Mexican Primrose-willow (*Ludwigia octovalvis*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2022
Revised, June 2022
Web Version, 7/21/2022

Organism Type: Plant
Overall Risk Assessment Category: High

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1 Native Range and Status in the United States

Native Range

From eFloras (2022):

"[…] widespread throughout Africa, S, SE, and SW Asia, Australia, Europe, North America, Pacific islands, South America […]"

From POWO (2022):

"Native to:
Alabama, Angola, Argentina Northeast, Assam [India], Bahamas, Bangladesh, Belize, Benin, Bismarck Archipelago [Papua New Guinea], Bolivia, Borneo, Brazil North, Brazil Northeast, Brazil South, Brazil Southeast, Brazil West-Central, Burkina [Burkina Faso], Cambodia, Cameroon, Cape Verde, Caroline Is. [Federated States of Micronesia, Palau], Cayman Is., Chad, Chile North, China South-Central, China Southeast, Colombia, Congo, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Eritrea, Ethiopia, Fiji, Florida, French Guiana, Gabon, Gambia, Georgia, Ghana, Guatemala, Guinea, Guinea-Bissau, Guyana, Hainan [China], Haiti, Honduras, Ivory Coast, Jamaica, Japan, Jawa [Indonesia], Kenya, KwaZulu-Natal [South Africa], Laos, Leeward Is. [group of Caribbean islands including Anguilla, Antigua and Barbuda, British and U.S. Virgin Islands, Guadeloupe, Montserrat, St. Kitts and Nevis, and St. Martin], Lesser Sunda Is. [Indonesia], Liberia, Louisiana, Madagascar, Malawi, Malaya [Malaysia], Mali, Maluku [Indonesia], Marianas [Northern Mariana Islands], Marshall Is., Mauritius, Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southeast, Mexico Southwest, Mississippi, Mozambique, Myanmar, Nansei-shoto [Japan], Nepal, Netherlands Antilles [Curaçao], New Guinea, New South Wales [Australia], Nicaragua, Niger, Nigeria, North Carolina, Northern Territory [Australia], Panamá, Paraguay, Peru, Philippines, Puerto Rico, Queensland [Australia], Rodrigues [Mauritius], Réunion, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Solomon Is., South Carolina, Sri Lanka, Sudan, Sulawesi, Sumatera [Indonesia], Suriname, Taiwan, Tanzania, Texas, Thailand, Tibet, Togo, Trinidad-Tobago, Uganda, Venezuela, Venezuelan Antilles, Vietnam, Western Australia, Windward Is. [group of Caribbean islands including Barbados, Dominica, Grenada, Martinique, St. Lucia, and St. Vincent and the Grenadines], Yemen, Zambia, Zimbabwe"

From Francis (2004):

"The original range of primrose willow is unknown. It grows today from Southern United States through the West Indies, and from Mexico through Central and South America to at least Bolivia (Hodgdon Herb[a]rium 2002, Natural Resources Conservation Service 2002). It […] grows in tropical and subtropical regions almost worldwide (Burkill 1997, Howard 1989, Liogier 1995)."

Status in the United States

According to USDA, NRCS (2022), *Ludwigia octovalvis* is native to Alabama, Florida, Georgia, Hawaii, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, Texas, and the U.S. Virgin Islands. However, some authors have suggested that *L. octovalvis* was introduced to Hawaii prior to European contact.

From Leach (2005):

"St John's (1978) study of the first collection of Hawaiian plants, made by Nelson in 1779, revealed seven weeds that may have inadvertently been brought by human agency at an earlier time [including] the willow primrose of probable American origin (*Ludwigia octivalvis* [sic] syn. *Jussiaea suffruticosa*), a plant characteristic of wet habitats; […]"

PIER (2018) classifies *L. octovalvis* as introduced and invasive (indicating establishment) in American Samoa (Swain's Island and Tutuila Islands) and Guam.

No regulations on *L. octovalvis* in the United States were found.

This species is difficult to find in trade in the United States. One Texas-based seller was found on eBay, offering 500 seeds for $3.00 (eBay 2022).

Means of Introductions in the United States

From Leach (2005):

"But for the islands with no European contact history prior to Cook, Merrill (1946, p. 339) wrote: 'yet even as the Polynesians themselves may possibly have introduced the sweet potato from America into Polynesia, at the same time they may also have introduced a few American weeds'."

"As Merrill (1946) showed, distinguishing the unintentional Polynesian introductions requires intensive study of the history of collecting on those islands on which the first European visits involved botanists. Hawaii is a significant example."

Remarks

From CABI (2021):

"L. octovalvis [sic] has a complex pattern of variation which makes it difficult to assign formal taxonomic categories. Raven (1963) recognized four subspecies, two of which have distinct ranges.

1. subsp. brevispala [sic] (Brenan) Raven
The only representative of the species present over much of Africa: sepals <6 mm long.
All other subspecies have sepals >6 mm long.

2. subsp. macropoda [sic] (Presl) Raven
The only one along the west coast of South America, from Ecuador to northern Chile.

3. subsp. sessiliflora [sic] (Mich.) Raven
With a range largely distinct from that of subsp. octovalvis [sic] within South America, but overlapping and confused in the Old World. Only subsp. sessiliflora [sic] is found in New Caledonia and southern India; it has a wider range in China, to southern Japan, but a much narrower range in the Pacific, only as far as Fiji. This subspecies is usually distinguishable from subsp. octovalvis [sic] by the presence of long erect hairs on the leaves, and ovate or subovate leaves (while subsp. octovalvis [sic] typically has few or no hairs, and lanceolate or linear leaves).

4. subsp. octovalvis [sic]
Uncommon in Africa; but nearly throughout India, to south-east China and Taiwan, and as far south as Australia, and through the Pacific to Hawaii, Tahiti and the Marquesas."

From eFloras (2022):

"The pattern of variation in this cosmopolitan species is extremely complex and needs further careful analysis; in the absence of a more definitive treatment, we have abandoned the subspecies recognized by Raven [1963]."

From Raven and Tai (1979):

"The kinds of densely pubescent, robust plants that we referred earlier to *L. octovalvis* subsp. *sessiliflora* (Mich.) Raven are especially distinctive in their extreme form, but they often grow side-by-side with less densely pubescent, more slender plants, the differences maintained by autogamy. […] To attempt to recognize the differences between these two sorts of plants in the formal taxonomy does not seem to accord with the biological realities of a remarkably complex species, and we now agree with Sreemadhavan (1966) that the species should not be subdivided formally (Raven, 1977)."

WFO (2022) lists numerous scientific name synonyms for this species, including:

Epilobium fruticosum Lour.
Jussiaea angustifolia Lam.
Jussiaea calycina C. Presl
Jussiaea clavata Jones
Jussiaea didymosperma H. Perrier
Jussiaea frutescens Jacq. f. ex DC.
Jussiaea fruticosa (Lour.) DC.
Jussiaea haenkeana Steud.
Jussiaea hirsuta Mill.
Jussiaea ligustrifolia Kunth
Jussiaea macropoda C.Presl
Jussiaea occidentalis Nutt. ex Torr. & A. Gray
Jussiaea octofila DC.
Jussiaea octonervia Lam.
Jussiaea octovalvis (Jacq.) Sw.
Jussiaea parviflora Cambess.
Jussiaea persicariaefolia f. major Schltdl.
Jussiaea peruviana var. octofila (DC.) Bertoni
Jussiaea pubescens L.
Jussiaea sagreana A. Rich.
Jussiaea suffruticosa L.
Jussiaea venosa C. Presl
Jussiaea villosa Lam.
Ludwigia angustifolia (Lam.) M. Gómez
Ludwigia pubescens (L.) H. Hara

Ludwigia sagreana (A. Rich.) M. Gómez
Ludwigia suffruticosa (L.) M. Gómez
Oenothera octovalvis Jacq.

Information for this report was gathered using the valid scientific name (*L. octovalvis*) and all the synonyms listed above, with special attention to *J. suffruticosa* as the most commonly used synonym over the past 50 years.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to WFO (2022), *Ludwigia octovalvis* is the accepted scientific name for this species.

From ITIS (2022):

Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Rosanae
Order Myrtales
Family Onagraceae
Genus *Ludwigia*
Species *Ludwigia octovalvis* (Jacq.) P.H. Raven

Size, Weight, and Age Range

From FAO (2022):

"A bi-annual […] that can grow to 100 cm tall."

From eFloras (2022):

"[…] perennial […] Stems 25-400 cm tall […]"

Environment

From eFloras (2022):

"Moist to wet places along streams, ponds, or lakes, often on disturbed and/or cultivated sites […] near sea level to 2200 m."

From Lansdown et al. (2019):

"This species is found in wide [sic] range of humid and wet places, including marshes, lakes and streams, ditches, on gravelly riverbeds and sandy or silty flood banks, rice fields and flooded grasslands."

"Freshwater"

From Sánchez-García et al. (2017):

"The germination of seven species occurring in coastal freshwater marshes in central Veracruz on the Gulf of Mexico was evaluated. […] The three most salt-tolerant species were *T. domingensis, L. octovalvis* and *C. digitatus*. Additionally, germination was higher under saturated conditions for all species except for *B. cylindrica*."

From CABI (2022):

"L. octovalvis [sic] is found in wet places, and experimental evidence confirms that it is highly tolerant of fluctuating water levels (Mohankumar and Alexander, 1989). The periderm of the plant tissues swells rapidly when immersed in water: this is probably a defence [sic] against waterlogging (Angeles, 1992). Like many rice weeds, the plant responds strongly to application of nitrogenous fertilizer (up to 100 kg/ha) by increased dry matter accumulation […] (Gaffer, 1985; Kim and Moody, 1989)."

Climate

From POWO (2022):

"Tropics & Subtropics"

Distribution Outside the United States

Native

From eFloras (2022):

"[…] widespread throughout Africa, S, SE, and SW Asia, Australia, Europe, North America, Pacific islands, South America […]"

From POWO (2022):

"Native to:
[…] Angola, Argentina Northeast, Assam [India], Bahamas, Bangladesh, Belize, Benin, Bismarck Archipelago [Papua New Guinea], Bolivia, Borneo, Brazil North, Brazil Northeast, Brazil South, Brazil Southeast, Brazil West-Central, Burkina [Burkina Faso], Cambodia, Cameroon, Cape Verde, Caroline Is. [Federated States of Micronesia, Palau], Cayman Is., Chad, Chile North, China South-Central, China Southeast, Colombia, Congo, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Eritrea, Ethiopia, Fiji, […] French Guiana, Gabon,

Gambia, […] Ghana, Guatemala, Guinea, Guinea-Bissau, Guyana, Hainan [China], Haiti, Honduras, Ivory Coast, Jamaica, Japan, Jawa [Indonesia], Kenya, KwaZulu-Natal [South Africa], Laos, Leeward Is. [group of Caribbean islands including Anguilla, Antigua and Barbuda, British Virgin Islands, Guadeloupe, Montserrat, St. Kitts and Nevis, and St. Martin], Lesser Sunda Is. [Indonesia], Liberia, […] Madagascar, Malawi, Malaya [Malaysia], Mali, Maluku [Indonesia], Marianas [Northern Mariana Islands], Marshall Is., Mauritius, Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southeast, Mexico Southwest, […] Mozambique, Myanmar, Nansei-shoto [Japan], Nepal, Netherlands Antilles [Curaçao], New Guinea, New South Wales [Australia], Nicaragua, Niger, Nigeria, […] Northern Territory [Australia], Panamá, Paraguay, Peru, Philippines, […] Queensland [Australia], Rodrigues [Mauritius], Réunion, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Solomon Is., […] Sri Lanka, Sudan, Sulawesi, Sumatera [Indonesia], Suriname, Taiwan, Tanzania, […] Thailand, Tibet, Togo, Trinidad-Tobago, Uganda, Venezuela, Venezuelan Antilles, Vietnam, Western Australia, Windward Is. [group of Caribbean islands including Barbados, Dominica, Grenada, Martinique, St. Lucia, and St. Vincent and the Grenadines], Yemen, Zambia, Zimbabwe"

From Francis (2004):

"The original range of primrose willow is unknown. It grows today […] through the West Indies, and from Mexico through Central and South America to at least Bolivia (Hodgdon Herberium 2002, Natural Resources Conservation Service 2002). It […] grows in tropical and subtropical regions almost worldwide (Burkill 1997, Howard 1989, Liogier 1995)."

Introduced

From POWO (2022):

"Introduced into:
Andaman Is. [India], Botswana, Burundi, Cabinda [Angola], Cape Provinces [South Africa], Central African Repu[blic], Cook Is., East Himalaya [Bhutan, China, India], Gilbert Is. [Kiribati], Gulf of Guinea Is. [Equatorial Guinea, São Tomé and Principe], […] India, Line Is. [Kiribati], Marquesas [French Polynesia], Namibia, Nauru, Nicobar Is. [India], Northern Provinces [South Africa], Ogasawara-shoto [Japan], Samoa, Society Is., Swaziland [Eswatini], Tokelau-Manihiki [New Zealand/Cook Islands], Tonga, Tuamotu [French Polynesia], Tubuai Is., Tuvalu, Wallis-Futuna Is., West Himalaya [India, Pakistan], Zaïre [Democratic Republic of the Congo]"

PIER (2018) classifies *L. octovalvis* as introduced and invasive in the Federated States of Micronesia (Kosrae Island), Fiji (six islands), French Polynesia (Gambier Islands, Marquesas Islands, Society Islands, Tuamotu Archipelago, Tubuai Islands), Kiribati (Gilbert Islands), Marshall Islands, Nauru, Papua New Guinea, La Réunion Island, and Seychelles Islands.

PIER (2018) reports the native versus nonnative status of *L. octovalvis* in Singapore as uncertain.

Establishment is also confirmed for introductions to Botswana (Ellery 2003), Central African Republic (Harris 2002), Cook Islands (McCormack 2007), Equatorial Guinea (Ghogue 2011),

Eswatini (Germishuizen 1997), Futuna (Prebble 2008), Japan (Mito and Uesugi 2004), Namibia (Burke 2000), Northern Line Islands (Wester 1985), Samoa (Whistler 1992), South Africa (Germishuizen 1997), Tokelau (Whistler 1988), Tonga (Fall 2010), and Tuvalu (Woodroffe 1985).

No further information could be found in the English language literature to confirm establishment in the Andaman Islands, Bhutan, Burundi, the Cabinda Province of Angola, the Democratic Republic of the Congo, the Nicobar Islands, or Pakistan.

Means of Introduction Outside the United States

From Fall (2010):

"Although Whistler (1995) suggests that *Ludwigia octovalvis* is a European introduction, the evidence presented below suggests it may have been introduced inadvertently by Polynesians. […] In Tonga, *Ludwigia* pollen first appears in Lapita-age sediments at Lotofoa Swamp (Zone LF 4) (Flenley et al. 1999). At Ngofe Marsh a single Onagraceae (cf. *Ludwigia*) pollen grain is found in association with *Colocasia* pollen in sediments dated to about 2000 yr BP."

Shukla and Sinha (2012) report the introduction of *L. octovalvis* to Chhattisgarh, India, as unintentional.

According to James et al. (2014), viable seeds of *L. octovalvis* were identified from a soil sample transported in a sea container from Tonga to New Zealand.

From Prebble (2008):

"Riley (1926) first collected this plant from Rapa in 1924, the earliest known record for the Austral Archipelago. Fosberg and St. John (1934) later recorded *L. octovalvis* from most of the Austral Islands."

"Guppy (1906:533) has indicated that the seeds of *Ludwigia* (*Jussiaea*) demonstrate a degree of buoyancy ('a few days'), and may be capable of long-distance dispersal, although this has not been successfully demonstrated. It seems more likely that this plant was transported as an inadvertent introduction embedded in soil attached to plants traded between or introduced to islands."

From Francis (2004):

"Long-distance dispersal is probably accidental on birds, machinery, or materials being shipped."

Short Description

From eFloras (2022):

"Herbs robust, erect, perennial, sometimes woody at base or even shrubby. Stems […] well-branched, densely spreading pubescent at least on upper stem, or puberulous or subglabrous. Petiole 1-10 mm; leaf blade linear to subovate, 1-14 × 0.3-4 cm, lateral veins 11-20 per side,

submarginal vein prominent, base narrowly or broadly cuneate, apex attenuate. Sepals 4, ovate or lanceolate, 6-15 mm. Petals yellow, broadly obovate, 6-17 × 5-17 mm. Stamens 8; filaments 1-4mm; anthers 1.2-4 mm; pollen in tetrads. Style 1.5-3.5 mm; stigma subglobose, shallowly 4-lobed. Capsule pale brown with 8 darker ribs, cylindric, terete, 1.7-4.5 cm, 2-8 mm in diam., thinly walled, readily and irregularly loculicidal; pedicel 1-10 mm. Seeds in 2 or more rows per locule, free, brown, 0.6-0.75 mm, raphe inflated and equal in size to seed body, evenly transversely ridged."

Biology

From FAO (2022):

"This weed is propagated by seeds, some of which germinate immediately in wet or flooded soils."

From Raven and Tai (1979):

"The kinds of densely pubescent, robust plants that we referred earlier to *L. octovalvis* subsp. *sessiliflora* (Mich.) Raven are especially distinctive in their extreme form, but they often grow side-by-side with less densely pubescent, more slender plants, the differences maintained by autogamy. In South America and Africa, the two sorts are nearly exclusively tetraploid (n = 16), whereas in Asia, the kinds of plants that exhibit parallel patterns of variation are almost all hexaploid (n = 24)."

"[…] autogamy [i.e., self-fertilization] is certainly the rule in all populations of this species worldwide."

From Francis (2004):

"After primrose willow plants in the tropics reach about 0.4 m, blooming and fruiting is continuous (author's observation, Long and Lakela 1976). In Texas, it is reported to bloom from July through October (Correll and Johnston 1970). Seeds collected in Puerto Rico averaged 54 million per kg. Placed on moist filter paper, 28 percent of them germinated within 14 days, most on the seventh day (author's observation). Local dispersal is by wind and water."

Human Uses

From Lansdown et al. (2019):

"This species is used in herbal medicines."

From Lin et al. (2014):

"We investigated the anti-aging effects of *Ludwigia octovalvis* (Jacq.) P. H. Raven (*Onagraceae*), an extract of which is widely consumed as a healthful drink in a number of countries. […] our data suggest that LOE [*Ludwigia octovalvis* extract] is a potent anti-aging intervention with potential for treating age-related disorders."

From Liu et al. (2016):

"Presently, *L. octovalvis* is being explored in several biotherapy and anticancer studies [Chang et al. 2004; Hsieh et al. 2009; Kadum Yakob et al. 2015]."

From Idris et al. (2016):

"The Biological Accumulation Coefficient (BAC) has been used as a guideline to choose potential plants for heavy metal phytoremediation. In the [this] study, the plants were screened based on BAC values for arsenic (As) and lead (Pb). The selected plants, *Melochia corchorifolia* L., *Ludwigia octovalvis* (Jacq.) P. H. Raven, *P.* [*Paspalum*] *vaginatum*, *Cyperus sphacelatus* Rottb., are potential as [sic] [arsenic] phytoremediators while *L. octovalvis* and *Melastoma malabathricum* L. are potential Pb phytoremediators."

This species is difficult to find in trade in the United States. One Texas-based seller was found on eBay, offering 500 seeds for $3.00 (eBay 2022).

Diseases

From Chung and Huang (1993):

"When spore suspensions of *A.* [*Alternaria*] *brassicicola* and *A. brassicae* [cruciferous black spot pathogens] were sprayed on the leaves of 5 weeds, densities of the pathogens on *Ludwigia octovalvis* […] decreased with time […]"

Threat to Humans

From CABI (2021):

"L. octovalvis [sic] is primarily a weed of rice, particularly in South-East Asia (Moody, 1989), where it infests a wide range of rice culture systems, especially dry-seeded rice (Indonesia, Malaysia, Philippines, Thailand), wet-seeded rice (Philippines, Thailand, Vietnam), transplanted rice (Indonesia, India, Malaysia, Philippines, Sri Lanka, Thailand, Vietnam) and upland rice (Indonesia, Philippines, Nepal). L. octovalvis [sic] also occurs in direct-seeded rice (India, Sri Lanka), tidal swamp rice (Indonesia), lowland rice (Cambodia, Laos), and seedling nursery rice (Philippines)."

"Raju and Reddy (1986) list L. octovalvis [sic] fourth in global-scale importance among broadleaved weeds that infest rice (out of a total of 350 weed species in rice, worldwide). This weed also affects plantation crops: for example, young cocoa plantations in Brazil (Mori et al., 1980). It is a troublesome weed of a range of irrigated crops in Africa (Cook, 1974). It has been reported as a pasture weed from the Southern Pacific region (Reynolds, 1978), and is a major broadleaved weed of legume crops, including soyabeans, in the Philippines."

3 Impacts of Introductions

From McCormack (2007):

"**NEGATIVE SIGNIFICANCE** [for the Cook Islands]**:** Weed - serious. **Comments:** Widespread and the most serious woody weed in Taro plots. Fast growing and difficult to remove."

From Prebble (2008):

"*L. octovalvis* is noted as a persistent weed in irrigated *Colocasia esculenta* [taro] pondfields throughout the Pacific, where in abandoned fields it can form dense monotypic stands. Kirch (1994) noted that *L. octovalvis* is a common weed on field systems in the western Pacific island of Futuna."

From Whistler (1988):

"*Ludwigia octovalvis* (Jacq.) Raven, Onagraceae, [is] an introduced weed of *pulaka* [*Cyrtosperma merkusii*, or swamp taro] pits on Olohega and Faka'o [Tokelau]."

4 History of Invasiveness

The History of Invasiveness for *Ludwigia octovalvis* is classified as High. The range of this species has expanded through introduction into multiple locations in southern Africa and the Pacific islands. There is substantial evidence of the negative impacts of *L. octovalvis* on agriculture (particularly of rice) within the native range; it is ranked fourth in global-scale importance among broadleaved weeds that infest rice (Raju and Reddy 1986 in CABI 2021). Information on impacts of introduction outside the native range was limited. However, a High History of Invasiveness classification is justified based on the consistent description of the species as a weed of taro agriculture across multiple Pacific islands, where it forms dense stands, and the report from the Cook Islands Natural Heritage Trust that it is a "serious" weed in the Cook Islands and "difficult to remove" (McCormack 2007).

5 Global Distribution

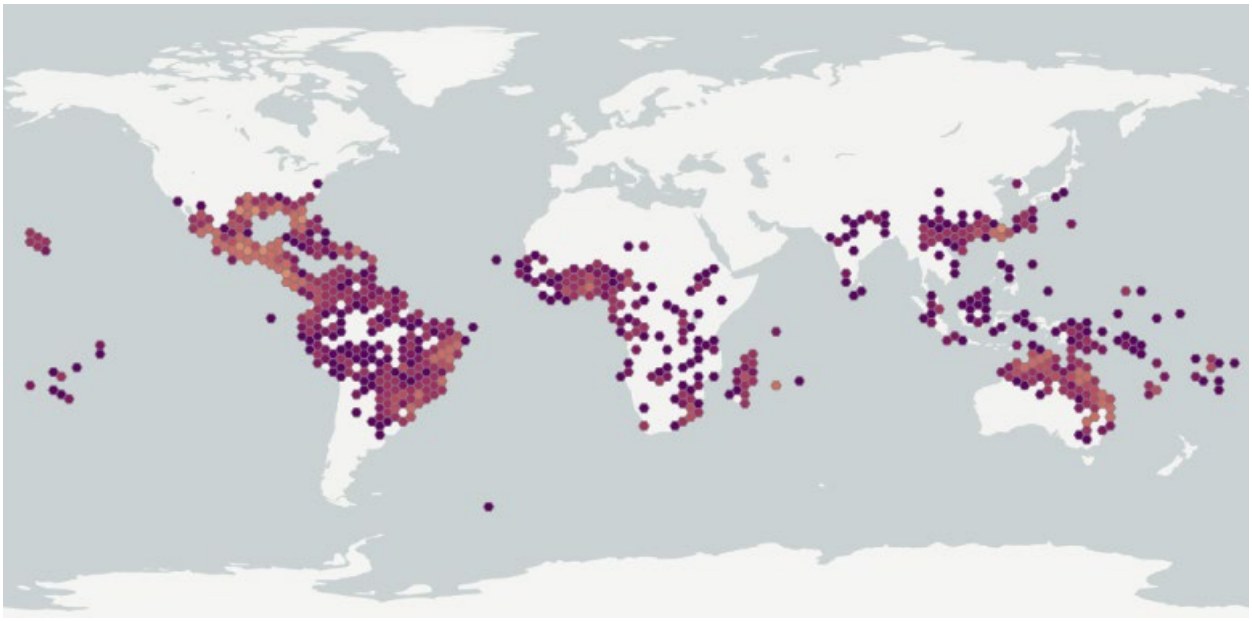

Figure 1. Known global distribution of *Ludwigia octovalvis*. Observations are reported from North America, South America, Africa, India, East Asia, Indonesia, Australia, and many islands in the Pacific and Indian Oceans. Map from GBIF Secretariat (2021).

Occurrences reported in Burundi, the Democratic Republic of the Congo, and South Korea were not used as source locations for the climate matching analysis (Section 7) because establishment could not be confirmed (see Distribution Outside the United States, above). The occurrence reported in the far southern Atlantic Ocean was not used as a source location for the climate matching analysis due to indication by GBIF Secretariat (2021) of a likely coordinate error.

6 Distribution Within the United States

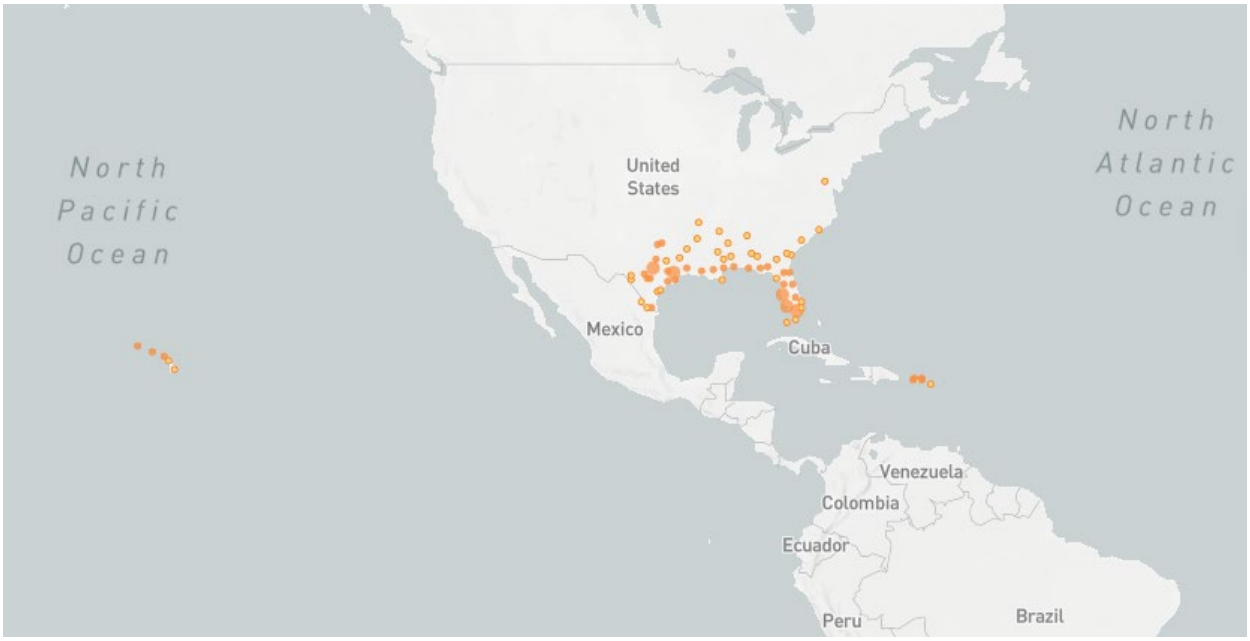

Figure 2. Known distribution of *Ludwigia octovalvis* in the United States. *L. octovalvis* occurrences are reported for the southeastern United States, Hawaii, and the U.S. Virgin Islands. Map from GBIF-US (2022).

The occurrence reported from Virginia was not included in the climate matching analysis because there is no evidence that *Ludwigia octovalvis* has established populations there. No georeferenced occurrences were available for portions of the species established range in American Samoa, Guam, or Puerto Rico. Reported occurrences within Pacific island nations under a Compact of Free Association with the United States (Federated States of Micronesia, Palau) are displayed by GBIF-US (2022) but are excluded from this map of U.S. distribution, which focuses on U.S. States and territories.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Ludwigia octovalvis* was medium or high across much of the contiguous United States with small areas of low climate match in northern New England and scattered through the West. Very high matches were found in peninsular Florida and in Gulf and southern Atlantic coast States from Texas to North Carolina; *L. octovalvis* is native to this portion of the country. High match was also found extending across the Great Plains from western Texas to Montana and North Dakota; in southern New Mexico, Arizona, and southern Nevada; and in southern and central California. Matches in the Great Lakes region and the Mid-Atlantic region ranged from medium-high on the southern margin of these regions to medium-low on the northern margin. The Rocky Mountain and Pacific Northwest regions showed mostly medium match, with significant areas of low match along the Pacific Coast, the eastern slope of the Cascade Mountains, the eastern slopes of the Rocky Mountains, and in the Sierra Nevada. The

overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) was 0.793, high (scores of 0.103 and greater are classified as high match). All but three States had a high individual Climate 6 score; Maine and New Hampshire had medium scores and Vermont had a low score.

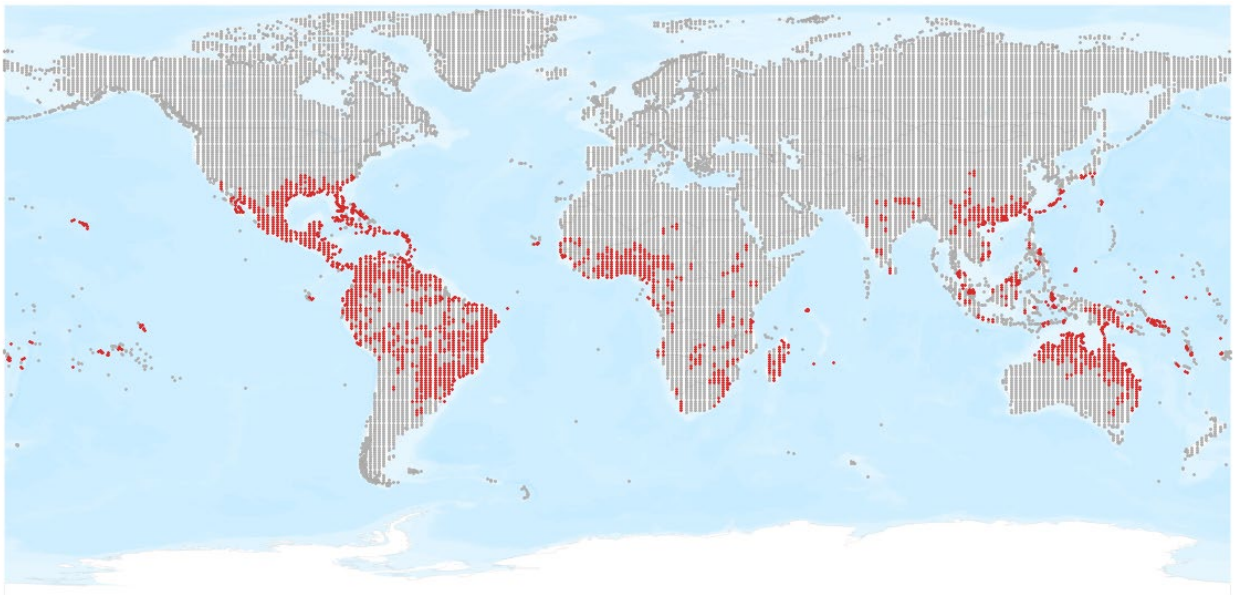

Figure 3. RAMP (Sanders et al. 2021) source map showing weather stations in North America, South America, Africa, South Asia, East Asia, Australia, and Oceania selected as source locations (red) and non-source locations (gray) for *Ludwigia octovalvis* climate matching. Source locations from GBIF Secretariat (2021). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

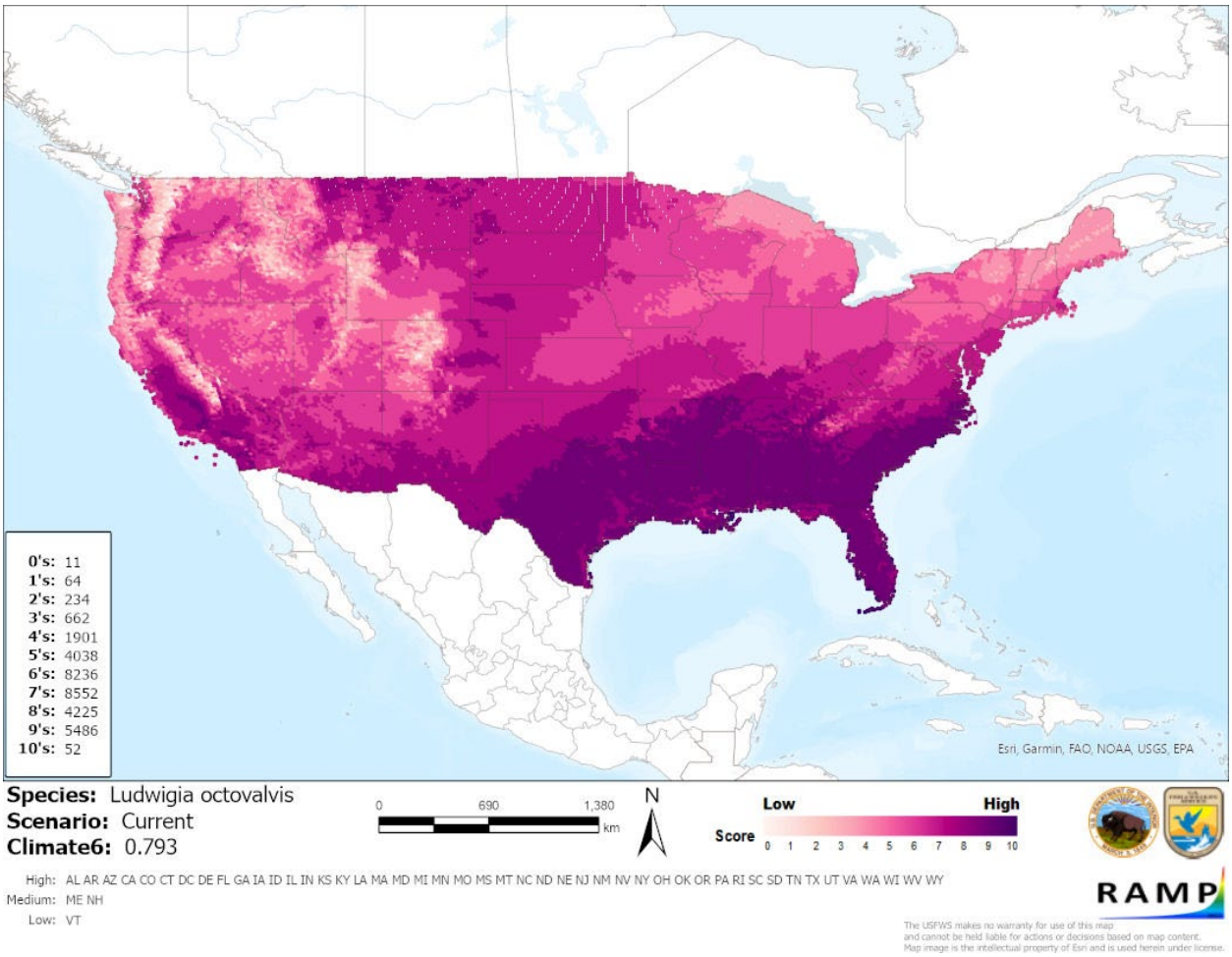

Figure 4. Map of RAMP (Sanders et al. 2021) climate matches for *Ludwigia octovalvis* in the contiguous United States based on source locations reported by GBIF Secretariat (2021). Counts of climate match scores are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

The certainty of assessment is medium. There is quality information available about the biology and ecology of *Ludwigia octovalvis*. Although there is decent information on the species present-day distribution, the original extent of the native range remains uncertain due to human-mediated introductions occurring thousands of years ago. Records of modern introductions were found,

many of which have resulted in population establishment outside the native range. The impacts of this species as an agricultural weed in its native range are clear; impacts within the introduced range are less thoroughly documented but widespread enough to provide the needed evidence about the species history of invasiveness.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Ludwigia octovalvis, the Mexican Primrose-willow, is an emergent aquatic plant with a nearly pan-tropical and -subtropical distribution. The species has diverse medicinal uses and has potential for use in bioremediation of heavy metal-contaminated environments. *L. octovalvis* is native to the southeastern United States, Puerto Rico, and the U.S. Virgin Islands, and it can occasionally be found in trade. Its status as native or introduced in Hawaii is uncertain. Other introductions of this species have been documented in southern Africa and several Pacific islands, resulting in established populations outside the native range. The history of invasiveness was classified as High due to several reports of negative impacts to taro agriculture on Pacific islands. The species is also a significant weed of rice fields within the native range. The climate match to the contiguous United States was high for *Ludwigia octovalvis*, with the highest matches occurring in the Southeast (where the species is native), Southwest, and Great Plains. The certainty of assessment was medium due to some uncertainty about the native range and the limited details available on impacts of introduction. However, impacts were reported from several locations where *L. octovalvis* has been introduced. The overall risk assessment category for *Ludwigia octovalvis* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (Sec. 4): High**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Medium**
- **Remarks, Important additional information: None**
- **Overall Risk Assessment Category: High**

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