2.4 Curlyleaf Pondweed

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Potamogeton crispus L.; submersed aquatic plant in the Potamogetonaceae (pondweed) family
Derived from *potamos* (Greek: river), *geiton* (Greek: neighbor) and *crispus* (Latin: curly) "curly-leafed plant close to the river"

Introduced from Europe in the mid 1800s
Present in all lower 48 states; particularly problematic in northern states and Canada

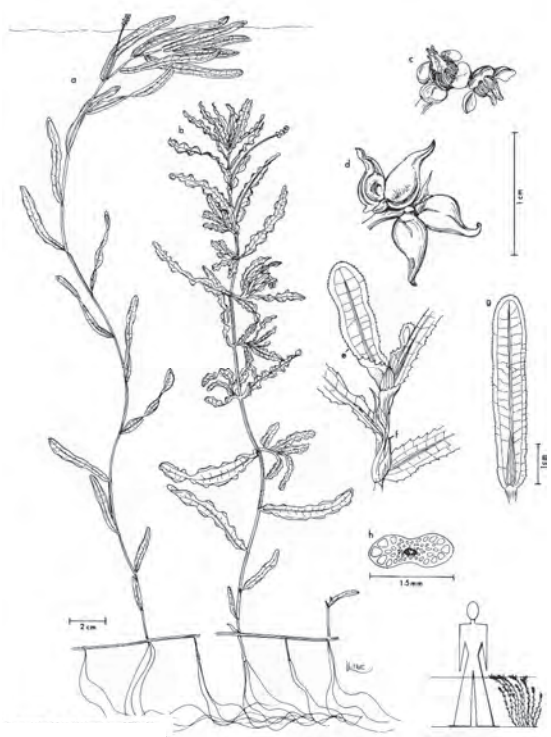
Introduction and spread

Native to Europe, Asia, Africa and Australia, the first known collection of curlyleaf pondweed in North America occurred in Philadelphia in 1841. The plant spread to the Great Lakes region in the early 1900s and today is found in

all of the contiguous 48 states. The spread of curlyleaf pondweed throughout the US can be attributed to boat and fish hatchery activity. Curlyleaf pondweed is now thoroughly naturalized in the United States and Canada and is considered an exotic weedy species throughout its range.

Description of the species

Curlyleaf pondweed is a rooted submersed herbaceous perennial monocot that grows in lake and river systems and aggressively outcompetes native submersed vegetation. The species has wavy leaves with finely serrated or toothed margins and a "crisp" leaf texture. Leaves are typically green early in the season and can become red when they near



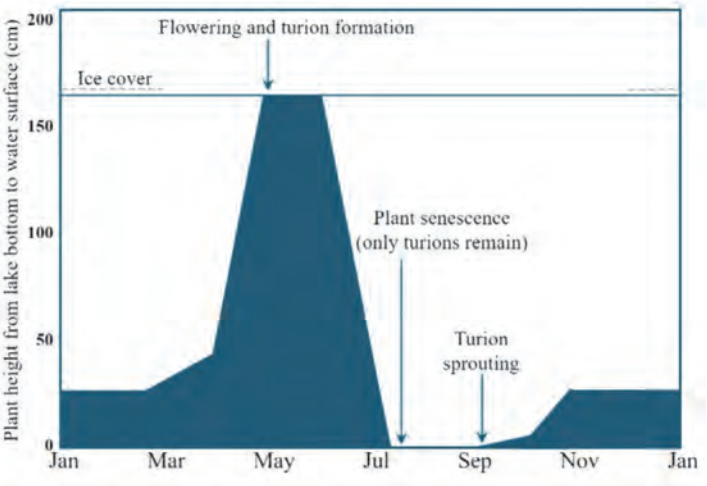
the water's surface. The oblong-shaped leaves are 1 to 3 inches in length and are attached to the stem in an alternate arrangement. Long spaghetti-like stems form as the plant quickly grows to the water's surface and develops into dense weedy mats.

Curlyleaf pondweed grows in conditions ranging from ice-covered waters with very low light intensities to summer conditions with very warm temperatures and intense sunlight. Colonization by curlyleaf pondweed is limited by light availability and the species typically inhabits waters that range from 3 to 6 feet in depth, but curlyleaf pondweed has been found at depths of more than 20 feet in very clear water. This species prefers to grow in still water, but curlyleaf pondweed is quite tolerant of flow and is found in many river systems throughout the US and Canada.

Curlyleaf pondweed is often found in nutrient-rich or eutrophic systems and the species has a high tolerance for nutrient pollution and low light conditions. In fact, the species is sometimes considered an indicator of pollution and eutrophication due to its tolerance of low light and high dissolved nutrients.

Reproduction

Curlyleaf pondweed reproduces primarily by producing turions and rhizomes. Turions are hardened modified reproductive buds that form from apical buds, in leaf axils or directly from rhizomes prior to plant senescence in early summer. A single plant produces an average of 5 turions, with each turion averaging 4 buds. Turions constitute over 40% of the total plant biomass prior to senescence and turion densities of more than 1,000 per square foot have been reported in lake sediments. Each turion can remain viable in the sediment for multiple seasons and can sprout multiple times. Flowering usually coincides with turion formation. Flowers are very small, inconspicuous and borne on small spikes that emerge above the water surface. Seeds are produced but germination rates are quite low (0.5%). As a result, reproduction of curlyleaf pondweed is due mainly to the production and sprouting of vegetative turions.



Curlyleaf pondweed has a life cycle that is fairly unique for submersed aquatic plants. Plants flower and produce turions, then die back or senesce typically in early summer. Turions lie dormant throughout the summer and then sprout in the fall when water temperatures drop to below 66 °F and daylength shortens to fewer than 11 hours of daylight. Plants grow and may reach from an inch to several feet in height until water temperatures fall below 50 °F. When temperatures drop below 50 °F, growth of curlyleaf pondweed slows or stops and plants overwinter in a very slow-growing or dormant state. Since the species overwinters with green growth above the sediment, curlyleaf pondweed often has an advantage over native species when growth resumes in the spring.

Curlyleaf pondweed can grow up to 4 inches per day when days become longer and water temperatures start to rise in early spring. Plants quickly grow to the surface and turion production and flowering begins. Dense mats of curlyleaf pondweed can form on the water surface and shade out competing species. Turion production and flowering are followed by senescence or dieback, which occurs by the 4th of July in many areas.

Problems associated with curlyleaf pondweed

Curlyleaf pondweed forms dense mats on the water's surface in May and June, which inhibits fishing, boating and other types of water recreation. Dense growth of curlyleaf pondweed in moving water systems can obstruct flow and can

exacerbate flooding due to large amounts of biomass obstructing river channels. Dense surface mats of plant material also limit light to low-growing submersed native species and monocultures of curlyleaf pondweed often result from this competition for light. Dense vegetation at the water's surface also can stagnate the water column and inhibit oxygen exchange from the surface to the lake bottom. Decomposing plant material under the weedy canopy further reduces dissolved oxygen levels in the water column. These conditions can reduce or eliminate fish (Section 1.2) and aquatic invertebrates in dense beds of curlyleaf pondweed. Mosquitoes (Section 1.5), on the other hand, find curlyleaf pondweed beds to be the ideal habitat.

Curlyleaf pondweed typically senesces when water temperatures rise and dissolved oxygen levels begin to decline. The large amount of decomposing biomass produced from senescence releases nutrients and decreases oxygen in the water column, which further stresses the aquatic community. Algal blooms commonly occur after senescence of curlyleaf pondweed and decreased water clarity and oxygen levels can persist for the entire summer season.

Management options

Curlyleaf pondweed often requires management in order to preserve the recreational and environmental value of the bodies of water infested by the species. The most effective and efficient way to protect waterbodies from curlyleaf pondweed and other invasive aquatic species is prevention. Curlyleaf pondweed is on a number of state noxious weed lists, which make it illegal to sell or transport the species. The best way to prevent the introduction of curlyleaf pondweed into new waterbodies is to ensure that all plant material is removed from boats and trailers. Boats, trailers and gear should be thoroughly inspected, washed (with hot water) and dried before moving to a different water body to prevent the spread of curlyleaf pondweed and other invasive aquatic species.

There are a number of options for control and management in bodies of water that are already infested with curlyleaf pondweed. Physical (Section 3.4) or mechanical (Section 3.5) control options include hand removal, benthic barriers and mechanical harvesting. Hand removal by raking or hand pulling using divers can be effective tools for controlling plants in localized areas, but these efforts can be costly and time-intensive. The turion bank in the sediment should also be considered with hand removal, since regrowth from turions can quickly reinfest cleared areas. Curlyleaf pondweed can also be spread by fragments, so measures should be taken to prevent fragments and turions from spreading. Benthic barriers are also effective for curlyleaf pondweed control in localized areas. The barriers prevent regrowth from turions in the sediment and, if barriers are maintained, can provide long-term control. However, benthic barriers are labor-intensive to install and maintain and often require installation permits. Mechanical harvesting can provide temporary control of curlyleaf pondweed, but can also exacerbate the spread of fragments and turions. Management programs can include mechanical harvesting to improve boater and recreation access by effectively "mowing the lawn" to remove nuisance growth, but disposal of harvested biomass can be problematic due to the large volumes of heavy plant material. Drawdown of a body of water is an effective method for seasonal control of curlyleaf pondweed. However, drawn-down areas of shoreline can quickly be reinfested by curlyleaf pondweed plants in deeper water and by sprouting of turions in the sediment. Also, drawdowns are non-specific and will likely damage populations of desirable native submersed plants as well.

There are currently no known insect or pathogen biocontrol agents that attack curlyleaf pondweed, but sterile triploid grass carp (Section 3.6.2) can provide control of the species. However, grass carp are non-specific herbivores that will

eat many native plant species. Grass carp are also illegal in many states; in states where they are allowed, their use often requires a state-issued permit and they can typically be used only in closed systems. Check with your state agency for current regulations.

Several aquatic herbicides – including diquat, endothall, flumioxazin, fluridone, penoxsulam, bispyribac and imazamox – can be used to effectively control curlyleaf pondweed. Diquat, endothall and flumioxazin are contact herbicides and are relatively fast-acting, whereas the other herbicides are systemic products that are often used as whole-lake treatments and require longer contact times for control (Section 3.7.1). Research has shown that early season treatments with herbicides can very effectively control curlyleaf pondweed and prevent turion production. Most native plant species are still dormant early in the spring, so treatment at this time prevents damage to many desirable native plants while providing selective control of curlyleaf pondweed. Since effective control early in the season prevents turion production, regrowth of curlyleaf pondweed is reduced the following year.

Summary

Curlyleaf pondweed is a problematic invasive submersed aquatic weed in the northern US and in Canada. The species grows and reproduces at very high rates and can quickly cover the entire surface of a body of water with dense monocultural growth. Dense growth of curlyleaf pondweed impedes recreation, reduces populations of native submersed plant species and alters the ecosystem so that it is inhospitable to fish and other fauna. Active management is often required to maintain the environmental and recreational value of water bodies infested with curlyleaf pondweed.

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