Myriophyllum spicatum L.

Eurasian watermilfoil

Family: Haloragaceae
Range: Primarily temperate regions in the Northern Hemisphere, but also in some sub-tropical to tropical areas. It is present in nearly every state in the United States, with the possible exception of Wyoming.
Habitat: Ponds, lakes, rivers, streams, canals, ditches. Usually in still or slow-moving water, but occasionally found in faster moving water of streams and rivers.
Origin: Native to Eurasia and first documented near Maryland around 1942, possibly introduced through the aquarium trade.
Impacts: Eurasian watermilfoil can develop colonies that form large sub-surface or surface mats. Mats impede water flow, interfere with boat traffic and recreational activities, create mosquito habitat, and displace native aquatic vegetation.
Western states listed as Noxious Weed: Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, South Dakota, Washington
California Invasive Plant Council (Cal-IPC) Inventory: High Invasiveness

Eurasian watermilfoil is a common submerged perennial with creeping rhizomes and finely dissected whorled submersed leaves. The stems can be 12 to 20 ft long, becoming emergent only while flowering or after stream or canal drawdown when moisture is still present. Submersed leaves are 3 to 6-whorled per node, pinnately dissected into linear lobes.

Inflorescences are terminal emerged spikes about 2 to 4 inches long. Flowers are pinkish, whorled and monoecious (male and female flowers develop separately on same plant). Fruits break apart into four one-seeded nutlets. At maturity, fruits detach and float for a period before sinking. In the field, reproduction by seed appears to be insignificant. Some populations produce many seeds, but seedlings are rarely observed. Seeds can survive at least 7 years under dry conditions. Seeds are consumed by waterfowl and may disperse to great distances with migrating birds. Reproduction is primarily vegetatively by rhizomes, stem fragments, and axillary buds. Stem fragments easily detach and root at lower nodes. They disperse with water, by clinging to the feet or feathers of water birds, and with human activities such as boating, mechanical harvesting, and the dumping of unwanted pond or aquarium contents.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, rotovating, bottom barriers)	Repeated mechanical removal or harvesting can help reduce stem densities, but escaped stem fragments can drift elsewhere and develop into new plants. This is mainly used to control small infestations. Removing and destroying stem fragments from recreational equipment, such as boat propellers, docking lines, and fishing gear can help prevent the spread of non-native watermilfoils. 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 produce large biomass and exceed 10 inches tall. Unlike parrotfeather, Eurasian watermilfoil is more easily controlled by several aquatic herbicides.
Cultural	Dewatering infested areas during periods of high temperature in summer can suppress regrowth. Similarly, dewatering during winter during periods of hard freezes can suppress growth the following spring and summer. Dewatering can also be integrated with a subsequent herbicide application.
Biological	There are three herbivorous insects that have been used to control Eurasian watermilfoil with varying success:

	milfoil weevil (*Euhrychiopsis lecontei*), a midge (*Critotopus myriophylli*), and a moth (*Acentria ephemerella*). The milfoil weevil is commercially available. The (sterile) triploid grass carp (white amur, *Ctenopharyngodon idella*) is a relatively nonselective herbivorous fish that will consume Eurasian watermilfoil, but usually only after it first consumes its preferred submersed plants such as native pondweeds and hydrilla.

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.

GROWTH REGULATORS	
2,4-D *Weedar 64*	**Rate:** For in-water applications: 0.5 to 1.5 ppm; exposures must be maintained for 5 to 10 days for optimal control **Timing:** Apply to water in early spring to early summer. **Remarks:** 2,4-D is a selective, systemic herbicide. It 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.
Triclopyr *Renovate*	**Rate:** For in-water applications: 1 to 2.5 ppm **Timing:** Apply to water in early spring to early summer. Applications in mid-summer can suppress biomass, but may result in rapid die-back that results in depressed dissolved oxygen. If mid-summer applications are made to infestations with high biomass, then only treat 1/3 to 1/2 of the area and wait 10 to 14 days before treating the remainder. **Remarks:** Triclopyr is a selective, systemic, fast-acting herbicide. Lower rates can be used if applied during early spring growth and when water movement is not likely to dilute or move the herbicide.
BRANCHED-CHAIN AMINO ACID INHIBITORS	
Bispyribac-sodium *Tradewind*	**Rate:** For in-water applications: 20 to 45 ppb; may be repeated to maintain concentration but not within 14 days of initial treatment; do not exceed 4 applications per year **Timing:** Apply to water in early spring to early summer (rapid growth). For drawdown treatment, apply during mid- to late-winter before refilling. **Remarks:** Bispyribac-sodium is a slow-acting herbicide and may take 4 to 6 weeks for control. For drawdown applications use 20 to 100 gal/acre of spray solution to wet the sediment. Bispyribac-sodium may be tanked mixed with other herbicides.
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) treatment: 5.6 to 11.2 oz product/acre (1.4 to 2.8 oz a.i./acre) **Timing:** Apply to water in early spring to early summer (rapid growth). For drawdown, apply during mid-late winter before refilling. **Remarks:** Penoxsulam is a slow-acting herbicide and may take 4 to 6 weeks for control. For drawdown applications use 20 to 100 gal/acre of spray solution to wet the sediment.
PIGMENT SYNTHESIS INHIBITORS	
Fluridone *Sonar*	**Rate:** For in-water applications: 5 to 20 ppb; exposures must be maintained for 5 to 7 weeks for optimal control. For dewatered (drawdown) treatment: 4 pt product (*Sonar*)/acre (2 lb a.i./acre) **Timing:** Apply to water in early spring to early summer. For dewatered treatment, apply to drained canal or exposed shorelines in fall or late winter before water is reintroduced. **Remarks:** Fluridone is a systemic herbicide that is slow-acting. It 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 (rapid growth). **Remarks:** Flumioxazin is rapidly degraded and is inactive if pH exceeds 8.5; use only if pH will not exceed 8.5; best to check water pH and apply in the early morning when pH is low.
GENERAL CELL TOXICANTS	
Endothall *Cascade*, *Teton* and *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 (see label for specific rate and duration of exposure). **Timing:** Apply to water in early spring to early summer. Can be used in mid-summer, but if biomass is large, partial treatments are recommended 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.
INORGANIC HERBICIDES	
Chelated copper *Komeen*, *Cutrine-Plus*	**Rate:** For in-water applications: 0.5 to 1 ppm elemental copper **Timing:** Apply to water in early summer (short plants and small biomass). **Remarks:** Chelated copper is a fast-acting contact herbicide. Retreatment may be required within 3 to 5 weeks. If biomass is large, treat only one-third of infested area to minimize decrease in dissolved oxygen (e.g. > 125 ppb calcium carbonate equivalent) and high pH (> 8). Chelated copper products are less affected by hard water and high pH compared to inorganic copper. Copper can accumulate in the environment.
Inorganic copper Various granular and liquid products	**Rate:** For in-water applications: 0.5 to 1 ppm elemental copper **Timing:** Apply to water in early summer (short plants and small biomass). **Remarks:** Copper is a fast-acting contact herbicide. Retreatment may be required within 3 to 5 weeks. If biomass is large, treat only one-third of infested area to minimize decrease in dissolved oxygen. Most inorganic copper formulations have poor efficacy in "hard water" (e.g. > 125 ppb calcium carbonate equivalent) and high pH (> 8). Copper can accumulate in the environment.
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 concentration recommended on the label. Colorants are not as effective on well-established plants in mid- to late summer.

RECOMMENDED 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.