DRAFT: WRITTEN FINDINGS OF THE
WASHINGTON STATE NOXIOUS WEED CONTROL BOARD
2020 Noxious Weed List Proposal

Scientific name:	*Limnobium laevigatum* (Humb. & Bonpl. ex Willd.) Heine
Synonyms:	*Limnobium stoloniferum* (G. Mey.) Griseb *Hydromystria laevigata* (Humb. & Bonpl. ex Willd.) Hunz. *Hydromystria stolonifera* G. Mey. *Salvinia laevigata* Humb. & Bonpl. es Willd. *Limnobium spongia* spp*. laevigatum* (Humb. & Bonpl. ex Willd.) Lowden
Common name:	South American spongeplant, frogbit, West Indian spongeplant, Amazon frogbit, smooth frogbit
Family:	Hydrocharitaceae
Legal Status:	Proposed as a Class A noxious weed for the 2020 state noxious weed list and proposed for the WSDA quarantine list (WAC 16-752).

Images: left, South American spongeplant in flower; center, underside of leaf showing the honeycomb-like aerenchymous tissue; right, South American spongeplant and its roots. All images by Jenifer Parsons, WA Department of Ecology.

Note on Taxonomy: In their revision of the genus, Cook and Urmi-König (1983), treated *Limnobium laevigatum* and *L. spongia* as separate species. However, in a more recent paper Lowden (1992) proposed that *Limnobium* consisted of only one variable species, with two sub-species. In recent years most papers favor classifying *L. laevigatum* as a separate species from *L. spongia*. That is also consistent with the treatment in the Flora of North America and the Flora of the Pacific Northwest Vol 2, and is accepted here.

Overall Habit:

South American spongeplant is a perennial herb that is generally free-floating, though it will also grow rooted in mud in shallow water or on wet shorelines. If water levels rise, rooted shoreline plants will continue to grow submersed (Cook and Urmi-König 1983). Young plants resemble duckweed, then they develop into a rosette stage and finally a mature phase with stalked emergent leaves (Willis et al. 2018). The floating leaves have spongy honeycomb-like aerenchymous tissue on their undersides, giving the plant its common name and providing floatation. It has small pale green to white flowers, and female flowers stalks bend as the fruit ripens so seeds are released in the water or sediment (Cook and Urmi-König 1983).

South American spongeplant can form dense mats on the water surface. Impacts from this growth habit include: crowding out and shading out other species, disruption to light and oxygen regimes in the water, and altering habitat (CABI 2018). In California, dense mats have prevented recreation access, blocked bird access to water, lowered dissolved oxygen which affects fish and other aquatic biota, blocked canals, pumps, and dams, increased flooding, crowded out native plants, and provided mosquito habitat (Akers 2015).

Roots/Rhizomes:
Roots are branched, with long root-hairs. The main roots are up to about 11.8 inches (30 cm long), with smaller roots up to about 3.9 inches (10 cm) long (Cook and Urmi-König 1983).

Stem:
Compact stems bearing leaves are up to 0.8 inches (20 mm) long. Runners (stolons) bearing daughter plants branch off the stem (Cook and Urmi-König 1983).

Leaves:
Mature leaves are broad and stalked, with a stipule to 0.9 inches (22 mm) long at the base. Stalks of aerial leaves are up to 10.6 inches (27 cm) long, those of floating leaves to 3.3 inches (8.5 cm) long. The blade is usually 0.8 to 2 inches (20 to 50 mm) long by 0.3 to 1.6 inches (8 to 40 mm) wide, usually with a rounded tip and base, though occasionally somewhat reniform or obovate. There is often honeycomb-like aerenchymous tissue, up to 0.4 inch (1 cm) thick on floating leaves (Cook and Urmi-König 1983).

Flowers:
Plants are monoecious (separate male and female flowers can be found on the same plant). Three greenish-white sepals are typically about 0.2 inch (5 mm) long by 0.08 inch (2 mm) wide and spreading. Petals on male flowers are about 0.3 inch (6.5 mm) long and 0.06 inch (1.5 mm) wide. Female flowers usually lack petals. Styles number 3 to 6 and are divided. Stamens are typically 6 in 2 rows. The male flowers can pollinate female flowers on the same plant (autogamous).

Fruits and Seeds:
Flowers are wind pollinated (Cook and Urmi-König 1983). After pollination the pedicel bends and fruits mature underwater or in mud.
Fruits are up to about 0.4 inch (9 mm) long, and contain up to 100 seeds. Seeds are small, about 0.04 inch (1 mm), and can germinate under water (Cook and Urmi-König 1983). Seeds can remain viable at least 3 to 4 years (DiTomasso et al. 2013).

Similar species:
South American spongeplant may be confused with American spongeplant (*Limnobium spongia*), the only other species in the genus. Characteristics used to distinguish the two species are: South American

spongeplant leaves are typically rounded at the tip and base, fruits are up to 0.20 inch (5 mm) in diameter, female flowers generally lack petals, male flowers usually have 6 stamens. American spongeplant leaves are typically heart-shaped; fruits are 0.16 to 0.47 inch (4 to 12 mm) in diameter, female flowers have petals, male flowers have 9 to 12 stamens.

Images: left, American spongeplant (*Limnobium spongia*) leaf shape, image by Shaun Winterton, Aquarium and Pond Plants of the World, Edition 3, USDA APHIS PPQ, Bugwood.org; right, European frog-bit (*Hydrocharis morsus-ranae*) with exclusively floating leaves, image by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Also, if plants are not in flower, South American spongeplant can be confused with *Hydrocharis* species. (frog-bit). *Hydrocharis morsus-ranae* (European frog-bit) has been found in Washington. It has exclusively floating leaves, unbranched roots, and generally lacks the spongy tissue on the underside of its leaves (Cook and Urmi-König 1983). *Eichhornia crassipes* (water hyacinth) is an invasive floating plant occasionally found in Washington, but its leaf stalks are swollen toward the base and has purple flowers.

Images: left, water hyacinth (*Eichhornia crassipes*) in flower, image by Shaun Winterton, Aquarium and Pond Plants of the World, Edition 3, USDA APHIS PPQ, Bugwood.org; right, examples of water hyacinth leaves with sectioned swollen leaf stalks, image by Leslie J. Mehrhoff, University of Connecticut, Bugwood.org.

Habitat:

South American spongeplant grows in wetlands, irrigation canals, lakes, reservoirs, rivers, streams, and ponds. It can grow in full sun or shade and prefers water temperatures between 59 and 64.4 degrees F

(15 - 28˚ C) and pH of 6 to 8 (CABI 2018). Plants can handle salinity up to 10 parts per thousand (Perryman 2013).

Images: left and right, South American spongeplant infestation in Pacific County, Washington. Images by Jenifer Parsons, WA Department of Ecology.

Geographic Distribution:

South American spongeplant is native to Mexico, Central America, the Caribbean including Puerto Rico, and south through South America to Buenos Aires, Argentina (Cook and Urmi-König 1983). It has been introduced to California and Washington in the United States, Zambia and Zimbabwe and perhaps countries downstream along the Zambezi River in Africa, Australia, Japan, Indonesia and Java (Howard et al. 2016, CABI 2018). Its spread has been through the horticulture industry, as it has been grown and sold in the aquatic plant trade under the common name frogbit or Amazon frogbit (USDA-APHIS 2013).

Distribution in North America:

South American spongeplant was first detected in California in 2003 in two isolated locations (Redding and Arcata). In 2007, it was found in the San Joaquin River, and then spread to the Sacramento-San Joaquin Delta by 2008. By 2010 it was present in 12 counties (CalIPC 2011, USDA-APHIS 2013).

History and Distribution in Washington:

South American spongeplant was first identified in a canal near Long Beach, Washington in 2016. In 2018, the population was confirmed to be persisting and thriving to the point of nearly covering the water surface in the canal. No other locations are known from Washington State. It was likely introduced by someone who purchased it as a water garden ornamental. To reduce the chance of future introductions, it was petitioned for addition to the Washington State Department of Agriculture's state quarantine plant list (WAC 16-752) and is currently going through the rule-making process. A USDA Weed Risk Assessment predicts that South American spongeplant could inhabit all of Western Washington (USDA-APHIS 2013), and it is reported to withstand frost where protected (CalIPC 2011).

Growth and Development:

South American spongeplant seeds germinate under water and seedlings float on the water surface. Very young seedlings resemble duckweed. The first two or three leaves are sessile or on very short stalks, but longer stalks develop with the third or fourth leaf (Cook and Urmi-König 1983). Initial leaves are floating, and gradually leaves develop that are emergent (Cook and Urmi-König 1983). The floating leaves develop honeycomb-like aerenchymous tissue on the underside to aid with floatation. Plants in

water less than about 12 inches (30 cm) deep will root in mud, and if water levels rise, they continue growing rooted and submersed, but daughter plants rise to the surface on runners (stolons). If water levels decline, plants can grow on muddy banks (Howard et al. 2016). Flowers develop within the first growing season. Pollination is by wind or possibly casual insect visitation (Cook and Urmi-König 1983, Lowden 1992). Once pollination has occurred, the flower stalk bends and the fruit matures under water or in mud (CABI 2018).

South American spongeplant will form floating islands of plants. Densities of up to 2,500 plants/m^2 have been recorded in California, with dense infestations producing more than 1,000 seeds/m^2.

Reproduction:
Reproduction is both by seed and the vegetative production of daughter plants (USDA-APHIS 2013). It reaches reproductive maturity in less than one year (CalIPC 2011). It is spread by water currents, wind blowing plants on the water, birds, watercraft and the horticulture plant trade (USDA-APHIS 2013, CABI 2018). Seeds can survive at least 3 to 4 years, forming a seedbank in the sediment (DiTomaso et al. 2013). The seedbank fuels rapid recovery when control projects have cleared areas of plants (Akers 2015).

Control:
Mechanical Methods:
Hand pulling can be effective for small populations, especially if the population is controlled prior to seed production (DiTomaso et al. 2013, CABI 2018).

Cultural Methods:
Because South American spongeplant is free floating, preventing spread on water currents or as rafts blown by wind is important (DiTomaso et al. 2013). Plants are reported to survive frost where protected, but not thought to be cold hardy where winter temperatures regularly drop below freezing (USDA-APHIS 2013). No data could be found on the effect of drying.

Herbicide:
DiTomaso et al. (2013) recommended early season treatment with any of the following herbicides: 2,4-D, glyphosate, imazamox, imazapyr or diquat. All would likely require retreatment of dense South American spongeplant patches to get plants that avoided initial treatment due to leaf-overlap. They also recommended using an approved surfactant to improve herbicide absorption.

In a trial of imazamox, penoxsulam, topramezone, florpyrauxifen-benzyl and carfentrazone-ethyl, Willis et al. (2018) found that best results were achieved with imazamox combined with a methylated seed oil surfactant. They also recommended examining sites four weeks after initial treatment to retreat any plants missed with the first treatment.

Trials of herbicides on the close relative, American spongeplant (*L. spongia*) have shown that diquat, imazapyr, imazamox, and penoxsulam all provide excellent control, while flumioxazin provided good control and triclopyr provided fair control (Enloe et al. 2018).

Use of pesticides in water is regulated in Washington State. All applicators must have an aquatic endorsement on their pesticide applicators license, which is issued by the Washington Department of Agriculture. In addition, coverage under a permit issued by the Department of Ecology is required. Contact the Washington Department of Ecology for details (https://ecology.wa.gov/Regulations-

Permits/Permits-certifications/Aquatic-pesticide-permits) or contact the county's noxious weed control board.

Biological Control Potential:
No known research is being conducted on biological control agents for South American spongeplant.

Economic Importance:
Detrimental:
South American spongeplant is considered weedy in its native range because it grows densely on canals built to transport wood, blocking passage (USDA-APHIS 2013). Its ability to form dense mats on the water surface also blocks recreational access to the water. In California, vegetative mats accumulate on infrastructure, blocking pumps, dams and gates (CABI 2018). Assumed environmental impacts include impacts to dissolved oxygen and habitat that could impact fisheries, however there is little in the literature on this species in particular (CABI 2018).

Beneficial:
South American spongeplant has been grown and sold as an ornamental pond plant.

Rationale for Listing:
South American spongeplant is regulated in California, subject to eradication efforts. The USDA-APHIS (2013) Weed Risk Assessment result for South American spongeplant was a 'high risk' ranking. It is predicted to be capable of establishing in Plant Hardiness Zones 8-13, which includes all of the western Washington lowlands. It is also 'prohibited matter' in New South Wales, Australia, preventing sale (NSW-DPI 2018) In California it outcompetes other invasive aquatic plants such as parrotfeather (*Myriophyllum aquaticum*) and water primrose (*Ludwigia* species) (Akers 2015). These facts, plus its demonstrated ability to survive and thrive for multiple years along the Washington coast, recommend this species for inclusion on the Class A noxious weed list with the goal of eradicating it from the state. Its inclusion on the Washington State quarantine list will hopefully prevent additional introductions.

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