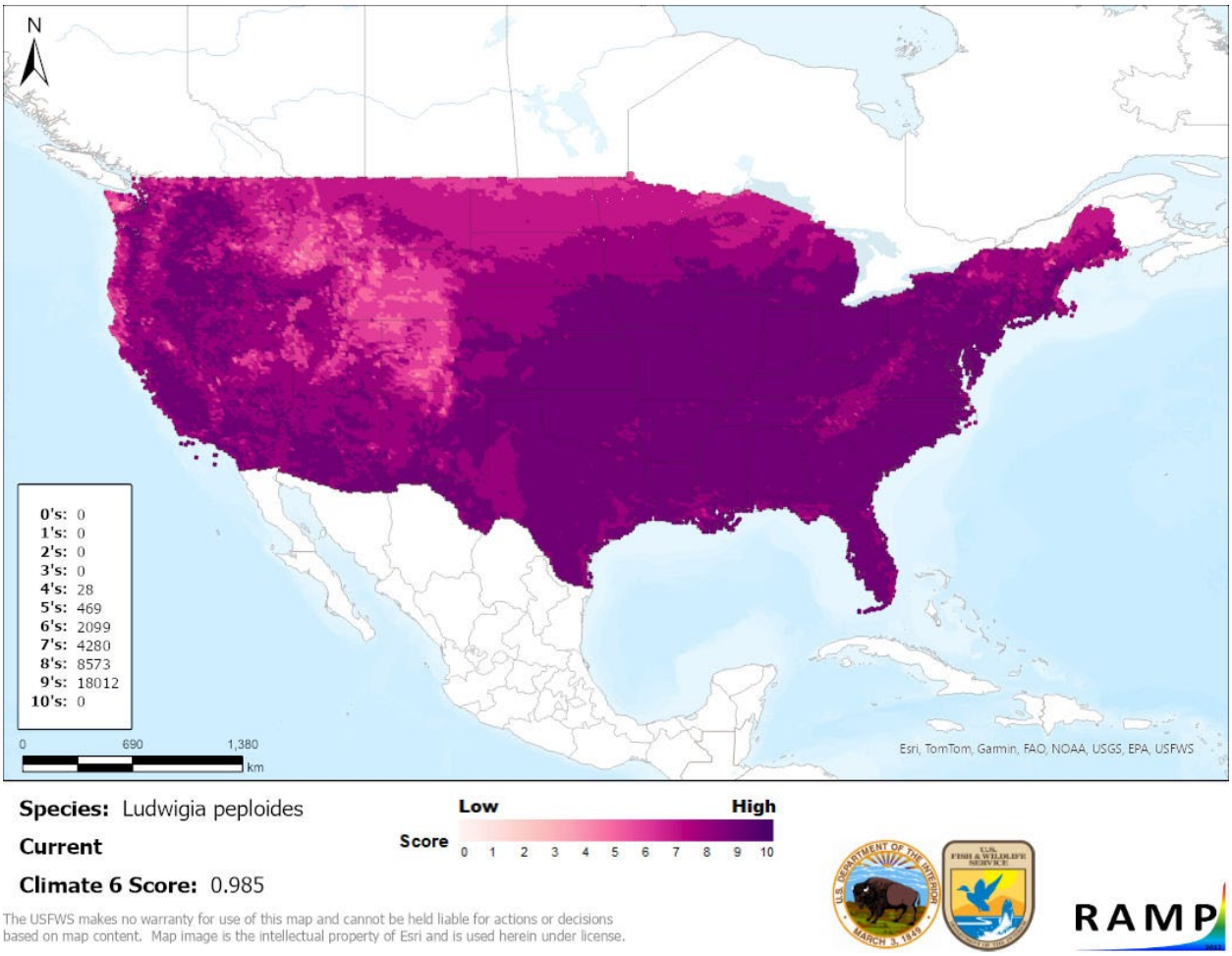

Figure 5. Map of RAMP (Sanders et al. 2023) climate matches for *Ludwigia peploides* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Ludwigia peploides* is classified as Medium. There is adequate information regarding the species biology, ecology, introductions, and impacts. Historically, there has been uncertainty regarding the native range of this species, adding complexity to the interpretation of information on distribution and impacts of introduction. This species is also difficult to distinguish from closely related *Ludwigia* sp. and some information is only reported at the genus level.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Ludwigia peploides, floating primrose-willow, is a flowering plant native to South America. There are multiple subspecies each with slightly different described native ranges. This species inhabits a variety of freshwater habitats and creates floating mats along the water's surface.

L. peploides has been introduced to and is considered invasive in many portions of the United States and several countries in Europe. Several negative impacts from introductions have been documented. *L. peploides* has shown to negatively impact water quality, decrease biodiversity, and interfere with native wildlife. It also impacts recreational usage of waterways. At least four States regulate this species. The History of Invasiveness for *Ludwigia peploides* is classified as High due to the records of introductions resulting in established nonnative populations and the associated documented negative impacts. The climate matching analysis indicates establishment concern for this species. The majority of the contiguous United States had a high match. Areas of medium match were found in the Western Mountains and Colorado Plateau. The Certainty of Assessment is classified as Medium due to the history of confusion regarding the native range of the species and the potential from some information to be confused between closely related congeners. The Overall Risk Assessment Category for *Ludwigia peploides* in the contiguous United States is High.

Assessment Elements

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

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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2022).

Under the future climate scenarios (figure A1), on average, high climate match for *Ludwigia peploides* was projected to occur in nearly all regions of the contiguous United States, including the Appalachian Range, California, Colorado Plateau, Great Basin, Great Lakes, Gulf Coast, Mid-Atlantic, Northeast, Northern Plains, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.968 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.997 (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 (0.985, figure 5) 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, Northeast, Northern Plains, 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 California saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Great Basin, Gulf Coast, Mid-Atlantic, Northeast, Northern Pacific Coast, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. The degree of change and extent of areas with moderate change increased with time. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

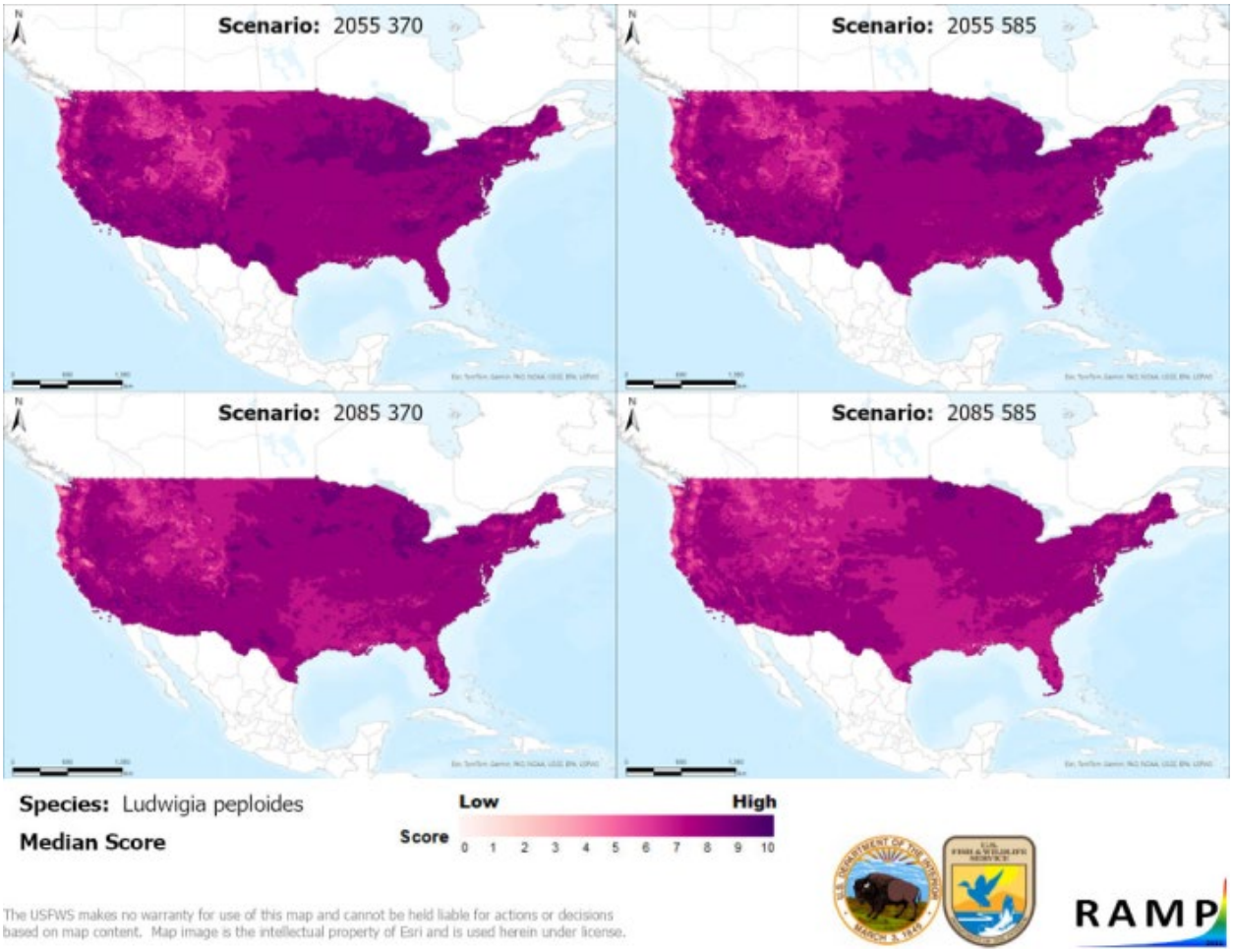

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Ludwigia peploides* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2022). Shared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

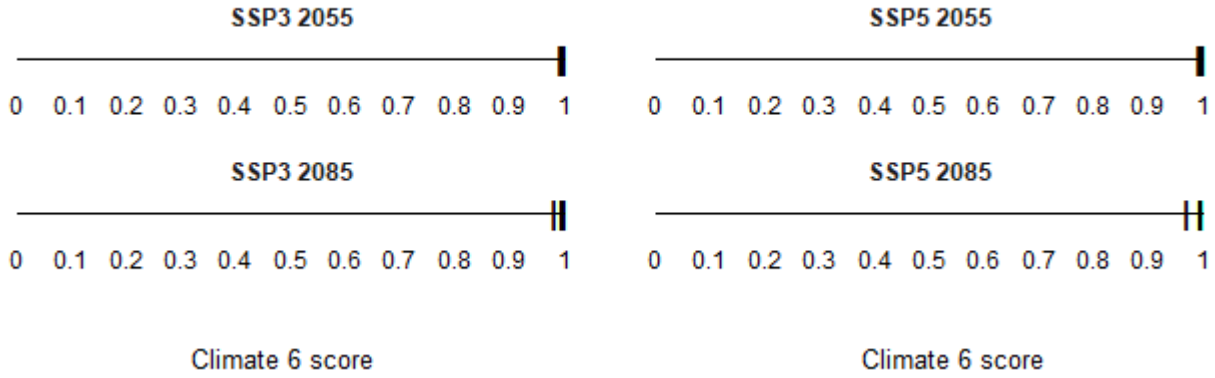

Figure A2. Comparison of projected future Climate 6 scores for *Ludwigia peploides* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

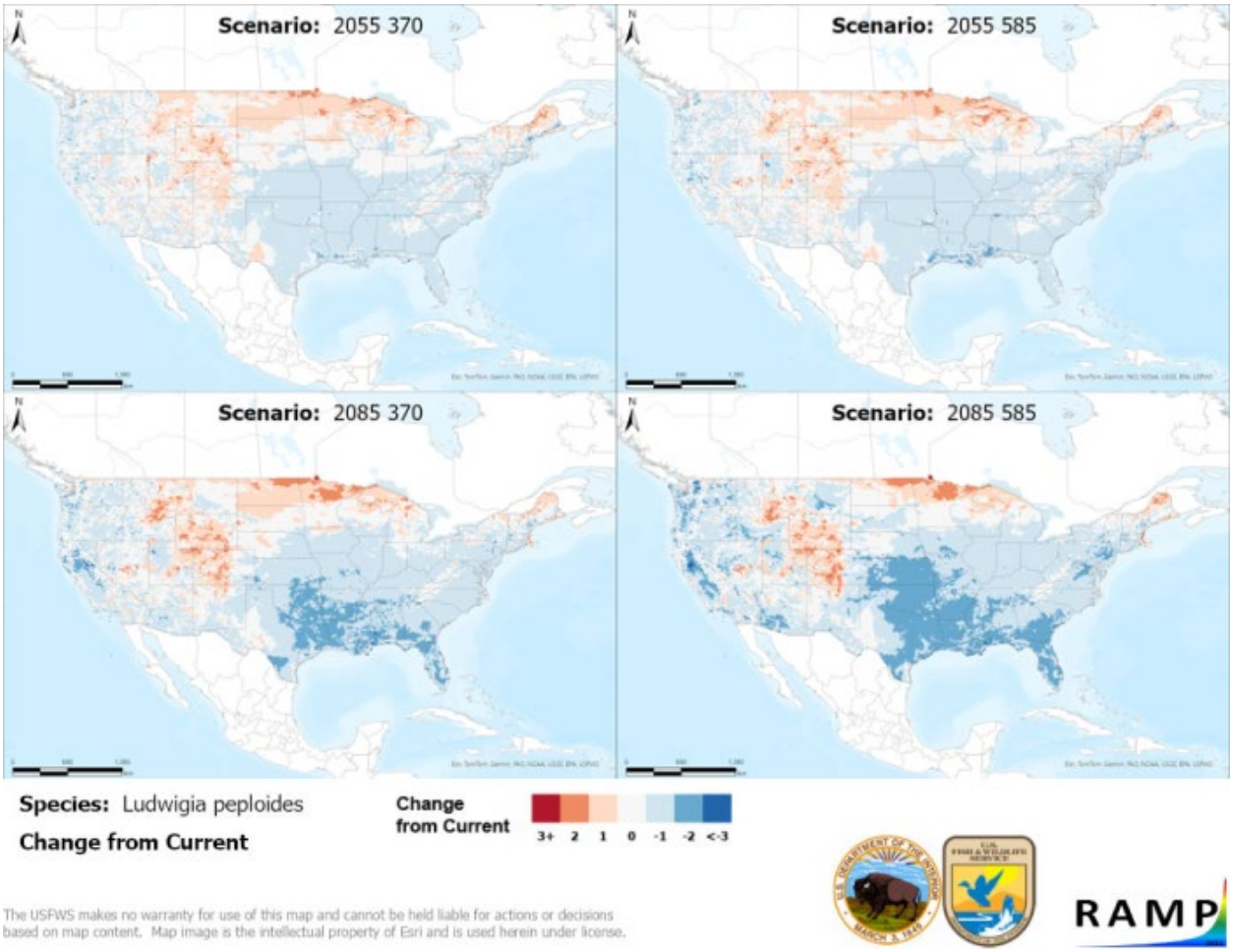

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 5) and the median target point score for future climate scenarios (figure A1) for *Ludwigia peploides* based on source locations reported by GBIF 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.

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