South American Spongeplant (*Limnobium laevigatum*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, July 2020
Revised, January 2021
Web Version, 3/25/2021

Organism Type: Plant
Overall Risk Assessment Category: High

Photo: Montiel OM. Licensed under CC NC-SA 3.0 Attribution-NonCommercial-ShareAlike 3.0 Unported. Available: http://www.worldfloraonline.org/taxon/wfo-0000769444 (July 2020).

1 Native Range and Status in the United States

Native Range

From CABI (2020):

"*L. laevigatum* originates from fresh water habitats of tropical and subtropical regions in Mexico, Central and South America and the Caribbean. It is native to Mexico, Brazil, Antigua, Cuba, Dominican Republic, Guadeloupe, Martinique, Montserrat, Puerto Rico, St. Lucia, Trinidad,

Costa Rica, El Salvador, Guatemala, Nicaragua, Panama, French Guiana, Guyana, Suriname, Venezuela, Argentina, Chile, Paraguay, Uruguay, Colombia, Ecuador and Peru (Bove, 2016; USDA-ARS, 2016). There are however contradictory reports on whether it's native to Chile or not. According to the USDA-ARS (2016) it is native to Chile however Hyde et al., (2016) state that *L. laevigatum* is not present in Chile."

Status in the United States

Part of the native range of *Limnobium laevigatum* is within Puerto Rico, a U.S. Territory. See Native Range above for a full description of the native range.

From CABI (2020):

"The species has been introduced to California, USA and has escaped into greater waterways including areas surrounding Redding and Arcata, the Sacramento River delta and the San Joaquin River and ponds and irrigation canals. *L. laevigatum* is now present in 12 counties in California (Calflora, 2016; Encyclopedia of Life, 2016)."

"Although *L. laevigatum* is now regulated and subject to eradication in California (USDA-APHIS, 2013), it's still grown and sold by the aquatic nursery plant trade (Hrusa et al., 2002)"

"*L. laevigatum* islisted [sic] as a noxious weed in California and has been classified as having high invasiveness by the California Invasive Plant Council (Cal-IPC) inventory (Cal-IPC, 2015). In New South Wales, Australia, this species is listed as a Prohibited Weed (NSW Department of Primary Industries, 2016). This means that it must be eradicated from land."

"*L. laevigatum* is listed as a state Noxious Weed (List Q) by the California Department of Food and Agriculture (CDFA) and is subject to eradication (Calflora, 2016; DiTomaso, 2010). A weed risk assessment by USDA-APHIS (2013) for *L. laevigatum* rated this species as 'high risk' and a 'major invader'. Although *L. laevigatum* is now regulated and subject to eradication in California (USDA-APHIS, 2013), it's still grown and sold by the aquatic nursery plant trade (Hrusa et al., 2002) so new introductions are likely. It has been estimated that about 29% of the USA would be suitable for *L. laevigatum* to establish (USDA-APHIS, 2013). This includes states in the western coast of the USA (Washington, Oregon and California) and the southern states (Texas, Arkansas, Louisiana, Mississippi, Alabama, Georgia, South and North Carolina, Florida, Hawaii and parts of Arizona and New Mexico)."

NAS (2020) reports established populations in *Limnobium laevigatum* in Nevada (Upper Carson basin, Lake Tahoe) and Washington State (Willipa Bay basin).

The following section refers to potential status in the United States, not current status.

From USDA APHIS (2013):

"Based on three climatic variables, we estimated that about 29 percent of the United States suitable for the establishment of *L. laevigatum* […]. That distribution is based on the species'

known distribution elsewhere in the world and includes point referenced localities and areas of occurrence."

"According to Mason County (2020), *L. laevigatum* is listed as a Class A Weed in Washington State. A Class A Weed is "Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. Eradication is required by law."

According to USDA APHIS (2013), is determined to be a "High Risk" noxious weed for the Plant Protection and Quarantine (PPQ) regulation.

Limnobium laevigatum is listed for sale, but currently sold out by Aquatic Arts (2021). This company does not ship to the State of California where the species is prohibited.

Means of Introductions in the United States

From USDA APHIS (2013):

"Propagules are dispersed by water and birds, and as hitchhikers on watercraft (Akers, 2010b)."

From CABI (2020):

"*L. laevigatum* was intentionally introduced to North American waterways through use in aquariums and aquascapes (Encyclopedia of Life, 2016)."

"Once introduced into a new area it is likely to spread rapidly due to its high reproductive potential and high propensity for dispersal (Anderson and Akers, 2011)."

Remarks

From CABI (2020):

"Common names for this species include South American spongeplant and Amazon or smooth frogbit (Encyclopedia of Life, 2016)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to WFO (2020), *Limnobium laevigatum* is the current valid name for this species.

From ITIS (2020):

Kingdom Plantae
  Subkingdom Viridiplantae
    Infrakingdom Strptophyta
      Superdivision Embryophyta
        Division Tracheophyta

Subdivision Spermatophytina
Superorder Eucarida
Class Magnoliopsida
Superorder Lilianae
Infraorder Brachyura
Order Alismatales
Family Hydrocharitaceae
Genus *Limnobium*
Species *Limnobium laevigatum*

Size, Weight, and Age Range

From DiTomaso et al. (2013):

"[…] about 2 ft tall […]"

"Seeds appear to survive for at least 4 years."

Environment

From CABI (2020):

"*L. laevigatum* originates from freshwater water habitats […] It occurs in rivers, ponds, lakes, canals and other aquatic habitats (Cook and Urmi-König, 1983). In Puerto Rico it is reported to grow in shallow ponds, sluggish shaded rivers, fresh-water ditches and swamps at or near sea level (USDA-APHIS, 2013).

In Brazil *L. laevigatum* occurs in a wide range of habitats from the Amazon Rainforest, Caatinga (xerophilous thorny forest and scrub of the drylands of north-eastern Brazil), Central Brazilian Savanna, Atlantic Rainforest, Pampa (grasslands from Southern Brazil) and Pantanal (periodically flooded grasslands by the rivers Paraná and Paraguay in Central-Western Brazil) (Bove, 2016)."

"Cold temperatures are more likely to limit its distribution. It grows in full sun, but in Puerto Rico it is also reported to grow in shady streams (Acevedo-Rodriguez and Strong, 2005; USDA-APHIS, 2013). The preferred water temperature is between 15-28°C and the preferred water's acidity is between 6-8 pH. Although it originates from fresh water habitats, it also grows in slightly saline waters and even outcompetes other species in this environment (Perryman, 2013)."

Climate

From USDA APHIS (2013):

"The map for *L. laevigatum* represents the joint distribution of Plant Hardiness Zones 8-13, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, steppe, mediterranean, humid subtropical, and marine west coast."

From CABI (2020):

"*L. laevigatum* originates […] in the tropics and subtropics. The USDA-APHIS (2013) reports on a minimum annual precipitation of 250 mm. But as an aquatic plant, precipitation is probably not a direct limiting factor. […] In South America this species has been recorded at altitudes of more than 2,000 m (Acevedo-Rodriguez and Strong, 2005)."

Distribution Outside the United States

Native

From CABI (2020):

"*L. laevigatum* originates from fresh water habitats of tropical and subtropical regions in Mexico, Central and South America and the Caribbean. It is native to Mexico, Brazil, Antigua, Cuba, Dominican Republic, Guadeloupe, Martinique, Montserrat, Puerto Rico, St. Lucia, Trinidad, Costa Rica, El Salvador, Guatemala, Nicaragua, Panama, French Guiana, Guyana, Suriname, Venezuela, Argentina, Chile, Paraguay, Uruguay, Colombia, Ecuador and Peru (Bove, 2016; USDA-ARS, 2016). There are however contradictory reports on whether it's native to Chile or not. According to the USDA-ARS (2016) it is native to Chile however Hyde et al., (2016) state that *L. laevigatum* is not present in Chile."

Introduced

From CABI (2020):

"The Council of Heads of Australasian Herbaria (2016) reports that populations of *L. laevigatum* have naturalized in the states of New South Wales and Queensland, Australia. Hyde et al., (2016) report that *L. laevigatum* is rare at a national level in Zimbabwe, but abundant in some dams near Harare. There is a report of this species in Zambia (Bingham et al., 2016) and Howard et al. (2016) report more localities in both Zimbabwe and Zambia. Kadono (2004) reports on a few occurrences of *L. laevigatum* in Japan."

This species is reported as introduced to Java and West Java, Indonesia (Akers (2010b) in CABI (2020)) and Belgium (Desmet et al. (2020) in GBIF Secretariat (2020)).

Means of Introduction Outside the United States

From Howard et al (2016):

"It is likely that original introductions of *L. laevigatum* [in Zimbabwe and Zambia] have occurred through aquariums, as there is a well-developed trade and use of this species as an attractive and useful plant (e.g. aquarium plant websites)."

"*Limnobium laevigatum* has become a favourite freshwater aquarium plant, which may explain the recent spread of this South American species to parts of North America (Gaimari and O'Donnell 2009), Japan (Perryman 2013), Eastern Australia (The Atlas of Living Australia 2015), and now Africa. The link between the spread of this species and the freshwater aquarium

trade, as a likely pathway for invasion, was noted after *L. laevigatum* was discovered in an urban waste water drain, in 2003, in a suburb of Perth, Western Australia (SERCUL 2013)."

From CABI (2020):

"Natural Dispersal
The juvenile plants of *L. laevigatum* have a great capacity for distribution because they are small, can float and are easily carried along by water currents (Encyclopedia of Life, 2016) and water surface winds (Howard et al., 2016). Seeds, seedlings (which develop in water) and entire plants are all dispersed by water (Lowden, 1992). There are reports of the seeds being spread by wind (Anderson and Akers, 2011).

Vector Transmission
Propagules of *L. laevigatum* can be dispersed by birds (Akers, 2010[b]).

Accidental Introduction
It is possible for propagules of *L. laevigatum* to be dispersed as hitchhikers on watercrafts (Akers, 2010[b])"

Short Description

From CABI (2020):

"*L. laevigatum* is a floating or emergent aquatic herb. Leaves are subcircular, floating, glabrous and glossy above, with a thick layer of air-filled spongy tissue beneath, base rounded or shallowly cordate. Juvenile plants grow in rosettes of floating leaves that lie prostrate upon the water surface. A distinguishing character of the juvenile plant is the presence of spongy aerenchyma tissue upon the underside of the leaf. Mature plants grow up to 50 cm tall and have emergent leaves borne on petioles that are not swollen or inflated like the spongy leaf stalks of water hyacinth. The plant produces stolons which bear ramets which may be the main source of new plants where flowers are unknown.

Flowers are small, white, and unisexual. Female flowers have an inferior ovary. The fruit is a fleshy, berry-like capsule 4–13 mm long and 2–5 mm in diameter, borne on a recurved pedicel, developing in mud or under water. The fruit contains up to 100 seeds. The seeds are 1 mm long, ellipsoid, and hairy (Cook and Urmi-König, 1983; Encyclopedia of Life, 2016)."

From Willis et al. (2018):

"Sponge plant can be difficult to identify as possesses three distinct growth patterns including: 1) a seedling stage mimicking duckweed (*Lemna* sp. and *Landoltia* sp.), 2) a rosette stage that looks similar to immature fragrant water lily (*Nymphaea odorata* Aiton), and 3) a stalked emergent stage often mistaken as water hyacinth [*Eichhornia crassipes* (Mart.) Solms] [Anderson 2011]. A key identification attribute of sponge plant is aerenchyma located on the underside of the leaf. Aerenchyma of seedling and rosette growth forms are obvious, although the mature emerged obovate leaves predominantly only have aerenchyma where the petiole and blade initially connect."

Biology

From CABI (2020):

"*L. laevigatum* can reproduce sexually through flower pollination and seed production (Encyclopedia of Life, 2016). The species is monoecious (there are separate male and female flowers on the same plant) (Acevedo-Rodriguez and Strong, 2005) and plants are autogamous (pollen from male flowers pollinate female flowers on the same plant). After pollination the pedicel of female flowers bends downward, forcing the fruit to develop in the water or in the mud (Cook and Urmi-König, 1983). The seeds can germinate underwater (Cook and Urmi-König, 1983). The survival time of seeds is not known. But at a pond in Redding, California seedlings of this species were appearing despite populations being almost completely suppressed for three years. This suggests that there may be a seed bank (Akers, 2010[b]). It can also reproduce vegetatively through fragmentation of stolon segments which connect rosettes (Cook and Urmi-König, 1983)."

"*L. laevigatum* often forms sub-communities with *Eichhornia azurea* (Murphy et al., 2003) and often grows and floats with *Eichhornia crassipes* (Howard et al., 2016)."

Human Uses

From CABI (2020):

"Economic Value
L. laevigatum is used in aquariums and aquascapes (Encyclopedia of Life, 2016) and is grown and sold by the aquatic nursery plant trade in many parts of the world. Putzke (2009) reports on use of aquatic macrophytes such as *L. laevigatum* for cultivation of the mushroom, *Pleurotus ostreatus* in wetlands.

Environmental Services
It has been reported that *L. laevigatum* has a potential role in bioremediation, the use of organisms to remove or neutralise pollutants from a contaminated site (Aponte and Pacherres, 2013)."

Diseases

No records of diseases were found for *Limnobium laevigatum*.

Threat to Humans

No threats to humans were found for *Limnobium laevigatum*. Economic impacts are described in the Impacts of Introductions section.

3 Impacts of Introductions

From CABI (2020):

"*L. laevigatum* can from dense mats across waterbodies (with up to 2,500 plants m-2 recorded). This can dramatically change the habitat structure, limit access by other species (e.g. some aquatic birds) and block light to the aquatic community below (Akers, 2010[b]). As a result this can decrease the biodiversity in an area (Akers, 2010[b]). Other impacts seem likely, but have not yet been documented for this species. A pest report from California suggests that the floating mats will probably alter many ecosystem processes such as carbon and nutrient cycling. It is likely that high organic inputs into water bodies will also reduce oxygen levels in the systems (Akers, 2010[b])."

"The dense mats of *L. laevigatum* have been reported to obstruct waterways, which reduces the quality or availability of irrigation water (DiTomaso, 2010). Observations in California confirm that vegetative mats consisting of *L. laevigatum* move with the current and pile up wherever there is an obstruction. The plants therefore accumulate in infrastructure for moving water and will likely jam weirs, dams, gates, and siphons, as well as being pulled into pumps where they will jam and damage the machinery. During high water, the plants may increase flood risk by piling against obstructions and clogging the channel (Akers, 2010[b]). In South America, its native range, *L. laevigatum* also forms dense mats which have been reported to disrupt thousands of kilometres of drainage canals dug for transporting timber (Fernández et al., 1990). The economic cost of this species in its introduced and native range is unknown."

"*L. laevigatum* islisted [sic] as a noxious weed in California and has been classified as having high invasiveness by the California Invasive Plant Council (Cal-IPC) inventory (Cal-IPC, 2015). In New South Wales, Australia, this species is listed as a Prohibited Weed (NSW Department of Primary Industries, 2016). This means that it must be eradicated from land."

"*L. laevigatum* is listed as a state Noxious Weed (List Q) by the California Department of Food and Agriculture (CDFA) and is subject to eradication (Calflora, 2016; DiTomaso, 2010). A weed risk assessment by USDA-APHIS (2013) for *L. laevigatum* rated this species as 'high risk' and a 'major invader'. Although *L. laevigatum* is now regulated and subject to eradication in California (USDA-APHIS, 2013), it's still grown and sold by the aquatic nursery plant trade (Hrusa et al., 2002) so new introductions are likely. It has been estimated that about 29% of the USA would be suitable for *L. laevigatum* to establish (USDA-APHIS, 2013). This includes states in the western coast of the USA (Washington, Oregon and California) and the southern states (Texas, Arkansas, Louisiana, Mississippi, Alabama, Georgia, South and North Carolina, Florida, Hawaii and parts of Arizona and New Mexico)."

From Howard et al. (2016):

"While *L. laevigatum* has been shown to be only slightly "aggressive" in competition with other floating water plants in its native South America (Milne et al. 2007), it has the potential to be invasive in freshwaters outside its natural range. These include southern USA (Akers 2010[b]; Perryman 2013), Western Australia (SERCUL 2013), Eastern Australia (Hawkesbury River County Council 2014) and Japan (Kadono 2004)."

According to USDA APHIS (2013), is determined to be a "High Risk" noxious weed for the Plant Protection and Quarantine (PPQ) regulation.

From USDA APHIS (2013):

"Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world."

"In California, it reduces biodiversity, changes community structure, and limits access to water bodies (Akers, 2010a)."

According to Mason County (2020), *L. laevigatum* is listed as a Class A Weed in Washington State. A Class A Weed is "Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. Eradication is required by law."

The following section refers to potential, not documented impacts.

From Perryman (2013):

"There is no scientific consensus on spongeplant's competitive ability. […] little is known about the Delta biology and ecology of spongeplant. Yet, it has been branded by the state as a vigorous competitor without any published support of the assertion."

"The plants' performance was not significantly different under ambient salinity conditions, […] But under medium salinity, spongeplant significantly outperformed pennywort, […] with water hyacinth insignificantly in between the two (Figure 6 [in source material]). And in high salinity, spongeplant significantly outperformed both water hyacinth and pennywort, […] In future [more saline] conditions, spongeplant may be able to outperform the others under elevated salinity which could promote a successful invasion."

4 History of Invasiveness

Limnobium laebigatum has a long history of introduction through intentional aquarist introductions and natural dispersion within invaded ranges. The species has been introduced and become established beyond its native range to the United States, Australia, and Zimbabwe. It has also been introduced but unknown if established in Indonesia, Japan, Belgium, and Zambia. Once introduced, this species readily disperses and reproduces naturally. *L. laebigatum* creates dense vegetative mats that reduce water quality, biodiversity, and cause economic impacts to

humans. There are documented negative impacts of introduction for this species. This species has been determined to be High Risk according to the USDA, and is a restricted species in the States of California and Washington. The history of invasiveness is classified as High.

5 Global Distribution

Figure 1. Known global distribution of *Limnobium laevigatum*. Observations are reported from South America, Central America, United States, Australia, Japan, Taiwan, Russia, Belgium, and Sweden. Map from GBIF Secretariat (2020). Information on populations in Sweden, Taiwan, and Russia was not corroborated in the literature and therefore those observations were not used to select source points for the climate match.

Georeferenced locations for populations reported in Java and West Java, Indonesia were not found and therefore, those populations were not used for selecting source points for the climate match.

6 Distribution Within the United States

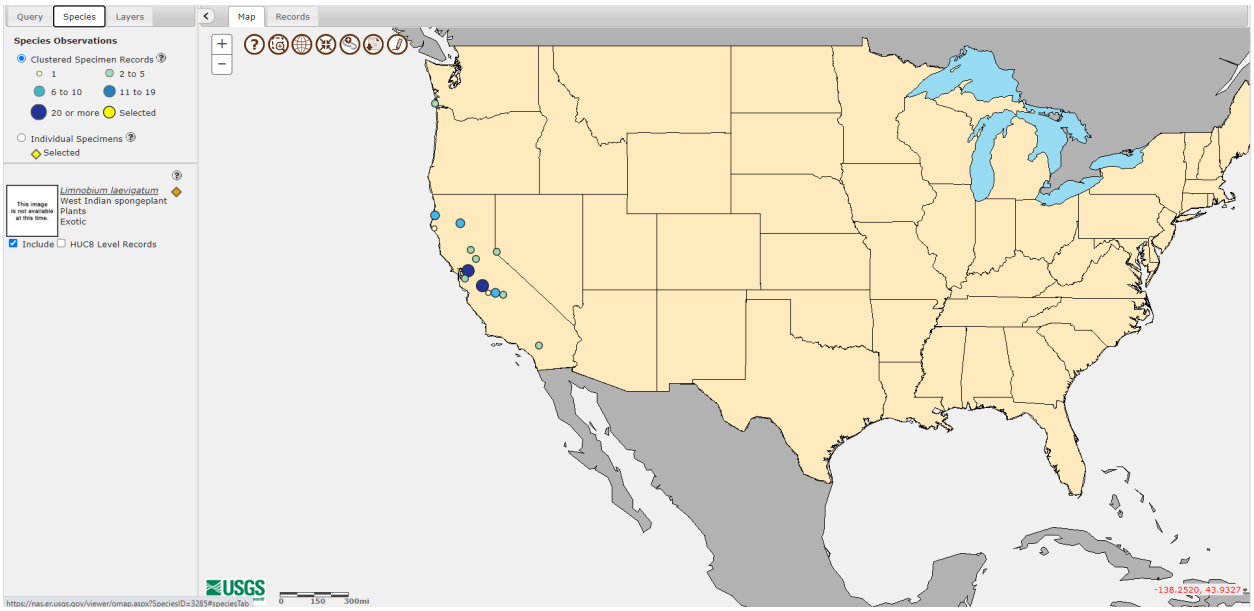

Figure 2. Known distribution of *Limnobium laevigatum* in the United States. Map from NAS (2020). Records are from California, Washington and Nevada.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Limnobium laevigatum* was generally high for the contiguous United States with t high matches along the Gulf Coast, southern Atlantic Coast, in a band from the mid-Atlantic to Texas, and in most Pacific coast States. Much of the rest of the United States had a medium match except the Northern Great Plains, western Great Lakes, northern New England, and small areas of the Pacific Northwest, which had a low match. The overall Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.358, high (scores 0.103 and greater are classified as high). The following States had medium individual Climate 6 scores: Arkansas, Colorado, Kansas, Kentucky, Michigan, Mississippi, Montana, New York, Rhode Island, and Tennessee. The following States had low individual Climate 6 scores: Connecticut, Iowa, Maine, Minnesota, North Dakota, Nebraska, New Hampshire, South Dakota, Vermont, Wisconsin, and Wyoming. All other States had high individual Climate 6 scores.

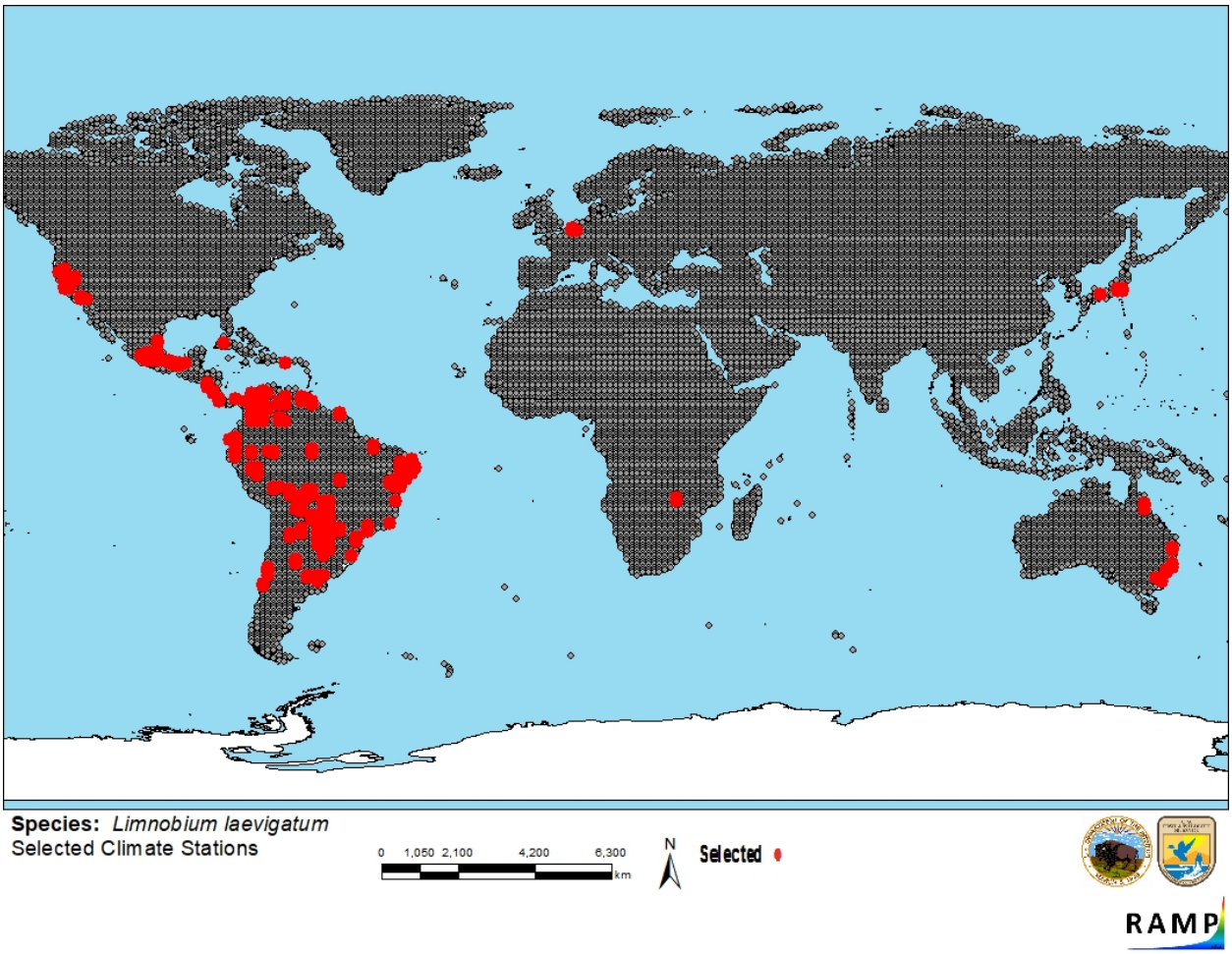

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in South America, Central America, North America, Caribbean, Australia, Africa, Europe and East Asia selected as source locations (red; Argentina, Chile, Uruguay, Paraguay, Brazil, Peru, Bolivia, Ecuador, Columbia, Venezuela, Guyana, French Guiana, Panama, Costa Rica, Nicaragua, Mexico, United States including Puerto Rico, Cuba, Dominican Republic, Zambia, Zimbabwe, Australia, Japan and Belgium) and non-source locations (gray) for *Limnobium laevigatum* climate matching. Source locations from GBIF Secretariat (2020). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

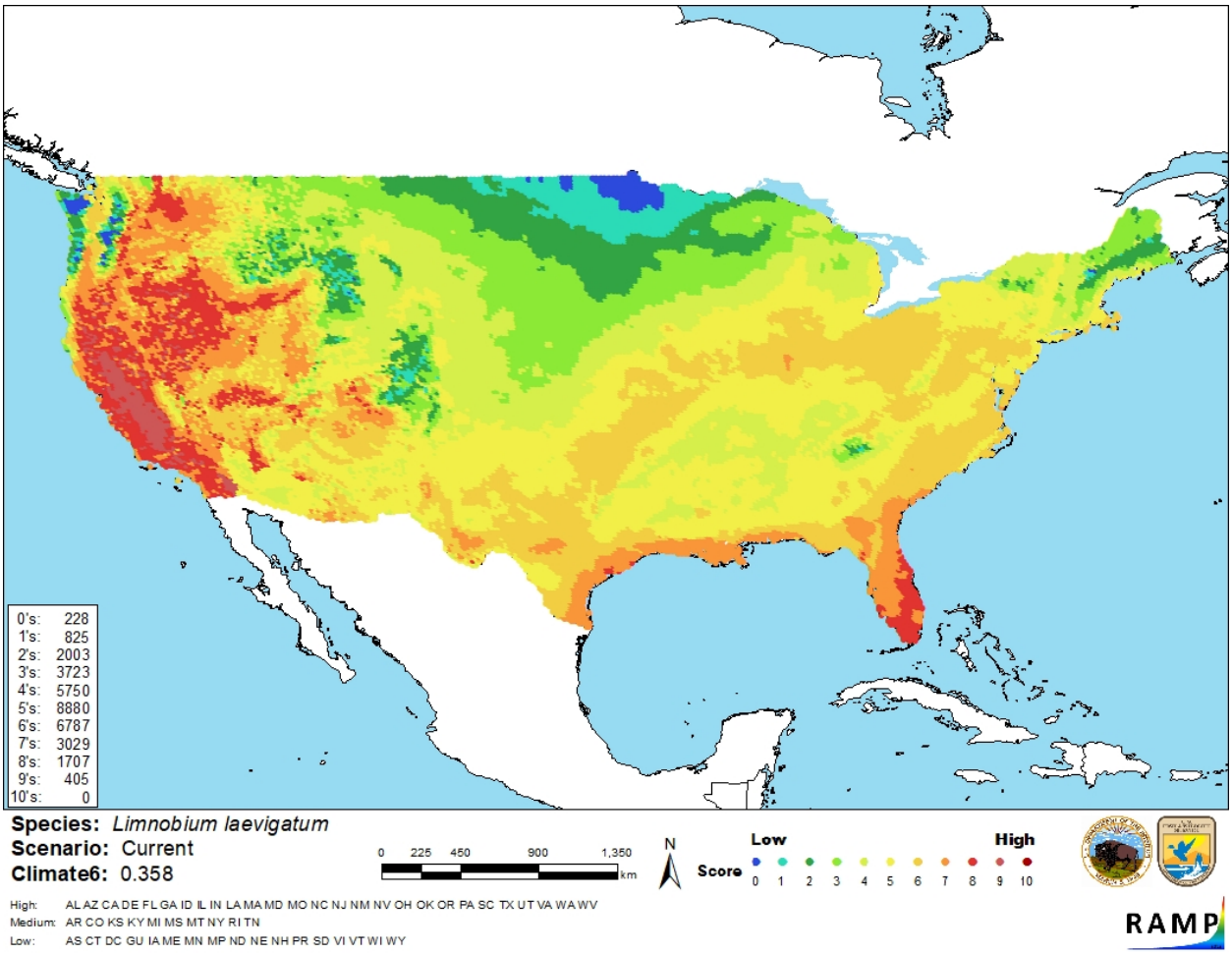

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Limnobium laevigatum* in the contiguous United States based on source locations reported by GBIF Secretariat (2020). Counts of climate match scores are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

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 this assessment is medium. There is ecological and biological information available about *Limnobium laevigatum*. Georeferenced location across its reported range are available for climate matching. There are records of introductions to the United States, Africa, Australia, Japan, and Belgium. There is information on impacts from these established

populations. However, the information on impacts comes mainly from scientific databases and unpublished reports instead of peer-reviewed literature which decreases certainty in the screening.

9 Risk Assessment

Summary of Risk to the Contiguous United States

South American Spongeplant, *Limnobium laevigatum*, is a floating, freshwater aquatic herb native to Mexico, Central and South America and the Caribbean, including Puerto Rico. *L. laevigatum* is commonly traded around the world for aquariums and aquascapes and reportedly, has a potential role in bioremediation. It has been introduced to and become established in many areas, including California, Nevada and Washington in the United States, Australia, and southern Africa. There are documented impacts from these introductions including, obstructing waterways, reducing water quality, and decreasing the biodiversity. It is regulated in more than one State and is considered a noxious weed by the USDA. The history of invasiveness is classified as High. The overall climate match with the contiguous United States is High, with a medium to high match across much of the United States. The certainty of assessment is Medium. Statements regarding impacts from introduction were found but documentation of the methods used to determine the impacts was not available. The overall risk assessment category 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: No additional remarks.**
- **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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