Figure 1: *Vallisneria australis*. Photo credit: NIWA (2020), Freshwater Invasive Species of New Zealand 2020.

California Pest Rating Proposal for

Vallisneria australis S.W.L. Jacobs and Les: Australian eelgrass, ribbonweed

Family: Hydrocharitaceae

Current Pest Rating: Q

Proposed Pest Rating: B

Comment Period: 10/13/2021 through 11/27/2021

Initiating Event:

Australian eelgrass has been identified from bodies of water in the Delta region of Northern California, with the identification confirmed by nuclear ITS DNA sequencing at the CDFA PPDC, and the species has been given an initial rating of Q. A pest rating proposal is required to evaluate the current rating and

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status of the species in the state of California.

History & Status:

Background: *Vallisneria australis* (Australian eelgrass) is a native of eastern Australia that has previously been included in a very broadly defined American species *V. americana* Michx. (see e.g., Haynes, 2000; Lowden, 1982). It has also sometimes been incorrectly identified as the Eurasian species *V. spiralis* L. The systematics of the genus was clarified using both morphological and DNA sequence data by Les et al. (2008), who recognized 14 to 15 species in the genus. Three species are native to North America and the remaining species are native to Australia, Eurasia, or Africa, with greatest species diversity in Australia. According to Les et al. (2008), *Vallisneria australis* differs from the widespread North American species *V. americana* in ecological and physiological characters, as well as a limited number of characters from plant morphology. *Vallisneria australis*, *V. americana* and *V. spiralis* form well-separated natural groups in their analyses of nuclear ITS DNA sequence data, but the species can be difficult to distinguish morphologically, particularly in the case of vegetative plant specimens. Well-developed plants of *V. australis* tend to have longer and wider leaves (1.6-3.5 versus 1-1.5 cm wide) than in *V. americana*, but the majority of diagnostic morphological features separating *V. australis* from other species including *V. americana* and *V. spiralis* are reproductive characters from the male or female flowers. Thus, the accurate identification of vegetative plants from wild or cultivated sources requires use of both available morphology and DNA sequence data from easily amplified regions such as the nuclear internal transcribed spacer region (ITS). Several species of eelgrass have been sold in the aquarium trade, which is a likely pathway of introduction of non-native populations into other areas including portions of Asia, New Zealand, Europe, and California (Mesterházy et al, 2021; NIWA, 2020; Wakesura et al., 2016).

Vallisneria australis is a rooted submersed freshwater aquatic perennial with a rosette habit and long creeping stems (stolons or rhizomes) at or below the bottoms of the bodies of water in which the plants occur. Male and female flowers are borne on separate plants (dioecious condition), but it is apparently not yet determined whether both male and female plants have been introduced into California (Patricia Gilbert, pers. com., 9-13-2021). In New Zealand, almost all populations of this introduced species contain only female plants, and seed production is not reported (NIWA, 2020). The morphology of the species is described here based primarily on our knowledge of plants in their native habitat in Australia (Les et al., 2008; Flora of Victoria, 2021). The elongate strap-shaped leaves of Australian eelgrass can be up to at least 3 meters long and 1.5-3.5 cm wide, with fine toothed margins towards the leaf apex. The 5-7 prominent longitudinal leaf veins are parallel and connected by small lateral veins. Many very small male flowers (< 0.5 mm) are clustered in membranous sheaths near the bases of the male plants and are released to float to the water surface. The filaments of the stamens are partially fused (free in *V. spiralis*) and lack hairs (hairy at the base of the androecium in *V. americana*). The small 3-parted female flowers are approximately 2-4 mm long, generally borne singly (sometimes up to 4 per inflorescence) in a tubular sheath at the end of a long narrow stalk (peduncle), oriented so that the flower has an opening at the water surface. After fertilization, the flower stalk becomes spirally coiled, pulling the developing fruit below the water surface. The narrowly cylindrical single-chambered fruits are approximately 2-16 cm long, breaking apart irregularly at maturity to release numerous small ellipsoidal seeds,

approximately 1.5-2 mm in length. The plant occurs in its native habitat in freshwater lakes, reservoirs, creeks, rivers, ponds, and irrigation channels (Flora of Victoria, 2021; Les et al., 2008). The species has been reported to occur in bodies of water up to at least 20 feet deep, and can grow in still to moderately fast-flowing water (New Zealand Plant Conservation Network, 2021).

Worldwide Distribution: *Vallisneria australis* is native to creeks, rivers, and other inland bodies of water in eastern Australia from Queensland south to Tasmania and South Australia and is reported as an introduced plant in Western Australia (Les et al., 2008; USDA GRIN, 2021). Australian eelgrass has also been introduced into New Zealand (with an earliest known record from 1897 (NIWA, 2020), and has been recently documented as an introduced plant in Japan (Wakesura et al., 2016), Europe (Belgium, Germany, Hungary, Italy; documented by Mesterházy et al., 2021), and northern California.

Official Control: *Vallisneria australis* has been designated as an unwanted organism under the National Pest Plant Accord of New Zealand (NIWA, 2020) and is under regional pest management in 5 regions of New Zealand. Other species of *Vallisneria* (*V. americana* in Indonesia and Timor-Leste, and the Eurasian and African species *V. spiralis* in New Zealand and Taiwan) are listed as harmful organisms in the USDA PCIT database (2021), and all aquatic plants are listed as harmful organisms by Madagascar. Given the taxonomic difficulties in the past classifications of the genus these designations are likely to have been intended to apply at least in part to plants now classified as *V. australis*.

California Distribution: Australian eelgrass has been documented as occurring along marinas, bridges, delta islands, and waterfronts at multiple sites in the Sacramento Delta region in Sacramento, San Joaquin, and Solano Counties during the summer of 2021. The identity of 5 of the populations has been confirmed by nuclear ITS DNA sequence analysis at the CDFA diagnostic laboratory (CDFA PDR database, 2021). Based on archived aerial images of some of the current populations it appears that plants of the species have been present in the Delta Region for several years prior to their identification at the CDFA diagnostic laboratories (Nicholas Rasmussen, pers. comm., 9-13-2021), and it appears likely that other populations may be present in northern California.

California Interceptions: *Vallisneria* plants identified only to genus have been intercepted in parcel shipments into California originating in Colorado, Florida, and Illinois, presumably being shipped for aquarium use (CDFA PDR database, 2021).

The risk **Australian eelgrass** would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** The plant could occur in open water habitats in other areas of California. Therefore, Australian eelgrass receives a **Medium (2)** in this category.

Evaluate if the pest would have suitable hosts and climate to establish in California.

Score: **2**

- Low (1) Not likely to establish in California; or likely to establish in very limited areas.
- **Medium (2) may be able to establish in a larger but limited part of California.**
- High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** Risk is **High (3)** as weeds do not require any one host, but grow wherever ecological conditions are favorable.

Evaluate the host range of the pest.

Score: 3

- Low (1) has a very limited host range.
- Medium (2) has a moderate host range.
- **High (3) has a wide host range.**

3) **Pest Dispersal Potential:** Australian eelgrass can spread locally in bodies of water by extension of the basal rhizomes or stolons and is also reported to spread by stolon fragmentation (New Zealand Plant Conservation Network, 2021; NIWA, 2020). Both vegetative plant fragments and seeds can be dispersed by natural water flow, on boats and boat trailers or dredging equipment, and by intentional planting in ponds or the disposal of pond or aquarium contents. Reproduction by seed has not yet been documented in California. Since the documentation of the presence of the species in northern California in 2021 it has been identified in portions of three counties in the Sacramento River Delta area, and continued spread is likely unless control is established. *Vallisneria australis* receives a **High (3)** in this category.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 3

- Low (1) does not have high reproductive or dispersal potential.
- Medium (2) has either high reproductive or dispersal potential.
- **High (3) has both high reproduction and dispersal potential.**

4) **Economic Impact:** Australian eelgrass can form tall underwater meadows that may block water flow needed for irrigation, navigation, and hydropower generation. The genus is considered a desirable plant in the aquarium trade, but this species has the significant disadvantage that its leaves grow to 3 meters in length, and the species has been documented as naturalizing in northern California as well as in New Zealand, Japan, and Europe. The species receives a **Medium (2)** in this category.

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: D, F

A. The pest could lower crop yield.
B. The pest could lower crop value (includes increasing crop production costs).
C. The pest could trigger the loss of markets (includes quarantines).

D. **The pest could negatively change normal cultural practices.**

E. The pest can vector, or is vectored, by another pestiferous organism. The organism is injurious or poisonous to agriculturally important animals.

F. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: **2**
- Low (1) causes 0 or 1 of these impacts.
- **Medium (2) causes 2 of these impacts.**
- High (3) causes 3 or more of these impacts.

5) **Environmental Impact:** The plant could invade the water systems of California, disrupt natural lake communities and potentially lower biodiversity by covering lake, reservoir, or riverine surfaces. It can also impede boat navigation. On the positive side, species of *Vallisneria* can provide useful food sources for waterfowl, fish, and other aquatic organisms (Les et al., 2008). Australian eelgrass receives a **High (3)** in this category.

Environmental Impact: A, D

A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.

B. The pest could directly affect threatened or endangered species.

C. The pest could impact threatened or endangered species by disrupting critical habitats.

D. The pest could trigger additional official or private treatment programs.

E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score:
- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- **High (3) causes two or more of the above to occur.**

Consequences of Introduction to California for Australian eelgrass*:* High (13)

Add up the total score and include it here.
-Low = 5-8 points
-Medium = 9-12 points
-High = 13-15 points

6) **Post Entry Distribution and Survey Information**: Australian eelgrass has been found to be established in several counties in the Delta Region of California. It receives a **Low (-1)** in this category.

Score: -1
-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one

suitable climate/host area (region).
-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of introduction score minus the post entry distribution and survey information score:

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= Medium (12)***

Uncertainty:

The ability of Australian eelgrass to invade open water in mild climates is well established. Its invasion of the California Delta appears to be in a relatively early stage, but it is unclear for how many years it has been present in northern California prior to its documentation in 2021. Additional populations of the species may be present in the state, particularly given the difficulties in distinguishing species of *Vallisneria* from vegetative plants. The degree of reproduction by seed among plants of *Vallisneria* in California is not yet known. No seed production has been observed in the introduced populations in New Zealand, where the introduction of Australian eelgrass has involved almost exclusively female plants (NIWA, 2020).

Conclusion and Rating Justification:

Australian eelgrass is a potentially invasive aquatic weed that has been documented from several localities in the Delta region of northern California. The species is one of several members of the genus that are sold in the aquarium trade on a global basis, and has been introduced into the freshwater environment in New Zealand, Europe, and Asia in addition to northern California. The species is less desirable as an aquarium plant than other members of its genus because it grows to 3 meters in leaf length. The genus is known to provide important food sources for waterfowl, fish and other aquatic animals elsewhere in North America, so the species may be subject to some level of natural control by herbivory. A “B” rating is recommended due to the likelihood of further spread and establishment in the absence of control measures.

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Responsible Party:

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***Comment Period: 10/13/2021 through 11/27/2021**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at plant.health[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.

- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: B
