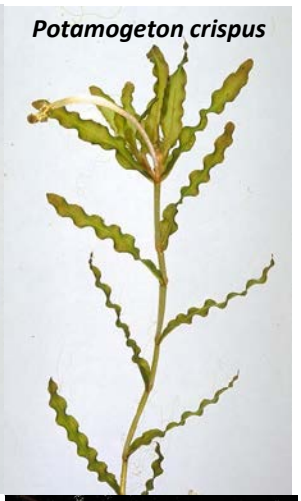
Potamogeton spp.; several pondweeds
Stuckenia pectinata (L.) Börner; sago pondweed

Pondweeds (submerged)



Family: Potamogetonaceae
Range: Throughout the U.S., including all western states.
Habitat: Ponds, lakes, streams, rivers, reservoirs, irrigation ditches, marshy areas. Most species commonly grow in shallow water, but can grow to depths of ~20 ft or more in clear water. Leafy and sago pondweed also grow in brackish water.
Origin: All pondweed species are native to the western United States except curlyleaf pondweed (*P. crispus* L.), which was introduced from Eurasia.
Impacts: In natural areas, most pondweeds are a desirable component of the aquatic community. They provide habitat and are an important food source for wildlife. However, colonies can be troublesome in drainage canals, irrigation ditches, and other controlled aquatic systems. Curlyleaf pondweed is very invasive in aquatic systems and is considered the most significant problem among the submerged pondweed species.
Western states listed as Noxious Weed: *P. crispus*, Washington
California Invasive Plant Council (Cal-IPC) Inventory: *P. crispus*, Moderate Invasiveness

The genus Potamogeton is comprised of many widespread, highly variable species that are often difficult to distinguish, resulting in much taxonomic confusion. The most common submerged species in the western United States are curlyleaf pondweed (*P. crispus*), leafy pondweed (*P. foliosus* Raf. var. *foliosus*), Illinois pondweed (*P. illinoensis* Morong), and sago pondweed (*S. pectinata* (L.) Börner).

The submerged pondweeds are all perennials, most with rhizomes. Most species hybridize with one or more other species. The leaves are generally alternate, but sometimes nearly opposite. Leaves of most species have a prominent midvein. Leaves vary in size and shape among species. Curlyleaf pondweed has a very wavy (undulate) leaf which makes it easy to distinguish.

Inflorescences consist of cylindrical spikes that are above the surface of the water, or floating on the surface in the case of sago pondweed. The flowers are greenish and inconspicuous. Plants are wind- and water-pollinated. Fruits are achene- or nutlet-like structures. Despite the fact that all species, except hybrids, produce seeds, seedlings are seldom encountered. When seeds are produced, they float and disperse with water, are ingested by wildlife, or cling to the feet, fur, or feathers of animals. Seeds surviving ingestion by birds germinate readily. Illinois pondweed seeds may survive up to ~5 years under moist conditions. Sago pondweed seeds survive up to ~1.5 years under dry conditions. Seed longevity of other species is poorly documented.

Most plants reproduce vegetatively from rhizomes or stem fragments. Curlyleaf pondweed develops turions (specialized stem buds that survive unfavorable conditions) in the leaf axils and/or at the tips of short axillary branches before dormancy. Turions are composed of few to several reduced, overlapping leaves.

Curlyleaf pondweed turions resemble brown pinecones. Sago pondweed reproduces vegetatively by tubers formed at the tips of the rhizomes.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, disking)	Repeated mechanical harvesting can help reduce stem densities, but escaped stem fragments can drift elsewhere and develop into new plants. Removing and destroying stem fragments from recreational equipment such as boat propellers, docking lines, and fishing gear can help prevent the spread of pondweeds. Several types of "bottom barriers' are available and are used to cover and smother specific infested areas. Materials used include polyvinyl chloride (pvc) sheets, small-mesh screens, and natural fibers such as jute. Bottom barriers are best installed in spring before plants produced large biomass and exceed 20 inches tall. In canals, backhoes and telescoop devices can be used to remove infestations, but these operations usually remove sediment as well. Because sago pondweed forms tubers in the sediment, excavation depths should reach at least 12 inches.
Cultural	Dewatering (draining) canals or lakeshores in mid-summer may suppress subsequent growth, but plants can easily resprout from rhizomes if bottom sediments remain moist and cool. Winter drawdown alone will not impact growth of sago pondweed since it produces vegetative propagules (tubers) protected within the sediment.
Biological	The (sterile) triploid grass carp (white amur) is a relatively nonselective herbivorous fish that will consume most pondweed species, including sago pondweed and curlyleaf pondweed. The fish do not selectively feed on "non-native" plants so careful monitoring of feeding impacts is necessary. In many canal systems non-selectivity is not a problem, as few or no plants are desired since they can interfere with efficient water delivery.

CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

BRANCHED-CHAIN AMINO ACID INHIBITORS	
Penoxsulam *Galleon*	**Rate:** For in-water applications: 25 to 75 ppb; may be repeated but not to exceed 150 ppb in an annual season. For dewatered (drawdown) applications: 5.6 to11.2 oz product/acre (1.4 to 2.8 oz a.i./acre) to canal or shorelines where plants grow **Timing:** Apply to water in early spring to early summer (rapid growth). For drawdown treatments, apply during mid to late winter before refilling. **Remarks:** Penoxsulam is a slow-acting herbicide and may take 4 to 6 weeks to achieve control. For drawdown applications use 20 to 100 gal/acre of spray solution to wet the sediment.
Imazamox *Clearcast*	**Rate:** For in-water applications: 50 to 100 ppb. For dewatered (drawdown) applications: 64 oz product/acre (8 oz a.e./acre); first flush of water in canals must NOT be used for irrigation **Timing:** Apply to water in early spring to early summer (rapid growth). Dewatered applications should be made in late winter at least 14 days before water will be reintroduced. **Remarks:** Use an approved surfactant.
PIGMENT SYNTHESIS INHIBITORS	
Fluridone *Sonar*	**Rate:** For in-water applications: 5 to 10 ppb; exposures must be maintained for 5 to 7 weeks for optimal control. For dewatered (drawdown) applications to dry canals or shorelines: 4 lb product (*Sonar*)/acre (2 lb a.e./acre), applied in 30 to 100 gal water/acre **Timing:** Apply to water in early spring to early summer. Dewatered applications should be made from fall to late winter, optimally when there is no standing water. **Remarks:** Fluridone is a slow-acting systemic herbicide that affects young, rapidly growing plants. Lower rates can be used if applied during early spring growth and when water movement is not likely to dilute or move the herbicide.

CONTACT PHOTOSYNTHETIC INHIBITORS	
Diquat *Reward*	**Rate:** For in-water applications: 0.1 to 0.25 ppm **Timing:** Apply to water in late spring to early summer. Diquat is a fast-acting contact herbicide that can be effective in mid- to late-summer, but if biomass is large, only a portion of the infested sites should be treated to minimize effects of reduced dissolved oxygen. **Remarks:** Diquat is quickly bound to, and becomes inactivated on, suspended clay particles and it should not be used in moderately or highly turbid water.
Flumioxazin *Clipper*	**Rate:** For in-water applications: 100 to 400 ppb **Timing:** Apply to water in early spring to early summer during rapid growth. **Remarks:** Flumioxazin is rapidly degraded and is inactive if pH exceeds 8.5. Use only if pH will not exceed 8.5. It is best to apply in the early morning when pH is low.
GENERAL CELL TOXICANTS	
Acrolein *Magnacide H*	**Rate:** For in-water applications: 1 to 15 ppm. Rate is variable and depends on target weeds, temperature and flow rates **Timing:** Apply to water in late spring to fall. No more than 8 applications are allowed per year. **Remarks:** Acrolein is a very fast-acting, nonselective contact herbicide and algaecide. It is a "Restricted Use" pesticide but can be used in some irrigation canals under specific conditions, with proper permits, and may only be applied by qualified, trained applicators. Symptoms of efficacy may appear in less than an hour and include discoloration of leaves and loss of turgidity.
Endothall *Cascade*; *Teton*; *Aquathol K*	**Rate:** For in-water applications: 1 to 3 ppm; exposures must be maintained for 24 to 48 hours or more for optimal control. The duration of contact depends on the concentration achieved (see label for specific rate and duration of exposure). **Timing:** Apply to water in early spring to early summer. Endothall can be used in mid-summer, but partial treatments are recommended if biomass is large to prevent large reduction in dissolved oxygen. **Remarks:** Endothall is a selective, contact herbicide. It affects young, rapidly growing plants and mature plants. Lower rates can be used if applied during early spring growth and when water movement is not likely to dilute or move the herbicide. Needs at least 4 hours of exposure time. Can mix with 0.5 ppm of copper (*Cleargate*) to also give good control. In moving water, an additional 'bump' treatment may be needed 3 to 4 miles from the main site of application to maintain a high enough concentration.
NON-HERBICIDAL CHEMICALS	
Dyes or colorants *Aquashade*	Although technically not herbicides, dyes and colorants control submerged aquatic plants by absorbing light in the water column and reducing photosynthesis. Applications should be made in early spring and repeated to maintain the concentration recommended on the label. Colorants are not as effective on well-established plants in mid- to late summer.

ECOMMENDED CITATION: DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.