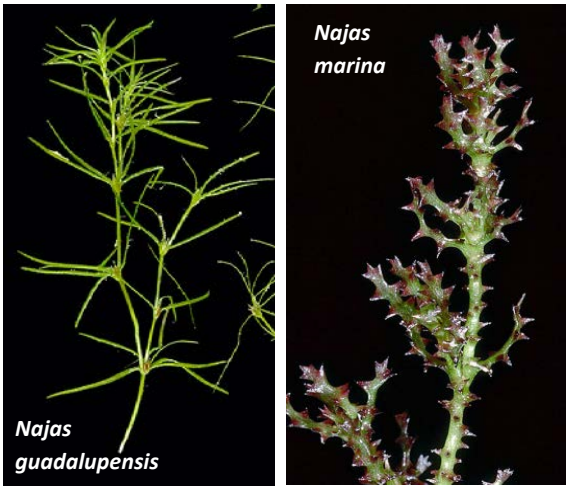
Najas guadalupensis (Spreng.) Magnus; southern naiad
Najas marina L.; hollyleaf naiad

Naiads



Family: Hydrocharitaceae or Najadaceae
Range: Southern naiad is found throughout the United States. Hollyleaf naiad is found in California, Arizona, Nevada, Utah and New Mexico.
Habitat: Southern naiad inhabits still or slow-moving water in a broad range of substrates, including ponds, lakes, reservoirs, canals, rice fields, and irrigation ditches. Grows at water depths of 3 to 15 ft and tolerates polluted water or slightly brackish water. Hollyleaf naiad inhabits fresh to brackish water marshes, ponds, lakes, slow-moving streams, canals, and irrigation systems
Origin: Southern naiad is a common widespread native of North and South America. Hollyleaf naiad is native to the southwestern United States.
Impacts: Both naiads are usually not considered weedy in natural habitats. The foliage and seeds are an important food source for wildlife, especially shorebirds and waterfowl. However, they can become troublesome in ditches, human-made ponds, and disturbed or controlled aquatic systems where populations can become locally dominant, forming dense submersed mats of vegetation.

A number of naiad species can be problems, but the two most common are southern naiad (*N. guadalupensis*) and hollyleaf naiad (*N. marina*). Both are submersed annuals with fibrous root systems and stolons, but the stolons do not persist. Detached parts can root in substrate or can survive freely suspended in the water. Southern naiad can have stems to 2 ft long and opposite to sub-opposite leaves. The stems are slender, highly branched, and rooting at the lower nodes. Unlike other *Najas* species in North America, hollyleaf naiad has stiff, conspicuously prickle-toothed leaf blades 1 to 3 mm wide, and stem internodes covered with minute prickles.

While southern naiad is monoecious (male and female flowers separate, but on the same plant), hollyleaf naiad is dioecious (male and female flowers on separate plants). Flowers are submerged, inconspicuous and typically solitary in the leaf axils. Flowers are water-pollinated. Plants produce abundant hard-seeded achenes that are dispersed by water and persist for a long time in the seedbank, though the actual length of viability in the seedbank is unknown.

NON-CHEMICAL CONTROL

Mechanical (pulling, cutting, dredging)	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 naiads. However, *N. marina* has robust spines that can irritate and scratch the skin of workers who may be physically removing and handling this plant. Several types of "bottom barriers" are available to cover and smother specific infested areas. Materials used include polyvinyl chloride (pvc) sheets, small-mesh screens and natural fibers such as jute and burlap. Bottom barriers are best installed in spring before plants produce large biomass and exceed 20 inches tall.
Cultural	Draining or dewatering during summer can suppress regrowth for a while, but seed bank and rhizomes may reestablish populations within a few weeks to months. Mid-winter dewatering may reduce subsequent spring growth, but only if a hard freeze occurs, and even then some propagules can survive.

Biological	Triploid (sterile) grass carp is the only effective biological control agent available for naiads, but it is relatively nonselective and state or local permits are usually required. If other native plants are desired, careful monitoring of feeding impacts should be part of the management program so that grass carp can be removed (or added) as needed.

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 application: 100 to 200 ppb for 4 to 6 weeks. For dewatered (drawdown) applications: 5.6 to 11.2 oz/acre (1.4 to 2.8 oz a.i./acre) **Timing:** Apply to water in spring to early summer. Fall applications may be effective when temperatures remain high. For drawdown treatment, apply in mid- to late winter. **Remarks:** Penoxsulam provides partial control and suppression. It is a slow-acting systemic herbicide.
PIGMENT SYNTHESIS INHIBITORS	
Fluridone *Sonar* (various formulations)	**Rate:** For in-water application: 45 to 90 ppb; exposures must be maintained for 5 to 7 weeks for optimal control. For dewatered sediments (drawdown) application: 4 pt product (*Sonar*)/acre (2 lb a.e./acre); use 30 to 100 gal/ acre spray volume **Timing:** Apply to water in early spring to early summer. For dewatered sites, apply in late fall or late spring before water is introduced. **Remarks:** Systemic, slow-acting herbicide. It affects young, rapidly growing plants. Lower rates can be used 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 application: 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. It is a contact herbicide that acts rapidly.
Flumioxazin *Clipper*	**Rate:** For in-water application: 100 to 400 ppb **Timing:** Apply to water in spring to early summer. Fall applications may be effective when temperatures remain high. **Remarks:** Do not use if pH is > 8.0; or use a buffer to reduce the pH to below 8.0. To minimize effects of high pH, apply from dawn to mid-morning. Due to photosynthesis of aquatic plants and algae, pH in the water column rises from mid-day to dusk under most circumstances.
GENERAL CELL TOXICANT	
Endothall *Cascade*; *Aquathol K*	**Rate:** For in-water application: 1 to 3 ppm; exposures must be maintained for 24 to 48 hours or more for optimal control (see label for specific rates and duration of exposures needed). **Timing:** Apply to water in early spring to early summer. Can be used in mid-summer but partial treatments are recommended if biomass is large in order 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*, *Nautique*	**Rate:** For in-water application: 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.

	Chelated copper products are less affected by hard water and high pH than inorganic copper. Copper can accumulate in the environment.
Inorganic copper Various granular and liquid products	**Rate:** For in-water application: 0.1 to 0.25 ppm **Timing:** Apply to water in late spring to early summer (short plants and small biomass). **Remarks:** Copper is a rapid 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.