WRITTEN FINDINGS OF
THE WASHINGTON STATE NOXIOUS WEED CONTROL BOARD

SCIENTIFIC NAME: *Sagittaria platyphylla* (Engelm.) J.G. Sm.

SYNONYMS: *Sagittaria graminea* Michx. var. *platyphylla* Engelm., *Sagittaria mohrii* J. G. Smith

COMMON NAMES: Delta arrowhead

FAMILY: Alismataceae

LEGAL STATUS: Washington State Noxious Weed Seed and Plant Quarantine (WAC 16-752-610:)

DESCRIPTION AND VARIATION:

OVERALL HABIT:

Sagittaria platyphylla is a perennial, herbaceous aquatic plant that grows in streams and lakes at elevation up to 900 m (Fig. 1) (Haynes and Hellquist 2022).

STEMS:

Plants are acaulescent (all leaves clustered at the base of the plant) with a leafless flower stalk arising from the ground level (i.e., a scape). Plants produce stolons (Fig. 2).

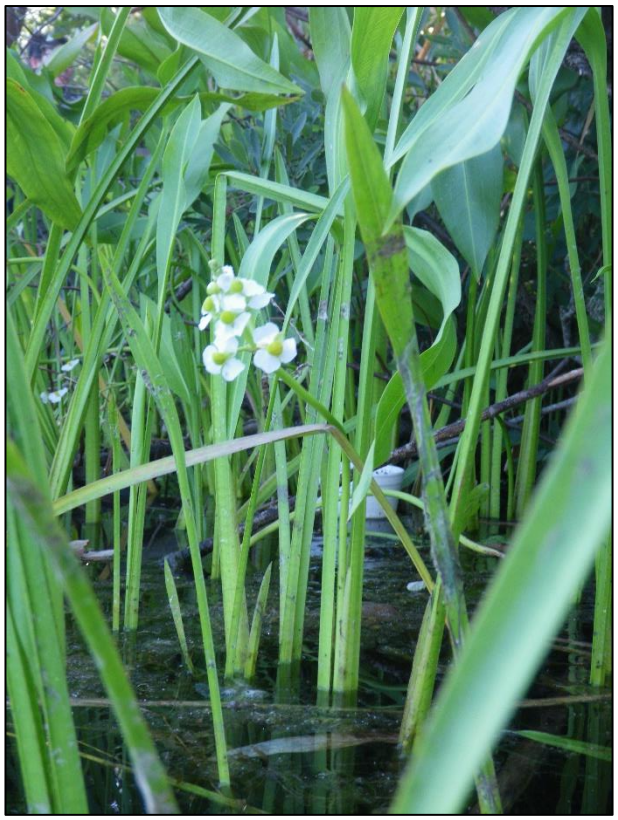


Figure 1. *Sagittaria platyphylla* with emergent leaves and flowers.

Figure 2. *Sagittaria platyphylla* plants connected by a stolon.

LEAVES:

Leaves can be submersed (below water) or emergent (above water). Leaf margins are entire. Submersed leaves are not separated into a petiole and leaf blade (i.e., they are phyllodial), are sessile, flattened above and beneath, up to 26 cm long and 0.5 cm broad (Fig. 3). Emergent leaves have a petiole and leaf blade, with the petioles somewhat triangular and 20–70 cm long; the leaf blades are linear-ovate to ovate, 4–16 cm long and 0.5–6.0 cm broad (Fig. 4). Emergent leaf blades are never arrow-shaped. Information above from Haynes and Hellquist (2022).

Figure 3. Fully submersed individuals of *Sagittaria platyphylla* with submersed phyllodial leaves (leaves are not separated into a petiole and leaf blade). Photo © Ben Legler.

Figure 4. Emergent leaves of *Sagittaria platyphylla*. Photos © Ben Legler.

FLOWERS:

Plants flower summer–fall. The inflorescence is a raceme with 3–9 whorls of flowers produced above the water's surface. Flowers are unisexual with male flowers located above female flowers. Flowers have 3 white petals, 3 sepals, and are up to 1.8 cm in diameter (Fig. 5). Sepals are persistent, may curve backward, and do not encase the flower or fruiting head. Male flowers have pubescent filaments that are longer than the anthers. The flower stalks (pedicels) for male flowers are generally thinner than those for female flowers. When fruiting, the pedicels are typically bent slightly downwards, back toward the stem (i.e., recurved; Fig. 6). Information above from Haynes and Hellquist (2022).

Figure 5. Flower stalk of *Sagittaria platyphylla* with male flowers above and female flowers below, 4 June 2025.

Figure 6. Fruiting *Sagittaria platyphylla*, with the oldest fruiting pedicels curved downwards. Left: male flowers above fruiting heads, 12 August 2025. Right: all fruiting heads, photo © Ben Legler.

FRUITS/SEEDS:

Fruits are achenes produced in globe-like heads 0.7–1.2 cm in diameter (Fig. 6) (Haynes and Hellquist 2022). The achenes are oblanceoloid, 1.2–2 mm long and 0.8-1.2 mm broad (Fig. 7). The achenes are beaked, with no abaxial keel. In Australian populations, individual *S. platyphylla* produced a mean of 850 achenes per fruiting head and 6,900 achenes per inflorescence (Adair et al. 2012).

Figure 7. Achenes of *Sagittaria platyphylla*. Photo by Alex Staunch.

ROOTS:

Plants produce corms and tubers, but no rhizomes (Haynes and Hellquist 2022). Roots are distinctly segmented (i.e., septate; Figs. 3 and 8).

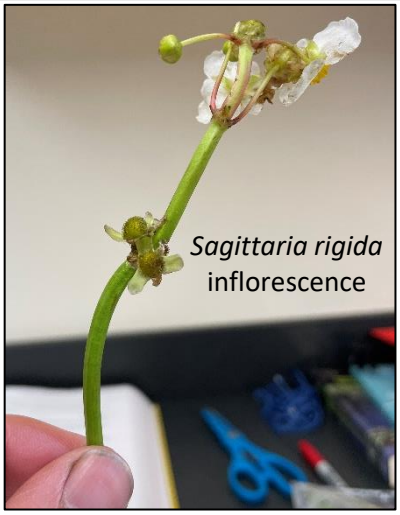
Figure 8. Roots of *Sagittaria platyphylla*. Note root segmentation (arrows), a distinctive trait of *Sagittaria* species.

SIMILAR SPECIES:

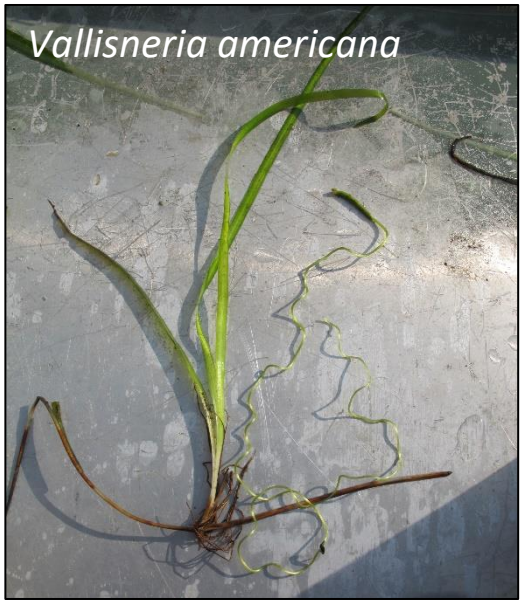
There are several similar and closely related species in the Alimataceae family present in Washington, including S*agittaria* spp. (4 species), *Alisma* spp. (3) and *Damasonium californicum*. The submersed leaves of *S. platyphylla* may also resemble the submersed leaves of *Vallisneria americana* (Hydrocharitaceae). Features of each look-alike taxa that distinguish them from *S. platyphylla* are listed below:

- *Alisma* spp.
    - Inflorescence branches multiple times (i.e., a panicle)
    - Achenes are arranged in a ring, not a round fruiting head
    - Roots are <u>not</u> segmented

    - Leaf blades are often slightly heart-shaped at the base (i.e., cordate)
    - Leaves are generally shorter than *Sagittaria* spp.
- *Sagittaria* spp.
    - *S. cuneata* and *S. latifolia*
        - Typically have arrow-shaped leaves
        - Pedicels curved upwards (ascending)
        - Stamen filaments <u>not</u> pubescent
        - Native to Washington; common
    - *S. rigida*
        - Fruiting heads sessile (distinguishes this species from all other *Sagittaria* spp. in Washington)
        - Inflorescence stems often curved.
        - Occasionally with arrow-shaped leaves, but lobes are much smaller than those of *S. cuneata* and *S. latifolia*
        - Introduced to Washington; isolated populations
    - *S. graminea*
        - Fruiting pedicels typically straight or curved upwards (ascending)
        - Pedicels for male and female flowers generally of similar thickness
        - Produces rhizomes
        - Does not produce stolons or corms
        - Class B Noxious Weed; isolated populations in Snohomish and Mason Counties
- *Damasonium californicum*
    - Distinct fringed petals and star-shaped fruiting head



    - Threatened species with limited distribution in Washington
- *Vallisneria americana*
    - Fully submersed species
    - Does not produce emergent leaves or flower stalks above the water's surface
    - Leaves have a shiny center stripe
    - Distinct spiral fruit stalk produced underwater later in season



HABITAT:

Sagittaria platyphylla grows in wetlands and on shallow margins of ponds, lakes, streams, and rivers, up to 900 m of elevation (Figs. 9 and 10)(Haynes and Hellquist 2022). It is associated with silty substrates and those high in potassium and organic matter (Wooten 1986, Adair et al. 2012). It grows readily in manmade drainage and irrigation channels and ditches. Fluctuating water levels favor its establishment.

Figure 9. Patch of *Sagittaria platyphylla* early in the growing season at Deep Lake, Thurston County, 6 June 2025. Note submersed leaves and newly developed emergent leaves.

Figure 10. Dense patch of *Sagittaria platyphylla*.

BIOLOGY

GROWTH AND DEVELOPMENT:

The optimal temperature for *S. platyphylla* germination is reported to be 21 °C and for growth 24 °C; achenes germinate best in silty sediment and will not germinate in complete darkness (Adair et al. 2012).

REPRODUCTION:

Plants reproduce via sexual reproduction as well as asexually via stolons (Fig. 2). In general, *Sagittaria* species are pollinated by flies, short-tongued bees, generalist bees, syrphids, and other small insects (Adair et al. 2012). Studies of similar species indicate that individual plants are likely self-incompatible; hence, pollination by another individual is likely necessary for viable seed production. *Sagittaria* achenes can be dispersed by animals or via floatation; *S. platyphylla* achenes can float on the water's surface for up to a week (Adair et al. 2012). While there is no documentation for *S. platyphylla*,

achenes of other *Sagittaria* can be spread by direct attachment to animals (epizoochory) and may be spread following ingestion by ducks (endozoochory; Adair et al. 2012). The length of seed viability is currently unknown. Asexual spread via stolons occurs primarily in water less than 0.5 m. The stolons senesce following development of the clonal individual; the rate of senescence is unknown (Adair et al. 2012).

GEOGRAPHIC DISTRIBUTION:

NATIVE DISTRIBUTION

Sagittaria platyphylla is native to the southeastern and Midwest U.S., and Mexico (Haynes and Hellquist 2022). The native U.S. native range extends west to Texas; north to Illinois, Ohio, and Pennsylvania; east to the Atlantic coast; and south to Florida (Fig. 11).

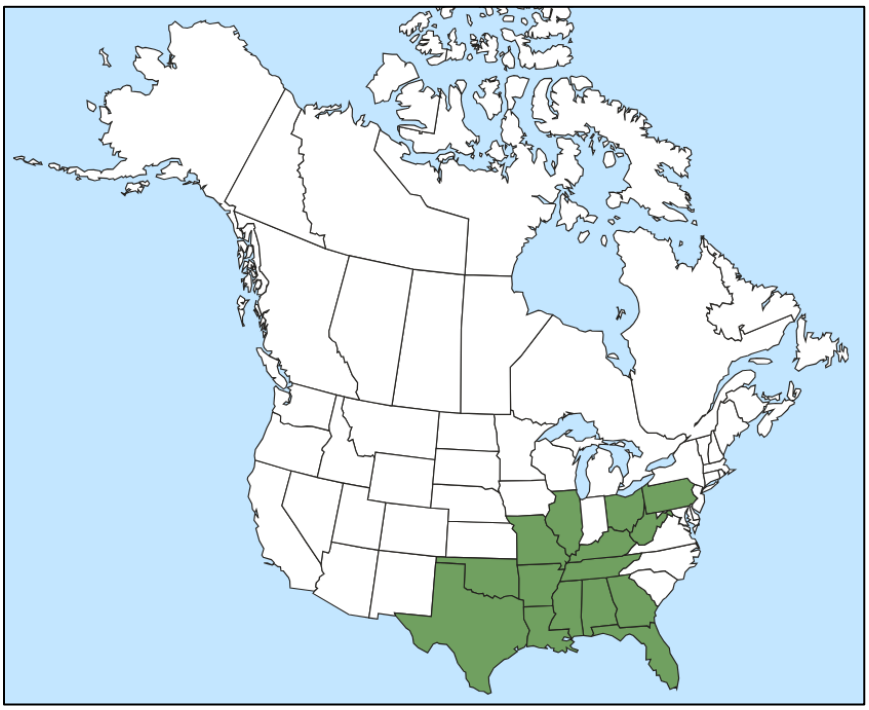


Figure 11. Native range of *Sagittaria platyphylla* in North America, north of Mexico (Haynes and Hellquist 2022).

NON-NATIVE DISTRIBUTION

Outside of the U.S., *S. platyphylla* has been introduced and become established in Russia, Indonesia, Panama, Australia, New Zealand, South Africa, and China (Adair et al. 2012, Wang et al. 2020). Aside from the west coast U.S. observations described below, *S. platyphylla* has not been documented as introduced elsewhere in the United States.

HISTORY:

Details about the introduction of *S. platyphylla* beyond its native range in the U.S. are lacking. The first introduced U.S. record was from Washington in 2003, followed by Oregon in 2013 (see sections below). These populations likely came from discarded or intentionally planted individuals that were acquired through the water garden and aquarium trade. Both introduced populations have spread locally but have not spread beyond the initial infested area. Similarity between other native and introduced *Sagittaria* species has possibly led to under-reporting of other U.S. introductions.

WASHINGTON:

In Washington, *S. platyphylla* is known to occur only in Deep Lake in Thurston County. The public boat access and much of the shoreline of Deep Lake is located within Millersylvania State Park. The Deep Lake population was identified as an unknown *Sagittaria* species during a 2003 Thurston County lakes survey. At that time, the Washington State Department of Ecology sent a specimen to Dr. Robert Haynes at the University of Alabama for confirmation of the species. In 2003, scattered patches were found on the north shore of Deep Lake. A 2005 survey identified additional patches on the north shore and some along the south shore. Monitoring has continued periodically by the Department of Ecology, and in 2013 a few additional patches were found, but no marked increase. No systematic surveys were conducted again until 2024. Surveys of the lake on 11 September 2024 and 4 June 2025 confirmed the presence of large, flowering populations near the public boat launch that were observed in previous surveys. The 2024 survey also identified: 1) small emergent populations along the entire shoreline, 2) fully submersed plants growing in the southwest portion of the lake, and 3) a population growing in the outflow stream that leads to nearby Scott Lake (Fig. 12). On the same day as the 2024 survey, a survey was conducted on Scott Lake, downstream of Deep Lake, and no *S. platyphylla* was identified. On 15 October 2025, a survey was conducted of the outflow stream from Deep Lake, north to the State Park property boundary. Several small *S. platyphylla* patches and individual plants were identified in the stream during the survey but no plants were found < 500 m from the park boundary (Fig. 12). All emergent *S. platyphylla* plants north of the trail crossing (dotted line) were hand pulled during the survey.

Figure 12. Locations of *Sagittaria platyphylla* (blue lines and triangles) in Deep Lake and outflow stream based on surveys conducted 4 June 2025 (lake) and 15 October 2025 (stream). Map provided by the Washington State Parks and Recreation Commission.

NEARBY TO WASHINGTON:

OREGON:

A small population of *S. platyphylla* was discovered in the Blue Heron Wetlands in Portland, Oregon, near the Columbia River in 2013 (Fig. 13). At the Blue Heron Wetlands, an initial infestation of < 20 plants increased to > 300 in one year (Alex Staunch, Mosaic Ecology, personal communication). The population has been heavily managed with herbicides and hand-pulling since its discovery, and as of 2024 the population consists of fewer than 10 individuals.

In 2015, a specimen identified as *S. platyphylla* was collected from a second location in Oregon, upstream of the Blue Heron Wetland site, also along the Columbia River (Fig. 13). However, there is uncertainty about the identification of this specimen from the collector and other experts who have viewed it. As of 2025, a follow-up visit to the location has not been conducted and the status of this potential population is currently unknown.

Figure 13. Herbarium records of *Sagittaria platyphylla* in Oregon, based on the Consortium of Pacific Northwest Herbaria.

IDAHO:

There are no records of *S. platyphylla* in Idaho in the Consortium of Pacific Northwest Herbaria, reported in the U.S. Geological Survey's Nonindigenous Aquatic Species database, or on iNaturalist.

BRITISH COLUMBIA:

There are no records of *S. platyphylla* in British Columbia in the Consortium of Pacific Northwest Herbaria. However, there is a probable, but unconfirmed iNaturalist sighting recorded in 2024 in Vancouver, BC: https://www.inaturalist.org/observations/241041103.

CALIFORNIA

There are no records of *S. platyphylla* in California in the Consortium of Pacific Northwest Herbaria, Consortium of California Herbaria, or the U.S. Geological Survey's Nonindigenous Aquatic Species database. There are two "Research Grade" observations of *S. platyphylla* in California recorded on iNaturalist; however, these observations require closer examination to confirm species identification. The California endemic *Sagittaria sanfordii* is very similar to *S. platyphylla* and mature achenes are needed to tell the species apart.

1. https://www.inaturalist.org/observations/46734071
2. https://www.inaturalist.org/observations/4120122

LISTINGS:

United States

- Oregon
    - A-Listed Noxious Weed (https://www.oregon.gov/oda/weeds/oregon-noxious-weeds/pages/law.aspx).

International

- Australia
    - Weed of National Significance (https://weeds.org.au/lists/established/)
- South Africa
    - National Environmental Management Biodiversity Act (NEMBA) Category 1a (species which must be combatted or eradicated; https://invasives.org.za/fact-sheet/delta-arrowhead/).

ECONOMIC AND ECOLOGICAL IMPORTANCE:

DETRIMENTAL:

Sagittaria platyphylla substantially impedes water flow and availability in irrigation systems in Australia (Adair et al. 2012). Established *S. platyphylla* plants trap sediment, facilitating germination and further spread. Costs associated with clearing *S. platyphylla* infestations in Australian irrigation systems has been reported to be up to AU$2 million per year (Adair et al. 2012). While these irrigation impacts have not yet been documented in other invaded countries, there is major concern regarding similar impacts in South Africa and China (Ndlovu et al. 2020, Wang et al. 2020).

Negative impacts in natural freshwater systems are less known. However, the ability of *S. platyphylla* to spread rapidly and form dense monocultures likely leads to the displacement of native species and may alter water flow. For example, a recent study of introduced *S. platyphylla* in the Yangtze River in China found dense monocultures in many areas and site-level declines in co-occurring alligator weed (*Alternanthera philoxeroides*)—another invasive aquatic plant species (Wang et al. 2020). In South Africa, *S. platyphylla* spread to over 70 new locations in 10 years since its initial introduction, and spread an average of 10 km/yr in flowing water systems (Ndlovu et al. 2020). In Oregon, an initial observation of < 20 individuals spread to > 300 the following year (Alex Staunch, Mosaic Ecology, personal communication).

BENEFICIAL:

Sagittaria platyphylla has traditionally been sold as an ornamental in the aquarium and water garden trade in the U.S. and internationally. The species is now prohibited for sale or trade in Washington and several other municipalities and countries (Adair et al. 2012). Before it was recognized as invasive in China, it was widely used in restoration plantings (Wang et al. 2020).

CONTROL:

MECHANICAL:

In irrigation channels and drains in Australia, mechanical removal with excavation machinery has been used to remove *S. platyphylla* (Adair et al. 2012). Similar methods, along with manually digging up plants, have been used to remove plants in South Africa (Ndlovu et al. 2020). In Oregon, hand removal was attempted for a small infestation in an ephemeral wetland; however, this approach was abandoned because entire plants could not be effectively removed (Alex Staunch, Mosaic Ecology, personal communication). At the Oregon wetland site, technicians noticed that *S. platyphylla* corms were left

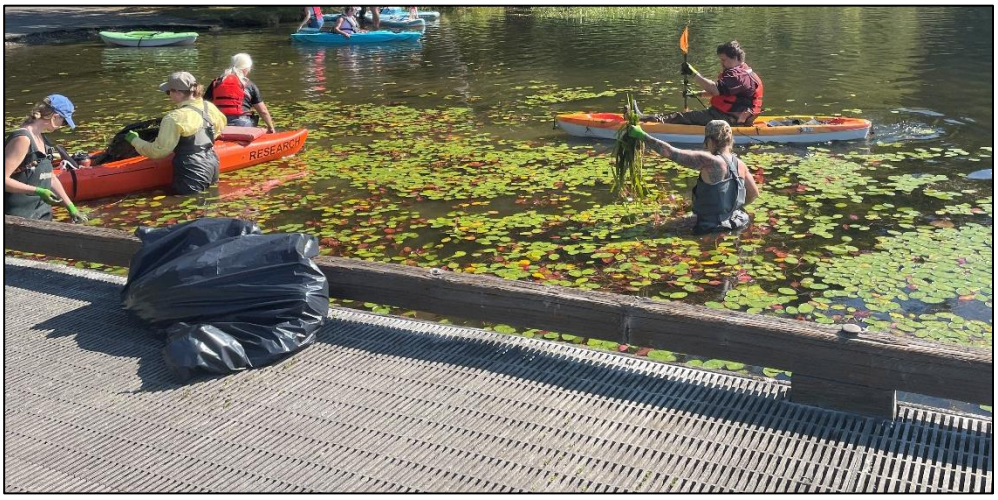


Figure 14. Hand pulling *Sagittaria platyphylla* at Deep Lake in Thurston County. Photo by Stella Waxwing.

intact or only partially removed following hand pulling. In Deep Lake in Washington, initial testing of hand pulling showed more promise—entire plants and roots were able to be removed from shallow water sites. A full-day removal project was implemented on 12 August 2025 resulting in ~3,000 lbs. of *S. platyphylla* removed (Fig. 14). Additionally, while surveying the Deep Lake outflow stream on 15 October 2025, several individual plants were hand pulled. The removal locations will be monitored to determine effectiveness of this approach.

CULTURAL:

Cultural control methods have not been thoroughly evaluated for *S. platyphylla* in natural systems. In irrigation channels, maintaining water levels above 0.5 m (1.64 ft.) and creating channels with steeper slopes can reduce the amount of emergent *S. platyphylla* plants, which pose the greatest nuisance (Adair et al. 2012).

BIOLOGICAL:

Nineteen herbivore species were observed feeding or reproducing on *S. platyphylla* in a study of its native range in the Southeast U.S. (Kwong et al. 2014). Of these species, the fruit-feeding weevil *Listronotus appendiculatus* was recently approved as a biocontrol agent for *S. platyphylla* in Australia. As of 2023, the weevil was being released at select locations in New South Wales and Victoria to study its effectiveness (Centre for Invasive Species Solutions 2025). *Listronotus appendiculatus* has not been documented in the Pacific Northwest, but this species and other *Listronotus* are known to feed on *Sagittaria* (Harms and Grodowitz 2009). Hence, the potential of these insects as biocontrol in Washington could be an area of future research.

CHEMICAL:

Glyphosate has predominantly been used for chemical control of emergent *S. platyphylla*. At the Blue Heron Wetlands site in Oregon, 3% glyphosate applied to emergent *S. platyphylla* plants reduced the population of over 300 individuals to consistently less than 15 after several years of treatment (Alex Staunch, Mosaic Ecology, personal communication): since 2021, fewer than 15 plants have been found each year at the site. Glyphosate has also been used to control *S. platyphylla* in Australia, where it has been shown to kill seedlings and reduce tuber weight (Adair et al. 2012). In Australia and South Africa, the impacts of glyphosate to adult emergent plants, however, have been less consistent, with higher application rates and application to greater amounts of foliage (≥ 60% of each plant) necessary for control (Adair et al. 2012, Ndlovu et al. 2020). Moreover, repeat treatments of glyphosate were often needed following plant regrowth.

Other herbicides that have been used for control of *S. platyphylla* and are approved for aquatic use in Washington waterbodies include 2,4-D, imazapyr, endothall, and flumioxazin (Adair et al. 2012, Clements et al. 2015, New South Wales Department of Primary Industries 2023). Additional herbicides that effectively control *Sagittaria* spp. in general, and are similarly approved for Washington use, include bispyribac-sodium and imazamox (Texas A&M Agrilife Extension 2025). In Australia, 2,4-D has been observed to cause rapid die-off of *S. platyphylla* leaves without translocation to belowground stems,

resulting in regrowth within 6–12 weeks (Adair et al. 2012). For closed water systems, a three-week exposure to endothall (dipotassium salt) at the maximum label rate substantially reduced *S. platyphylla* biomass, particularly submersed plants (Clements et al. 2015). In that study, the number of submersed plants were reduced by 68%, whereas only the aboveground portion of plants with emergent leaves were eliminated, leaving those plants able to resprout.

RATIONALE FOR LISTING:

Sagittaria platyphylla is recognized as a highly invasive species where it has been introduced in North America, Australia, Asia, and Africa. In neighboring Oregon, it is listed as a Class A Noxious Weed and targeted for eradication. It is on national weeds lists in Australia and South Africa, where it has spread rapidly and negatively impacted natural and manmade systems. First identified in Washington in 2003, *S. platyphylla* has persisted and spread within Deep Lake in Thurston County for over 20 years. Its ability to survive, spread, and flower in Deep Lake indicates that it is well-adapted to survive in other Washington waterbodies. Moreover, Deep Lake is within Millersylvania State Park and is a popular lake for recreation; a large, persistent population near the public boat access and swimming area provides an opportunity for this species to be unintentionally transported to other waterbodies. Adding *S. platyphylla* to the Noxious Weed List as a Class A Noxious Weed would: 1) facilitate the eradication of this species from Deep Lake (and Washington), 2) improve the ability to acquire state and federal funds for its control, and 3) increase awareness of this species so that additional or new populations can be identified and eradicated quickly.

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