Submersed Aquatic Vegetation

Cabomba caroliniana Gray (Gray Fanwort)

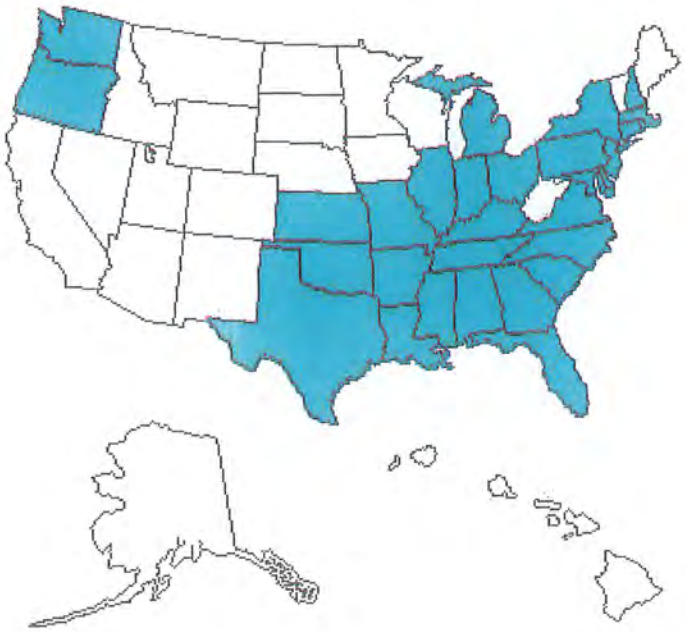
Family: Cabombaceae

Home Range/U.S. Introduction:

Cabomba caroliniana A. Gray is native to much of the eastern United States and has been introduced into Oregon and portions of the northeastern United States (Wiersema 1997). It is a popular aquarium plant, which probably accounts for its introduction into areas outside of its native range. Plants from the southeastern United States sometimes have purplish foliage and flowers (Godfrey & Wooten 1981, Tarver *et al.* 1986, Hanlon 1990). This color variant has been segregated as a distinct species, *C. pulcherrima* (Harper) Fassett, or considered a variety of *C. caroliniana.*

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

Fanwort is an herb with numerous stems and fibrous roots. Plants grow submersed except for the floating leaves, which are inconspicuous and subtend the flowers (due to the inconspicuous nature of the floating leaves that are present only during flowering they are not used in the identification system). The submersed leaves are opposite, with petioles, and the blade is dissected into palmate linear segments. When present, the floating leaves are alternate, petiolate, simple with blades elongate to linear-elliptic and peltate, about 1 to 3 cm long. Flowers are on

stalks, single from the axils of the floating leaves. There are 3 sepals and 3 petals, much alike, white to pink or purplish. The fruit has 3 seeds.

Habitat/Growth Characteristics:

Cabomba grows in ponds, lakes, reservoirs, sloughs, ditches, canals and slow moving streams. It reproduces primarily by fragmentation but may also reproduce by seed (Hanlon 1990).

Problems:

Fanwort can sometimes form dense growth in water bodies of the southeastern United States and can impede water flow in ditches and canals and interfere with recreational activities (Tarver *et al.* 1986).

References:

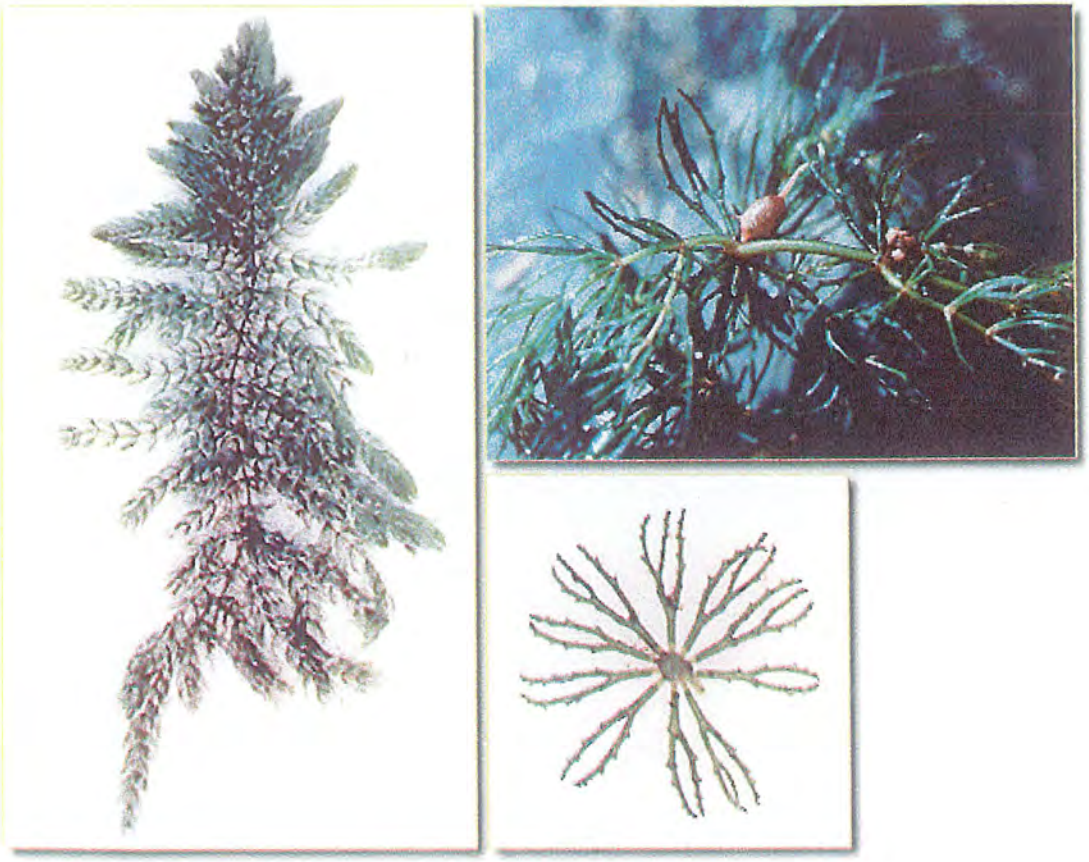
Godfrey, R. K. and J. W. Wooten. 1981. Aquatic and Wetland Plants of Southeastern United States. Dicotyledons. The University of Georgia Press, Athens, Georgia.

Hanlon, C. 1990. A Florida native - *Cabomba* (fanwort). Aquatics 12(4):4-6.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Wiersema, J. H. 1997. Cabombaceae. In: Flora of North America. Volume 3. Magnoliophyta: Magnoliidae and Hamamelidae. Oxford University Press, Oxford. pp. 78-80

Ceratophyllum demersum L. (Coontail)



Family: Ceratophyllaceae

Home Range/U.S. Introduction:

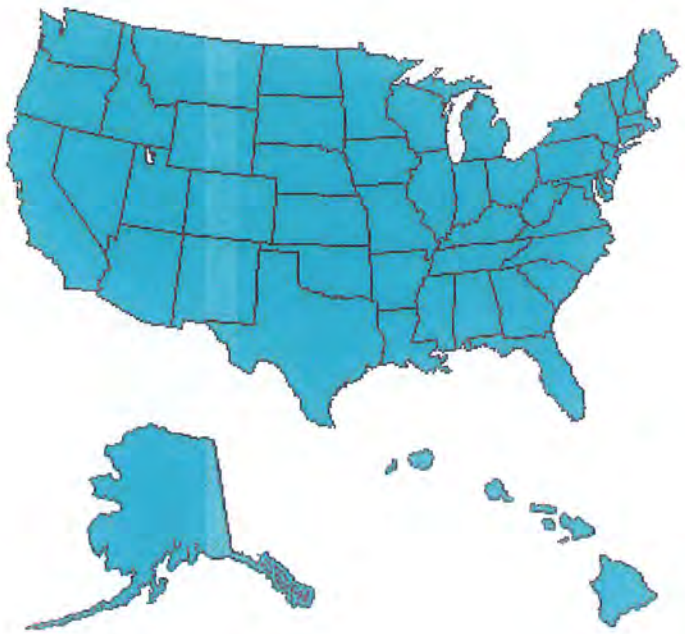
Ceratophyllum demersum L. is native and the most widespread of the three species of *Ceratophyllum* in the United States. Other species of *Ceratophyllum* in the United States are *C. echinatum* A. Gray, which is principally distributed in the eastern United States with disjunct populations in the northwestern United States, and *C. muricatum* Chamisso, which is known from a few coastal areas of Florida, Georgia, and North Carolina (Les 1997). *Ceratophyllum submersum* L. has been reported from the United States (Lowden 1978, Godfrey & Wooten 1981), but according to Les (1997) reports of this species are based on specimens of *C. demersum* or *C. muricatum* that lack or have reduced spines on the fruits.

U.S. Distribution (Based on published data collected in 1997):

C. demersum

C. echinatum

U.S. Range Map:



Species Description:

This genus is comprised of perennial plants growing beneath the water surface. Plants produce only one branch per node. Plants lack roots, but branches are sometimes modified as "rhizoids", giving the plants a rooted appearance. Leaves are sessile, whorled, about 3 cm long, 5 or more at a node, rigid and often brittle. The leaves of *C. demersum* are 1 or 2 (rarely 3) times forked into 2 to 4 filiform or linear segments that have small, visible teeth along the margin. In *C. echinatum*; the leaves are usually 3 to 4 times forked with inconspicuous marginal teeth. In both species, each leaf segment is tipped by 2 bristles. Flowers are unisexual, very small, solitary in the axil of a leaf whorl, each flower subtended by an 8 to 10 parted, 1 to 2 mm long, involucre. Sepals and petals are absent. The fruit is a one-seeded achene that has a terminal spine and usually two basal spines in *C. demersum*. In addition to two basal spines and one terminal spine, *Ceratophyllum echinatum* usually has 2 to 13 spines along the lateral margins of the achene. In rare instances, basal spines and marginal spines of the achene are lacking for both species.

Habitat/Growth Characteristics:

Coontail grows in slow moving rivers and streams, ponds, lakes, lagoons, swamps, and irrigation ditches. It is often found mixed with rooted submersed plants such as watermilfoil which likely hold the rootless coontail "in place". While the primary method of reproduction in coontail is by fragmentation (Jones 1931), it can also reproduce by seed. *Ceratophyllum demersum* is often weedy and is reported as tolerant of fluctuating water levels and moderate turbidity (Tarver *et al.* 1986). *Ceratophyllum echinatum* typically grows in cooler, clearer and more oligotrophic water than *C. demersum* and is rarely a nuisance weed (Les 1986, 1997).

Problems:

Ceratohyllum demersum often grows in dense populations and can restrict small boat navigation and recreational water use. Coontail may become the dominant plant in some habitats and crowd out other species.

References:

Godfrey, R. K. and J. W. Wooten. 1981. Aquatic and Wetland Plants of Southeastern United States. Dicotyledons. The University of Georgia Press, Athens, Georgia.

Jones, E. N. 1931. The morphology and biology of *Ceratophyllum demersum.* Studies in Natural History, Iowa University 13:11-55.

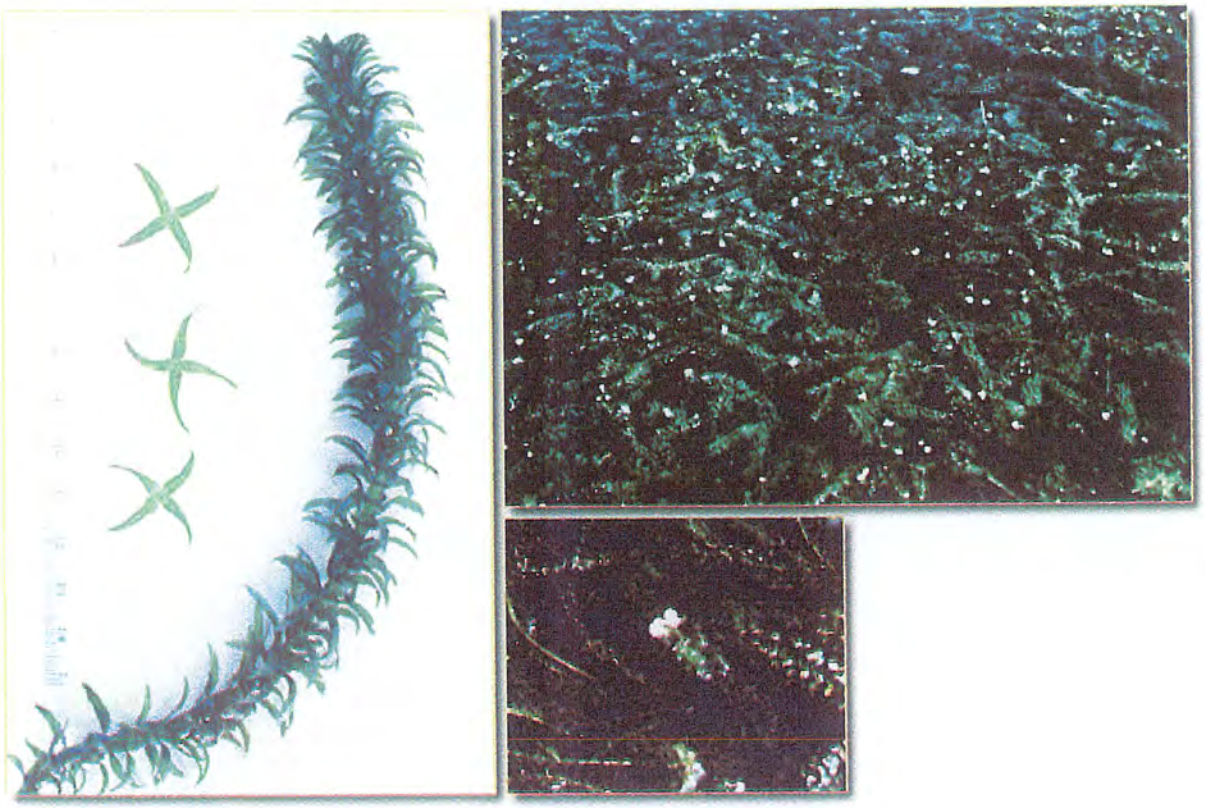
Les, D. H. 1986. The phytogeography of *Ceratophyllum demersum* and *Ceratophyllum echinatum* in glaciated North America. Canadian Journal of Botany 64:498-509.

Les, D. H. 1997. Ceratophyllaceae. In: Flora of North America. Volume 3. Magnoliophyta: Magnoliidae and Hamamelidae. Oxford University Press, Oxford. pp. 81-84.

Lowden, R. M. 1978. Studies in the submersed genus *Ceratophyllum* L. in the neotropics. Aquatic Botany 4:127-142.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Egeria densa Planch. (Brazilian Elodea)



Synonym(s): *Anacharis densa* (Planch.) Victorin

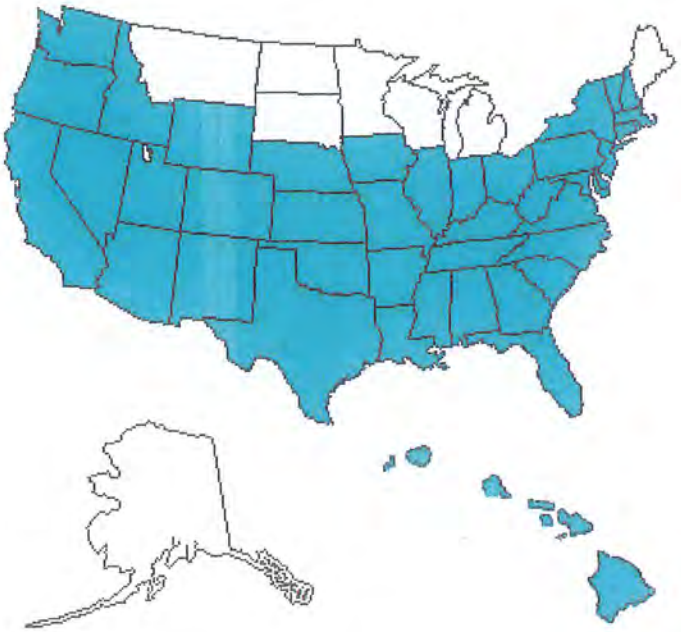
Elodea densa (Planch.) Caspary

Family: Hydrocharitaceae

Home Range/U.S. Introduction:

This species is native to southeastern Brazil but now naturalized in the eastern United States, from New Hampshire and Vermont southward to central Florida, westward to Nebraska, Kansas, Oklahoma, Texas, Oregon, California, Arizona, New Mexico, and Utah (Cook & Urmi-Konig 1984). The earliest record in the United States was in 1893 from Long Island. It was praised in horticultural literature as an attractive aquarium plant and, for this reason was offered for sale by 1915. It was reported cultivated in Hawaii in 1932 and had become established in the wild by 1937. It is also a popular object for experimental investigation in the laboratory which may have aided its wide distribution.

U.S. Range Map:



Species Description:

Plants grow submersed, rooted in the substrate or, commonly, free in the water. Stems are elongate, slender, 2 to 3 mm thick, single or sparingly branched. Lowermost leaves are opposite, otherwise in whorls, the number per whorl variable, usually 3 to 6, mostly 4 on the upper portion of the stem and the growing tips at the water's surface. The leaves are sessile, nearly linear, their apices subobtuse or abruptly very short acuminate, very finely toothed on the margins and sometimes on the midrib below, 1.4 to 2.5 cm long, 1.6 to 5.0 mm wide. The flowers are 1.2 to 1.8 cm wide, unisexual (only male plants known to us in our area), produced in spathes which are sessile in the axils of the leaves, their stalks bringing them to or raising them just above the water surface. The three sepals are green; the three petals are white.

Egeria can usually be differentiated from hydrilla, *Hydrilla verticillata* (L.f.) Royle, and elodea (*Elodea canadensis* Michx.) by the following characters:

Leaves mostly in whorls of 4 at sterile nodes, leaves 1.4 to 2.5 cm long *Egeria densa*

Leaves of stems at growing tips at water's surface usually in whorls of 3 or 5 or more; leaves not or mostly not exceeding 1.5 cm long, the longest sometimes to 2 cm

Leaves mostly in whorls of 5 or more; margins of the leaves with teeth perceptible to the naked eye; midribs on lower leaf surface (when fresh) with a few conical protuberances tipped by sharp 1-celled teeth; fresh leaves notably rough to the touch *Hydrilla verticillata*

Leaves mostly in whorls of 3; margins of the leaves not having teeth perceptible to the naked eye; midribs of lower leaf surface not pronounced, not bearing teeth; fresh leaves not rough to the touch *Elodea canadensis*

Habitat/Growth Characteristics:

Plants grow submersed, rooted in the substrate excepting when pieces of plants are found free in the water. Populations are found in streams, ponds, lakes, reservoirs, and constructed lagoons. Plants grow in both still and flowing water. The roots are adventitious, developing at nodes bearing lateral branches. *Egeria* produces "double nodes" (each branching or budding node actually consists of two nodes close together) on the stems which may readily root and develop into new shoots.

Problems:

In the state of Florida, *E. densa* is said to occupy a total area of 53.4 ha; in South Carolina, it is reported by Getsinger & Dillion (1984) to have colonized over 10,000 ha in the Santee-Cooper River System in the late 1970's and early 1980's. Populations of plants dominate the environment by vigorous growth and are often found as pure stands. The spread of this plant is probably directly the result of man's activity since it is perhaps the most universally available aquarium plant.

References:

Cook, C. D. K. and K. Urmi-Konig. 1984. A revision of the genus *Egeria* (Hydrocharitaceae). Aquatic Botany 19:73-96.

Getsinger, K. D. and C. R. Dillon. 1984. Quiescence, growth, and senescence of *Egeria densa* in Lake Marion. Aquatic Botany 20:329-338.

Elodea canadensis Michx. (Elodea)

Synonym(s): *Philotria canadensis* (Michx.) Britt.

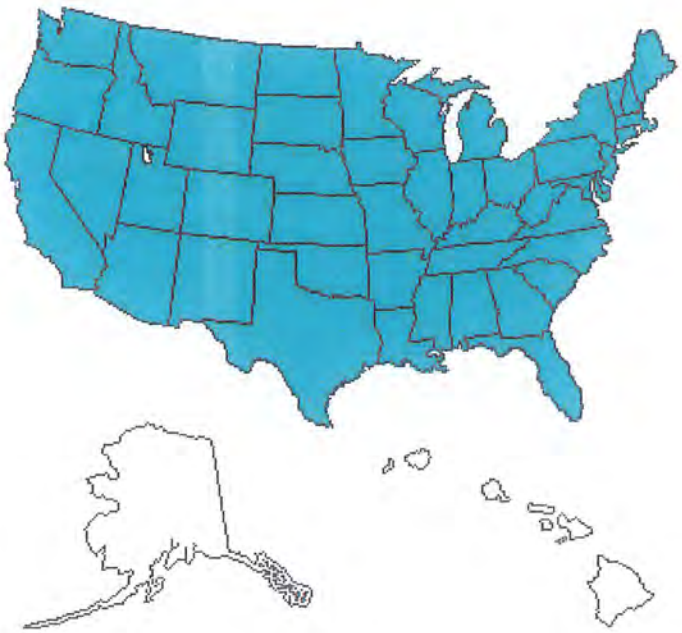
Anacharis canadensis (Michx.) Planch.

Family: Hydrocharitaceae

Home Range/U.S. Introduction:

Elodea canadensis Michx. is native and one of three species of *Elodea* found in the United States (Cook & Urmi-Konig 1985).

U.S. Range Map:



Species Description:

Elodea canadensis is a perennial submersed aquatic, rooted or drifting free when broken loose, very brittle, fragmenting easily. The stem is sparsely branched. The lowest leaves are alternate or in whorls of 3, sessile, linear to oblong or ovate, to 13 mm long, to 5 mm wide, obtuse, acute or acuminate at the tip, margins toothed. Upper leaves are opposite or mostly in whorls of 3, 1-nerved; toward the stem apex, leaves are usually overlapping in regular rows and lying along the stem, oblong or ovate. The unisexual flowers are from a spathe in the axils of the leaves. Male flowers are on a stalk up to 15 mm long, female flowers raised to the surface of the water on a stalk. Petals are white. The fruit is a capsule.

Elodea canadensis can usually be differentiated from hydrilla, *Hydrilla verticillata* (L.f.) Royle, and egeria (*Egeria densa* Planch.) by the following characters:

Leaves mostly in whorls of 4 at sterile nodes, leaves 1.4 to 2.5 cm long *Egeria densa*

Leaves of stems at growing tips at water's surface usually in whorls of 3 or 5 or more; leaves not or mostly not exceeding 1.5 cm long, the longest sometimes to 2 cm

Leaves mostly in whorls of 5 or more; margins of the leaves with teeth perceptible to the naked eye; midribs on lower leaf surface (when fresh) with a few conical protuberances tipped by sharp 1-celled teeth; fresh leaves notably rough to the touch *Hydrilla verticillata*

Leaves mostly in whorls of 3; margins of the leaves not having teeth perceptible to the naked eye; midribs of lower leaf surface not pronounced, not bearing teeth; fresh leaves not rough to the touch *Elodea canadensis*.

Habitat/Growth Characteristics:

The plants grow in lakes, ponds and in slow moving water in rivers, canals and streams. They are sometimes found in slightly brackish coastal waters. Plants die back in autumn, and spring regrowth is from underground stems crowned by roots or winter buds.

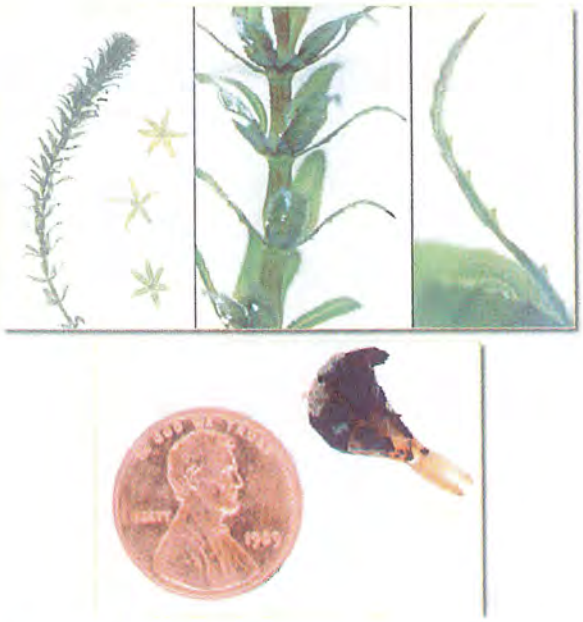
Problems:

Dense populations of plants reduce the water temperature and oxygen concentrations. This species was introduced to Australia and has become the most obstructive and persistent of all aquatic plants infesting irrigation supplies and drainage channels. Plants also have become widespread and troublesome in New Zealand.

Reference:

Cook, C. D. K. and K. Urmi-Konig. 1985. A revision of the genus *Elodea* (Hydrocharitaceae). Aquatic Botany 21:111-156.

Hydrilla verticillata (L.f.) Royle (Hydrilla)

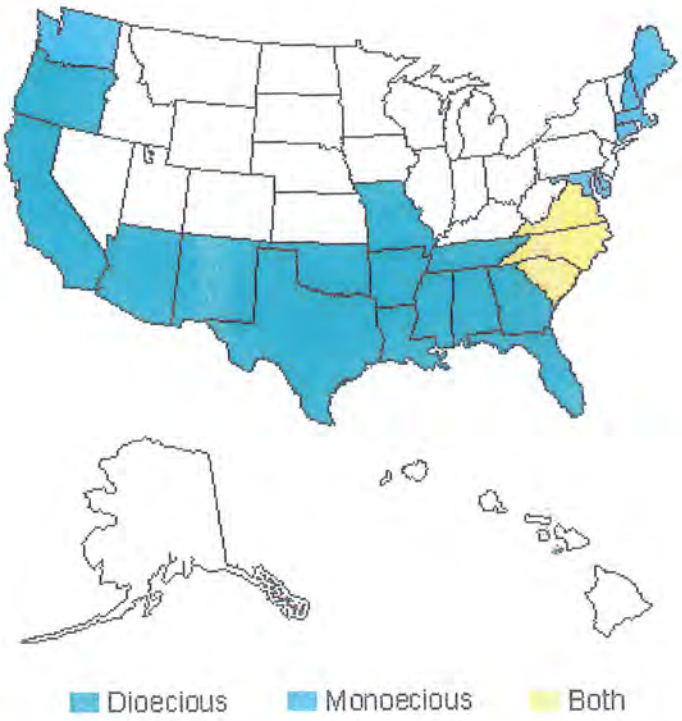


Family: Hydrocharitaceae

Home Range/U.S. Introduction:

Hydrilla verticillata (L.f.) Royle is an introduction from the Old World (Cook & Luond 1982) that was first discovered in the United States in 1960 and is now abundantly naturalized in many parts of the United States (Langeland 1996). Plants have attractive foliage and are planted in aquaria which are often emptied into freshwater habitats. Hydrilla is easily confused with *Egeria densa* Planch., Brazilian elodea or Egeria, and *Elodea canadensis* Michx., Canadian elodea, Waterweed.

U.S. Range Map:



Species Description:

The plants grow submersed, are mostly perennial but sometimes annual, and have horizontal stems in the substrate forming tubers under certain conditions. Stems are ascending and usually are sparsely branched until the plants near the water surface and then become profusely branched. Under certain conditions, turions (actually bulbil-like structures) form in the leaf axils. Stems can be up to 8.5 m long and grow to the surface of the water where the branchlets extend horizontally. Leaves are 1-nerved, sessile, whorled, 3 to 12 at a node but mostly 5 or more, mostly shorter than 1.5 cm long, linear to lanceolate or rarely widely ovate, broadest at the base, the sides nearly paralleling to near the acute tip that terminates in a single spine cell. Leaf margins are serrate, the teeth visible to the naked eye. Fresh leaves are notably rough to the touch. The midrib on the upper surface is often tinged with red and on the lower surface, usually, has 1-celled sharp teeth or spines. Flowers are unisexual, arising from the leaf axil; plants are monoecious or dioecious. The flowers are small, less than 6 mm in diameter, translucent to white; female flowers are usually produced in the fall and are on long thread-like stalks 2 to 4 cm long from leaf axils of the upper branches that carry the flowers to the water surface. Male flowers are solitary, small, on short stalks in the leaf axil and break off as buds, opening explosively on the water surface.

Hydrilla can usually be differentiated from Canadian elodea (*Elodea canadensis* Michx.) and egeria (*Egeria densa* Planch.) by the following characters:

Leaves mostly in whorls of 4 at sterile nodes, leaves 1.4 to 2.5 cm long *Egeria densa*

Leaves of stems at growing tips at water's surface usually in whorls of 3 or 5 or more; leaves not or mostly not exceeding 1.5 cm long, the longest sometimes to 2 cm

Leaves mostly in whorls of 5 or more; margins of the leaves with teeth perceptible to the naked eye; midribs on lower leaf surface (when fresh) with a few conical protuberances tipped by sharp 1-celled teeth; fresh leaves notably rough to the touch *Hydrilla verticillata*

Leaves mostly in whorls of 3; margins of the leaves not having teeth perceptible to the naked eye; midribs of lower leaf surface not pronounced, not bearing teeth; fresh leaves not rough to the touch *Elodea canadensis*

Habitat/Growth Characteristics:

Plants grow in canals, springs, streams, ponds, lakes and reservoirs. Most populations of hydrilla in the United States are dioecious. However, populations of monoecious hydrilla occur in North Carolina and northward into the mid-Atlantic states (Langeland 1996). Hydrilla can reproduce by four methods: fragmentation, tubers, turions, and seed. Tubers in the hydrosoil can remain viable for several years (Langeland 1996) and allow the plant to survive cold temperatures and periods of drought (Tarver *et al.* 1986). Although the importance of seed production in the spread of hydrilla has not been researched extensively, it is probably of minor importance compared to vegetative reproduction (Langeland 1996). Hydrilla has a high growth rate and lower light requirement for photosynthesis than most other submersed plants (Langeland 1996) which allows it to grow at greater depths and outcompete most other species. It also forms a dense canopy at the surface of the water and "shades out" other submersed plants (Tarver *et al.* 1986).

Problems:

This species is probably the worst submersed aquatic weed in the United States. Plants form large, dense populations which displace native species, restrict flow, and impair small boat navigation and other recreational uses (Tarver *et al.* 1986, Langeland 1996). In addition to being spread by natural fragmentation, plants are sometimes spread from lake to lake by fragments attached to boat motors and trailers. Hydrilla also is thought to be intentionally introduced into "new" water bodies in an effort to enhance sport fishing for black bass.

References:

Cook, C. D. K. and R. Luond. 1982. A revision of the genus *Hydrilla* (Hydrocharitaceae). Aquatic Botany 13:485-504.

Langeland, K. A. 1996. *Hydrilla verticillata* (L.f.) Royle (Hydrocharitaceae), the perfect aquatic weed. Castanea 61(3):293-304.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Myriophyllum aquaticum (Vell.) Verdc. (Parrotfeather)

Synonym(s): *Myriophyllum brasiliense* Camb.

Myriophyllum proserpinacoides Gillies ex Hook. & Arn.

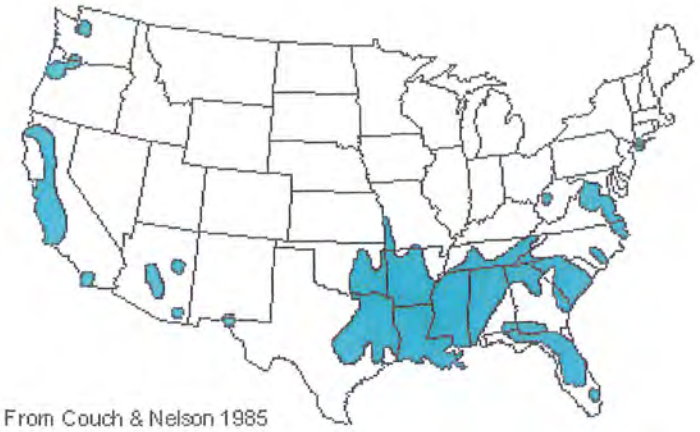
Family: Haloragaceae

Home Range/U.S. Distribution:

Myriophyllum aquaticum (Vell.) Verdc. is native to South America. The first known collection of parrotfeather in the United States was in 1890 (Nelson and Couch 1985). Parrotfeather is sporadically naturalized across much of the United States, likely as a result of plants escaping or being discarded from aquaria or ornamental pools. Its spread may have been further enhanced by intentional placement in water bodies to provide a source of plants for sale.

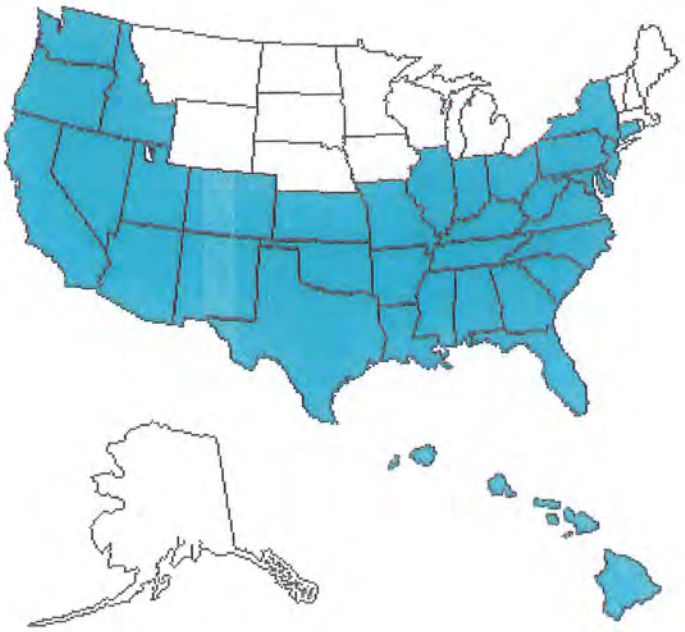
In many of the older manuals and taxonomic literature parrotfeather is referred to as *Myriophyllum brasiliense* Camb., which is a synonym for *M. aquaticum*.

U.S. Distribution (Based on published data collected in 1997):



From Couch & Nelson 1985

U.S. Range Map:



Species Description:

The stems of parrotfeather are moderately elongate, relatively stout, partially submersed but with a considerable portion of the leafy branches erect. The leaves are in whorls of 3 to 6, pinnately dissected, stiffish, and with 6 to 18 linear-filiform divisions on each side of the leaf. Leaves on the erect stems are grayish-green, 2.5 to 5 cm long, feather-like, the leaf divisions 4 to 8 mm long toward the leaf apex, reduced basally. Flowers of North American plants all female, whitish and in the axils of essentially unreduced leaves.

Habitat/Growth Characteristics:

Parrotfeather grows in sluggish waters, edges of streams, lakes, ponds, irrigation ditches, canals, sloughs, and spring-fed runs. It is rooted in the substrate with part of the stem beneath the surface of the water and a portion of the stem emersed. Parrotfeather forms creeping rhizomes which may give rise to multiple stems. Stems branch and root at the nodes allowing for the formation of fragments. Because only pistillate (female) plants occur in North America, all reproduction is asexual.

Problems:

Populations of parrotfeather may become quite dense and completely colonize small ponds and sloughs and impede water flow in drainage ditches and irrigation canals. It may also outcompete and replace native species that are of more value to fish and wildlife.

References:

Aiken, S. G. 1981. A conspectus of *Myriophyllum* (Haloragaceae) in North America. Brittonia 33: 57-89.

Nelson, E. N. and R. W. Couch. 1985. History of the introduction and distribution of *Myriophyllum aquaticum* in North America. In: L. W. J. Anderson (ed.), Proceedings of the First International Symposium on watermilfoil (*Myriophyllum spicatum*) and related Haloragaceae species. Aquatic Plant Management Society, Washington, D.C. pp. 19-26.

Myriophyllum heterophyllum Michx. (Variable-Leaf Milfoil)

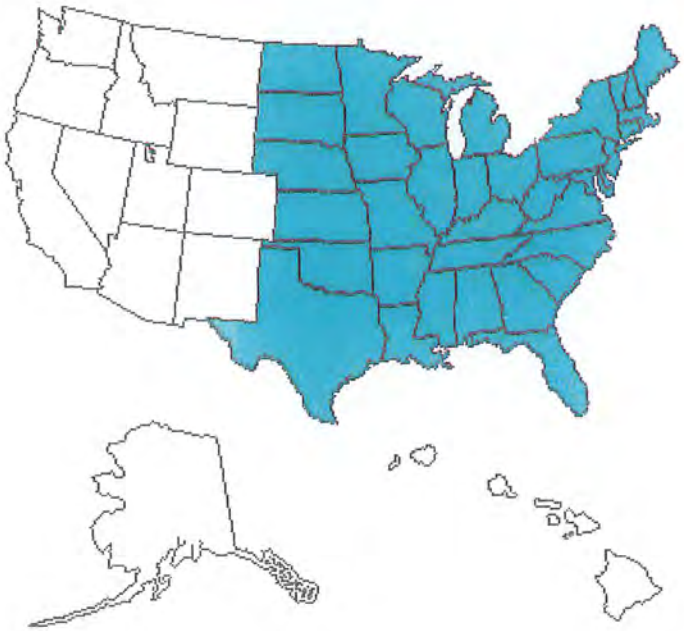
Family: Haloragaceae

Home Range/U.S. Introduction:

Myriophyllum heterophyllum Michx. is native to the United States and ranges throughout the eastern United States, westward to North Dakota and south to New Mexico. The bracts subtending the flowers on the emersed spike of *M. heterophyllum* are readily visible and appear almost leaf-like in contrast to the dissected leaves of the submersed stems. Hence, the common name, variable-leaf milfoil.

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

Variable-leaf milfoil is a rooted perennial and submersed except for the flowering spikes that are emersed and from 5 to 25 cm long. The submersed stems are stout (up to 8 mm in diameter), reddish, often with numerous branches. Submersed leaves are 4 to 6, whorled, up to about 6 cm long with 6 to 14 pairs of narrow segments. The emersed flowering spikes have bright green, leaf-like bracts that are in whorls of 4 to 6 with toothed to entire margins. The bracts are 4 to 12 mm long and more than twice the length of the small flowers that are borne in the axils of the leaf-like bracts. The fruit is hard, four-lobed, 1 to 1.5 mm long, and splitting into four distinct segments (mericarps).

Habitat/Growth Characteristics:

Variable-leaf milfoil is found in ponds, lakes, streams, ditches and spring-fed swamps and sloughs. Reproduction is by seed and fragmentation. Regrowth occurs from rhizomes rooted in the hydrosoil. Plants stranded on mud and dewatered shorelines often develop numerous, erect spikes that are readily visible due to the bright green leaf-like bracts. Variable-leaf milfoil also is occasionally sold as an aquarium plant (Tarver *et al.* 1986).

Problems:

Myriophyllum heterophyllum can be an aggressive plant in some situations and may interfere with water movement, boating, swimming, fishing and other recreational activities (Tarver *et al.* 1986, Crow and Hellquist 1983).

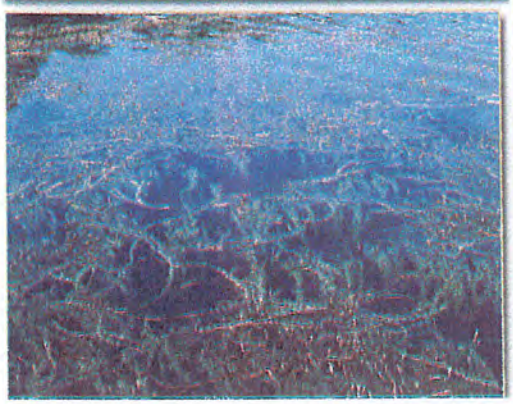
References:

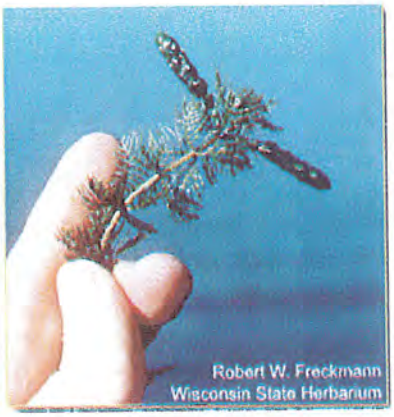
Aiken, S. G. 1981. A conspectus of *Myriophyllum* (Haloragaceae) in North America. Brittonia 33: 57-89.

Crow, G. E. and C. B. Hellquist. 1983. Aquatic vascular plants of New England: Part 6. Trapaceae, Haloragaceae, Hippuridaceae. Station Bulletin 524. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and wetland plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Myriophyllum sibiricum Komarov (Northern Watermilfoil)





Synonym(s): *Myriophyllum exalbescens* Fern.

Family: Haloragaceae

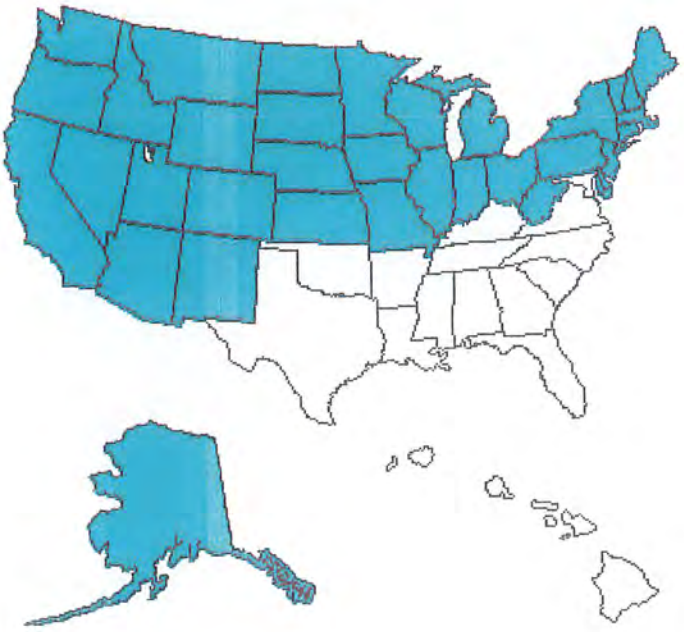
Home Range/U.S. Introduction:

Myriophyllum sibiricum Komarov is native to the United States. Morphologically, it is similar to Eurasian watermilfoil (*Myriophyllum spicatum* L.), an introduced species that is native to Europe, Asia and North Africa. *Myriophyllum sibiricum* was not described until 1919 (Fernald 1919), and specimens of *M. sibiricum* collected prior to this date were most often labeled *M. spicatum*. Additional confusion resulted with the introduction and establishment of Eurasian watermilfoil that occurred sometime during the late 1800's to the early 1940's (Reed 1977, Couch and Nelson 1985). Because of the morphological similarities of the two species and past taxonomic confusion regarding their distinctness, the ranges of these two species reported in floras and taxonomic manuals may not be entirely accurate.

A study by Ceska and Ceska (1986) has shown that *Myriophyllum sibiricum* Komarov is the correct name for North American, European, and Asian plants referred to *M. exalbescens*. Thus, *M. exalbescens* is a synonym of *M. sibiricum*.

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

Plants of northern watermilfoil are submersed except for a short (4 to 10 cm), emersed flowering spike. Most of the submersed stems appear erect, often whitish, with sparse branching near the water's surface. Leaves are whorled, pinnately dissected, with 4 or sometimes 5 leaves per node. The number of pairs of leaf divisions is variable, ranging from 4-14 pairs per leaf. Leaves are stiff and projecting at approximate right angles when the plant is removed from the water. Cylindrical turions consisting of smaller, compacted, and darker green leaves often are present at the tips of the branches and main stem during the latter portion of the growing season. Flowers are whorled and in spikes with the pistillate flowers at the lower nodes of the spike and staminate

flowers at the upper nodes. The stem below the flowering spike is about the same diameter as the main stem of the spike. The floral bracts subtending the pistillate flowers are shorter to rarely equaling the flowers.

Myriophyllum sibiricum is often difficult to distinguish from the introduced and more weedy Eurasian watermilfoil. Characters useful in separating the two species are discussed under *M. spicatum.*

Habitat/Growth Characteristics:

Myriophyllum sibiricum is found in lakes, ponds, and streams and is most abundant north of the mean January isotherm of 0 degrees C (Aiken and Walz 1979). The stems of northern watermilfoil generally are erect in the water column and rarely branch near the surface as is the case with Eurasian watermilfoil. These characteristics allow light penetration into the water and the development of a submersed plant community that may consist of several species (e.g., pondweeds, naiads, coontail, and others). Vegetative reproduction of northern watermilfoil is predominantly from turions or by fragmentation that results from natural decay or mechanical breakage of stems and branches. Turions are formed late in the growing season and remain attached to the parent plant until the following spring (April) when they are released as the stems and branches decay (Aiken *et al.* 1979, Aiken and Walz 1979).

Problems:

As is the case with all aquatic plants, northern watermilfoil can be a problem when it grows in excessive populations and is the wrong place. However, problems caused by this native milfoil are minor in comparison to Eurasian watermilfoil which can exclude native species by forming dense surface mats that restrict light required for development of a diverse submersed plant community.

References

Aiken, S. G. 1981. A conspectus of *Myriophyllum* (Haloragaceae) in North America. Brittonia 33: 57-89.

Aiken, S. G. and K. F. Walz. 1979. Turions of *Myriophyllum exalbescens*. Aquatic Botany 6: 357-363.

Aiken, Susan G., P. R. Newroth, and I. Wile. 1979. The biology of Canadian weeds. 34. *Myriophyllum spicatum* L. Canadian Journal of Plant Science 59: 201-215.

Ceska, A. and O. Ceska. 1986. Notes on *Myriophyllum* (Haloragaceae) in the Far East: The identity of *Myriophyllum sibiricum* Komarov. Taxon 35: 95-100.

Couch, R. C. and E. Nelson. 1985. *Myriophyllum spicatum* in North America. In: L. W. J. Anderson (ed.), Proceedings of the First International Symposium on Watermilfoil

(*Myriophyllum spicatum*) and Related Haloragaceae Species, The Aquatic Plant Management Society, Washington, D.C., pp. 8-18.

Fernald, M. L. 1919. Two new *Myriophyllums* and a species new to the United States. Rhodora 21: 121-124.

Reed, C. F. 1977. History and distribution of Eurasian watermilfoil in United States and Canada. Phytologia 36:417-436.

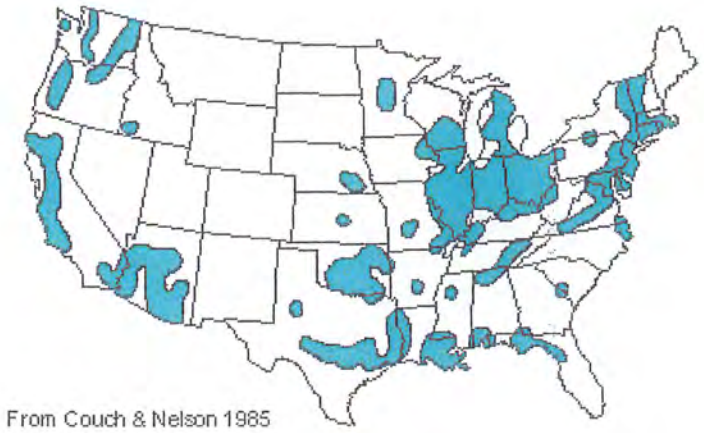
Myriophyllum spicatum L. (Eurasian Watermilfoil)

Family: Haloragaceae

Home Range/U.S. Introduction:

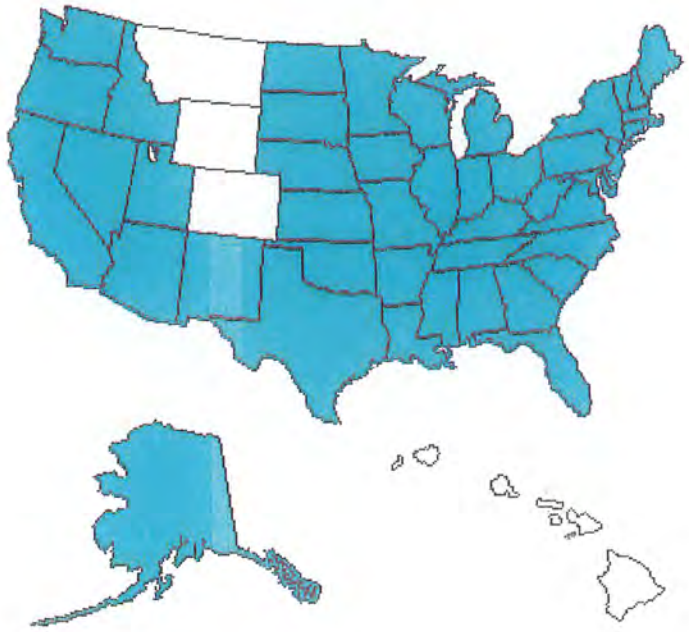
Myriophyllum spicatum L. is an aggressive weed that is native to Europe, Asia, and North Africa. Because of morphological similarities and past taxonomic confusion between Eurasian watermilfoil and the native, northern watermilfoil (*Myriophyllum sibiricum* Komarov), it is difficult to determine the exact time of introduction. A study of herbarium specimens by Couch and Nelson (1985) indicate Eurasian watermilfoil was established in the United States by the 1940's, while other investigators report that Eurasian watermilfoil may have been in the United States since about 1900 or even earlier (Reed 1977).

U.S. Distribution (Based on published data collected in 1997):



From Couch & Nelson 1985

U.S. Range Map:



Species Description:

Plants of Eurasian watermilfoil are rooted and submersed except for a short (3 to 8 cm) emersed flowering spike. Primary stems are generally branched and often form a dense canopy on the water's surface. Leaves are whorled, 4 or rarely 5 leaves per node, each leaf pinnately dissected into narrow, linear segments. The number of pairs of leaf segments is highly variable, ranging from 5 to 24 for each leaf. Leaves cling to the stem above each node when removed from the water. Turions are absent. The flowers are whorled and in spikes with the pistillate flowers at the

lower nodes of the spike and staminate flowers at the upper nodes. The stem below the flowering spike is curved to lie parallel with the water surface and is about twice the diameter of the lower stem. Floral bracts subtending the pistillate flowers are equal or slightly longer than the flowers.

The following set of characters are used by Aiken (1981) in distinguishing Eurasian watermilfoil from northern watermilfoil:

Stem thickened below the inflorescence to almost double the width of the lower stem, usually curved to lie parallel with the water surface; scales at the inflorescence nodes 2-3, black, distinct in fresh material; plants never forming turions **Eurasian watermilfoil**

Stem not thickened below the inflorescence, straight; scales at the inflorescence nodes 0-2, black or brown, indistinct; plants forming turions of black green leaves from October to June **Northern watermilfoil**

Habitat/Growth Characteristics:

Eurasian watermilfoil is a highly invasive and aggressive species that colonizes reservoirs, lakes, ponds, streams, small rivers and brackish waters of estuaries and bays. As stems of Eurasian watermilfoil near the water surface, they branch profusely and often form a dense canopy that reduces light availability for "understory" species. *Myriophyllum spicatum* dies back to propagating root crowns during the winter months and does not form turions as does *M. sibiricum*. Spread of Eurasian watermilfoil is primarily by asexual means. Long range dispersal is primarily by fragmentation that results from mechanical breakage or autofragmentation which occurs after flowering and at the end of the growing season. Fragments produced by either method may be transported over long distances by water currents. Fragments may also be transported from one water body to another when fragments become attached to boat trailers. Once established, individual plants may expand for distances of a few meters by the production of stolons. Although Eurasian watermilfoil produces large quantities of viable seed, very few seedlings have been observed in field situations, and seed are considered to be of minor importance in dispersal of *M. spicatum* (Smith and Barko 1990).

Problems:

Eurasian watermilfoil may "shade out" and outcompete desirable native species and form monospecific colonies over large areas of some water bodies. Dense mats and colonies of *M. spicatum* can restrict swimming, boating, bank fishing, and negatively impact aesthetic appeal. Fragments and floating mats may clog water intakes at power generation facilities and potable water intakes. Dense stands of Eurasian watermilfoil provide habitat for mosquitoes and may increase populations of some species of mosquitoes (Aiken *et al.* 1979, Smith and Barko 1990). Because of the problems caused by Eurasian watermilfoil, large-scale management programs have been implemented by the Tennessee Valley Authority, the U.S. Army Corps of Engineers, and governmental agencies in Canada.

References:

Aiken, S. G. 1981. A conspectus of *Myriophyllum* (Haloragaceae) in North America. Brittonia 33: 57-69.

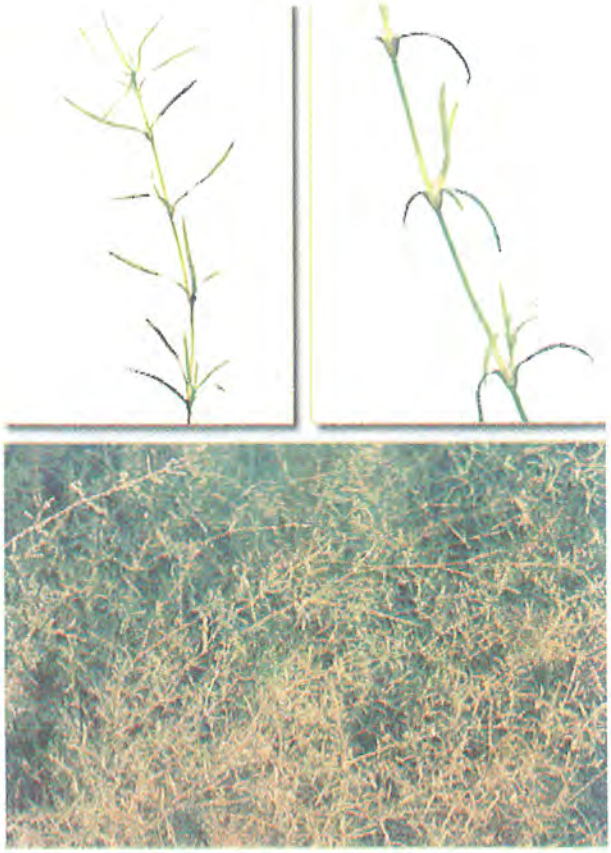
Aiken, S. G., P. R. Newroth, and I. Wile. 1979. The biology of Canadian weeds. 34. *Myriophyllum spicatum* L. Canadian Journal of Plant Science 59: 201-215.

Couch, R. and E. Nelson. 1985. *Myriophyllum spicatum* in North America. In: L. W. J. Anderson (ed.), Proceedings of the First International Symposium on watermilfoil (*Myriophyllum spicatum*) and related Haloragaceae species. Aquatic Plant Management Society, Washington, D.C. pp. 8-18.

Reed, C. F. 1977. History and distribution of Eurasian watermilfoil in United States and Canada. Phytologia 36: 417-436.

Smith, C. S. and J. W. Barko. 1990. Ecology of Eurasian watermilfoil. Journal of Aquatic Plant Management 28: 55-64.

Najas guadalupensis (Spreng.) Magnus (Southern Naiad)

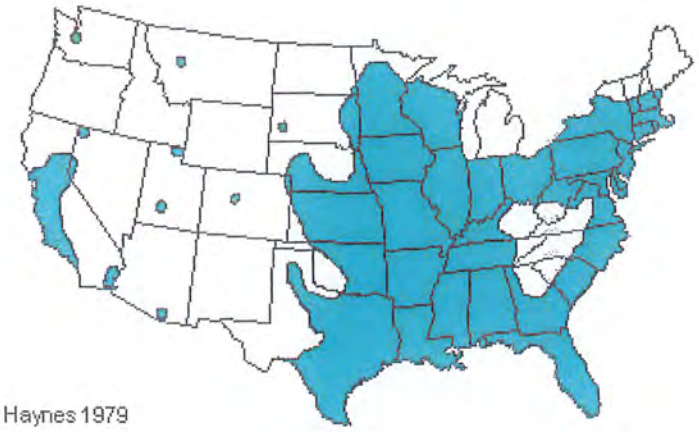


Family: Najadaceae

Home Range/U.S. Distribution:

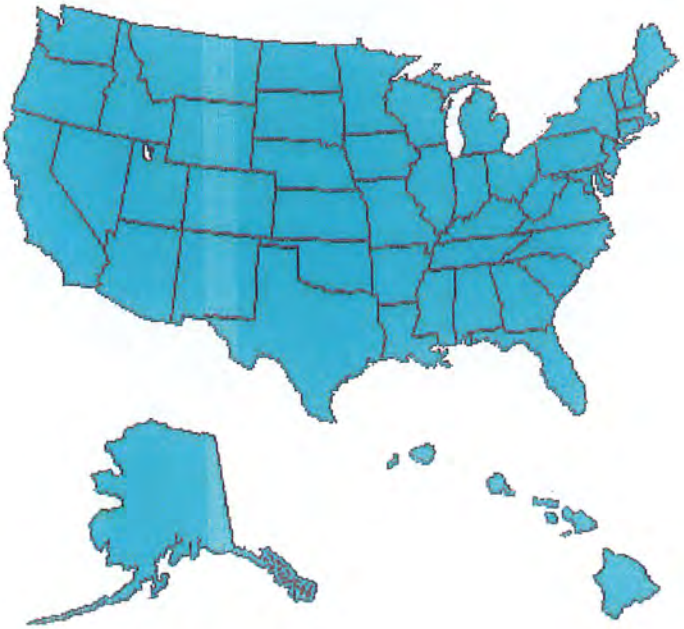
Najas guadalupensis (Spreng.) Magnus is native and widespread in the United States. Haynes (1979) recognizes *N. guadalupensis* as having four varieties. Of these, var. *guadalupensis* is the most widespread and ranges over much of the United States. The other three varieties have more restricted distributions. Variety *floridana* Haynes & Wentz is distributed throughout Florida and also is found in central Alabama and southern Georgia. Variety *muenscheri* (Clausen) Haynes is restricted to the Hudson River system of New York, and var. *olivacea* (Rosendahl & Butters) Haynes is a northern plant that ranges from central New York west to Minnesota and Iowa. Seven other species of *Najas* are reported by Haynes (1979) as occurring in the United States. Because several of the species are morphologically similar, identification of the various species can sometimes be difficult. One should always attempt to collect specimens with seeds to facilitate identification.

U.S. Distribution (Based on published data collected in 1997):



Haynes 1979

U.S. Range Map:



Species Description:

Plants of *N. guadalupensis* are rooted, submersed, and from 0.1 to 1.0 m long. The leaves are usually opposite or subopposite, from 0.2 to 2.0 mm wide, and 0.3 to 3.3 cm long. The teeth along the leaf margin are small, 18 to 100 per side, and barely visible to the naked eye. Sheaths at the base of the leaf are rounded to slightly auriculate. The flowers are small, inconspicuous and borne in the leaf axils on the same plant. Seeds are 1.2 to 3.8 mm long, fusiform, with 4- to 6-angled areolae arranged in 20 to 60 rows.

Habitat/Growth Characteristics:

Southern naiad is found in marshes, ponds, lakes, reservoirs, rivers, streams, canals, and occasionally in slightly brackish water. It is typically a shallow water species that can form dense monospecific colonies or is often found in association with other submersed aquatics such as spinyleaf naiad, pondweeds, and muskgrass. Like spinyleaf naiad, reservoir populations of southern naiad may fluctuate dramatically over a period of a few years in response to changes in the amount of available light (Peltier and Welch 1970). Southern naiad seems to be more tolerant of turbidity, warming of water temperatures, and eutrophication than some of the other native species of *Najas* and has spread in some regions of the United States over the past century (Wentz and Stuckey 1971).

Problems:

Najas guadalupensis can form dense colonies in shallow water and hinder swimming, fishing, boating, and other forms of water contact recreation. It is a major problem species in Florida and is reported to impede water flow in drainage and irrigation canals (Tarver *et al.* 1986). However, the plant is a valuable waterfowl food and can provide habitat and substrate of fish and invertebrates (Tarver *et al.* 1986, Brooks and Hauser 1978).

References:

Brooks, R. E. and L. A. Hauser. 1978. Aquatic vascular plants of Kansas I. Submersed and floating leaved plants. Technical Publication No. 7. State Biological Survey of Kansas, Lawrence, Kansas.

Haynes, R. R. 1979. Revision of North and Central American *Najas* (Najadaceae). Sida 8: 34-56.

Peltier, W. H. and E. B. Welch. 1970. Factors affecting growth of rooted aquatic plants in a reservoir. Weed Science 18:7-9.

Tarver, D. P, J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Wentz, W. A. and R. L. Stuckey. 1971. The changing distribution of the genus *Najas* (Najadaceae) in Ohio. Ohio Journal of Science 71: 292-302.

Najas marina L. (Spiny Naiad)

Synonym(s): *Najas gracilis* (Morong) Small

Najas major All.

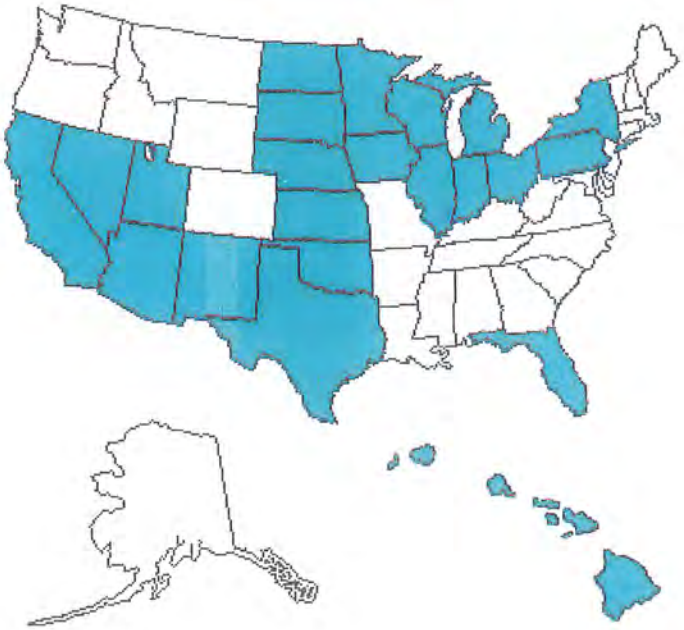
Family: Najadaceae

Home Range/U.S. Introduction:

Najas marina L. is native, and although widely distributed in the United States, populations are clustered in widely ranging geographic areas (see distribution map). Presumably, this is because of its habitat requirement of brackish or highly alkaline waters. The prickly internodes and prickles along the midrib on the underside of the leaves make *N. marina* one of the easiest species of *Najas* to recognize (Haynes 1979).

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

Najas marina is submersed with brittle stems up to about 0.5 m long that are often branched toward the upward portion of the plant. The internodes of the stem usually have conspicuous, brownish, prickly teeth. The leaves are opposite or sometimes in whorls of three, 0.5 to 4.0 cm long, and have triangular teeth along the leaf margins and prickles along the midrib on the underside of the leaf. Plants are dioecious with the male and female flowers borne on separate individuals. The flowers are solitary in the leaf axils. The female flowers produce ovoid seeds 2.0 to 4.5 mm long that have 3 to 4-angled areolae that are irregularly arranged.

Habitat/Growth Characteristics:

Holly-leaved water-nymph is found in brackish or highly alkaline ponds, lakes, and coastal and inland marshes. Plants are reported to reproduce by seed and fragmentation (Tarver *et al.* 1986). Studies by Vierssen (1982) have shown seed germination of *N. marina* to be best in decomposing organic matter, at 24° C under dark conditions. Agami and Waisel (1986) found the germination of *N. marina* to be increased after passing through the digestive tract of mallard ducks and postulate that ducks may be a major factor in long range dispersal of *N. marina*.

Problems:

Najas marina can sometimes interfere with boating and fishing. However, the plant is considered to be an excellent waterfowl food (Tarver *et al.* 1986).

References:

Agami, M. and Y. Waisel. 1986. The role of mallard ducks (*Anas platyrhynchos*) in distribution and germination of seeds of the submersed hydrophyte *Najas marina*. Oecologia (Berlin) 68: 473-475.

Haynes, R. R. 1979. Revision of North and Central American *Najas* (Najadaceae). Sida 8: 34-56.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Vierssen, V. W. 1982. Some notes on the germination of seeds of *Najas marina*. Aquatic Botany 12: 201-20.

Najas minor All. (Slender Naiad)

Family: Najadaceae

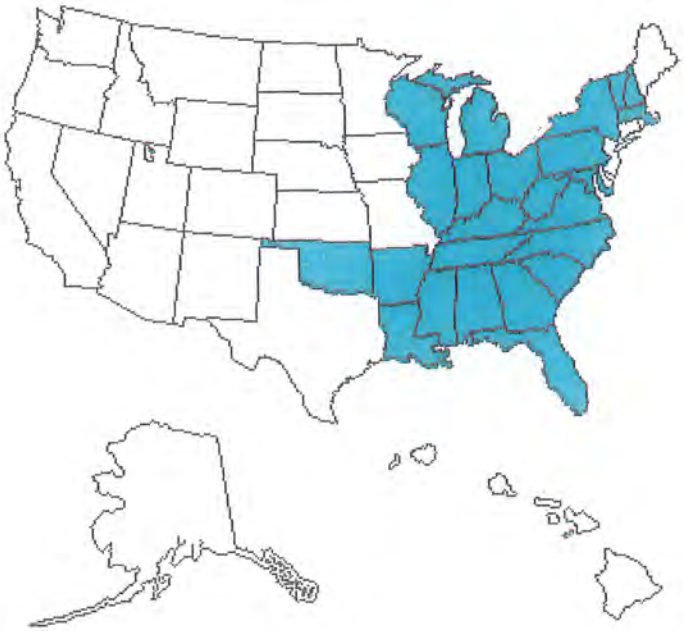
Home Range/U.S. Introduction:

Najas minor All. is an introduced species that was first collected in the United States in the 1930's (Merilainen 1968, Wentz and Stuckey 1971). Since that time, spiny-leaf naiad has spread throughout much of the eastern United States and can be found from New York south to Florida and west to Arkansas. Seven other species of *Najas* are reported by Haynes (1979) as occurring in the United States. Because several of the species are morphologically similar, identification of the various species can sometimes be difficult. One should always attempt to collect specimens with seeds to facilitate identification.

U.S. Distribution (Based on published data collected in 1997):

Haynes 1979

U.S. Range Map:



Species Description:

Najas minor is an annual that is rooted and grows submersed. The stems are up to 2.5 m long and are profusely branched near their apex. Leaves are opposite or subopposite, about 1 mm wide and 0.5 to 3.5 cm long, becoming stiff and recurved with age. The leaves have 7 to 15 small, but conspicuous teeth along each leaf margin. Sheaths at the base of the leaf are truncate to auriculate. Flowers are small, inconspicuous, and borne in the leaf axils on the same plant. The seeds are 1.5 to 3.0 mm long and slightly curved with rectangular areolae arranged in distinct longitudinal rows.

Habitat/Growth Characteristics:

Spiny-leaf naiad can be found in ponds, lakes, reservoirs, and slow moving streams. It is more tolerant of turbidity and eutrophic conditions than some of the native species of *Najas* and has replaced them in many instances (Wentz and Stuckey 1971). Although spiny-leaf naiad can reproduce by fragmentation, the primary means of reproduction appears to be by seed. Data collected from reservoirs in the Tennessee River system have shown seed banks of *N. minor* to be tens of millions of seed per hectare at productive sites. During the late summer or early fall, the stems of spinyleaf naiad become brittle, and the profusely branched apical portions of the stem break into small fragments. Seeds remain attached in the leaf axils, and the fragments are dispersed by wind and water currents. Populations of *Najas* within reservoirs can fluctuate dramatically over a period of a few years and have been correlated with years of low rainfall and increased amounts of available light (Peltier and Welch 1970).

Problems:

Najas minor can form dense, monospecific stands in shallow water and hinder swimming, fishing, boating, and other forms of water contact recreation. It often grows with other submersed aquatics such as southern naiad, pondweed, coontail, and watermilfoil.

References:

Haynes, R. R. 1979. Revision of North and Central American *Najas* (Najadaceae). Sida 8: 34-56.

Merilainen, J. 1968. *Najas minor* All. in North America. Rhodora 70: 161-175.

Peltier, W. H. and E. B. Welch. 1970. Factors affecting growth of rooted aquatic plants in a reservoir. Weed Science 18: 7-9.

Wentz, W. A. and R. L. Stuckey. 1971. The changing distribution of the genus *Najas* (Najadaceae) in Ohio. Ohio Journal of Science 71: 292-302.

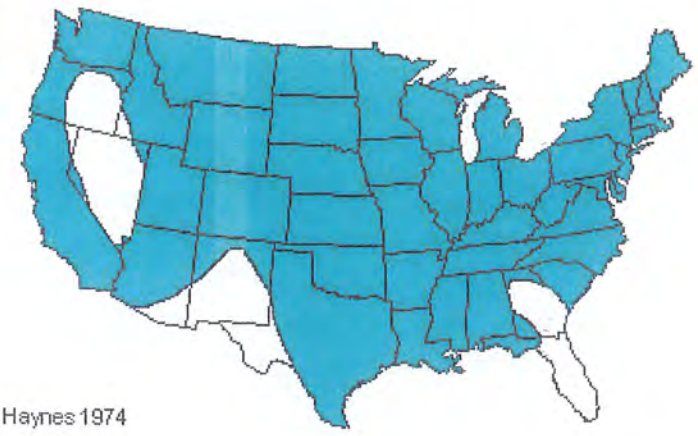
Potamogeton crispus L. (Curlyleaf Pondweed)

Family: Potamogetonaceae

Home Range/U.S. Introduction:

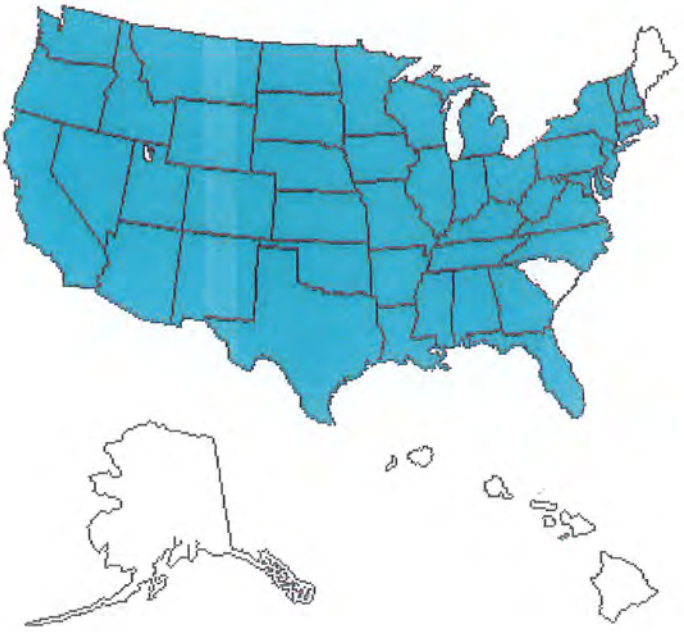
Curly pondweed, *Potamogeton crispus* L., is native to Eurasia and apparently was introduced into the United States in the mid 1800's (Stuckey 1979). Prior to 1900, the distribution of *P. crispus* was the northeastern United States. By 1930 curly pondweed had spread westward to several states of the Great Lakes region. The species has since spread across much of the United States (see distribution map), presumably by migrating waterfowl, intentional planting for waterfowl and wildlife habitat, and possibly even as a contaminant in water used to transport fishes and fish eggs to hatcheries (Stuckey 1979).

U.S. Distribution (Based on published data collected in 1997):



Haynes 1974

U.S.Range Map:



Species Description:

Curly pondweed is a perennial and has elongate, slender rhizomes that are buff or reddish. The stems of curly pondweed are flattened. Leaves are entirely submersed, sessile, oblong to broadly linear, 3 to 8 cm long and 5 to 12 mm wide. The leaf tip is usually rounded and sometimes minutely cuspidate. The leaf margins are finely toothed, undulate and crisped. Stipules are translucent and soon disintegrating. Bur-like turions that are up to about 5 cm long often form during the spring and late summer months and consist of three to seven small, thickened leaves that project from the stem at a slight upward angle. Flowers are borne on a short spike that extends above the surface of the water. The fruits are flat, 4 to 6 mm long (including the beak) and have a distinct, pointed beak that is erect or somewhat curved and about 2 to 3 mm long.

Habitat/Growth Characteristics:

Potamogeton crispus grows in lakes, reservoirs, ponds, rivers, streams, and springs. It can grow in clear to turbid and polluted waters and in alkaline or brackish waters (Stuckey 1979). Curly pondweed produces seed, but the importance of seed in the spread and maintenance of populations is unknown (Stuckey 1979) and is assumed to be less important than turions (Sastroutomo 1981). In most portions of its range, *Potamogeton crispus* typically reaches peak biomass in the late spring or early summer months, forms turions, then declines and "survives" the warmer months in a dormant state (i.e., as a turion) (Cypert 1967, Stuckey 1979, Sastroutomo 1981, Tobiessen and Snow 1984, Nichols and Shaw 1986). As water temperatures cool during the late summer or fall months, the turions germinate, grow through the winter months with the plants reaching peak biomass in the spring before most other submersed macrophytes begin their growth cycle. Once established, the plants regrow and form colonies from rhizomes.

Problems:

Dense colonies of curly pondweed can restrict access to docks and sport fishing areas during spring and early summer months. Because populations of curly pondweed usually decline during the summer months, it does not directly compete with many of the native submersed species.

References:

Cypert, E. 1967. The curly-leaved pondweed problem at Reelfoot Lake. Journal of the Tennessee Academy of Science 42:10-11.

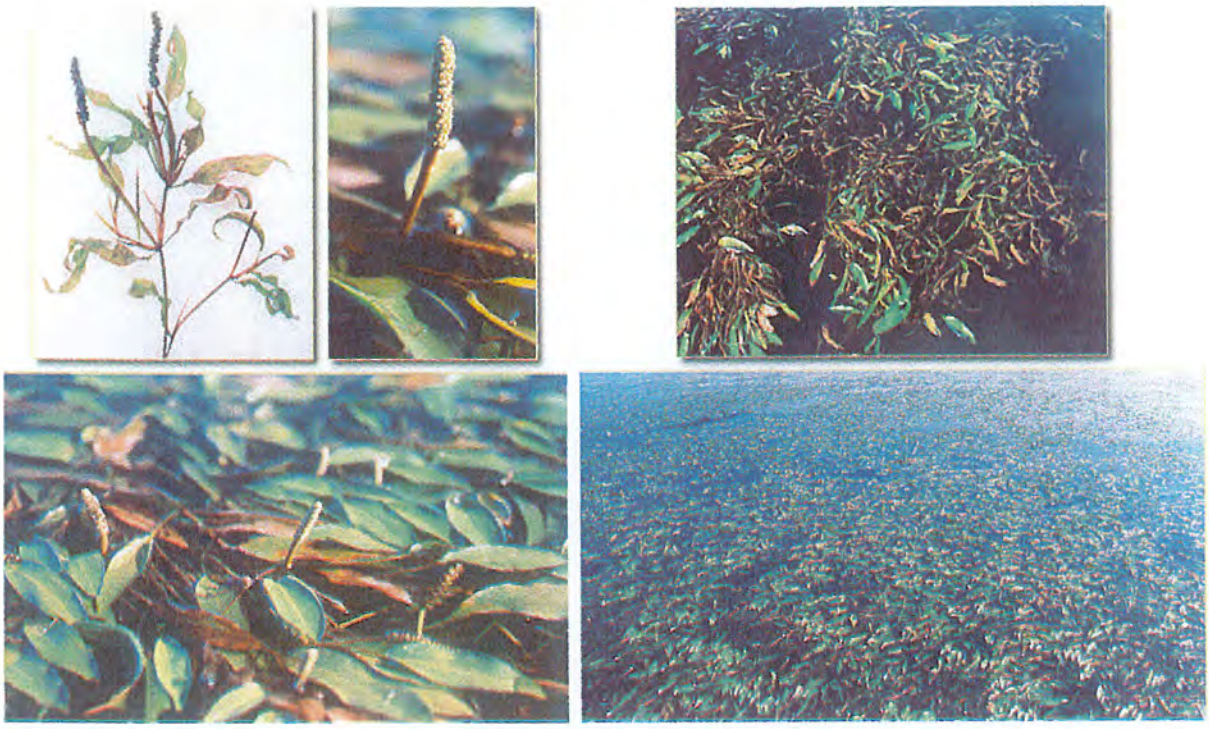
Nichols, S. A. and B. H. Shaw. 1986. Ecological life histories of the three aquatic nuisance plants, *Myriophyllum spicatum*, *Potamogeton crispus*, and *Elodea canadensis*. Hydrobiologia 131: 3-21.

Sastroutomo, S. S. 1981. Turion formation, dormancy and germination of curly pondweed, *Potamogeton crispus* L. Aquatic Botany 10: 161-173.

Stuckey, R. L. 1979. Distributional history of *Potamogeton crispus* (curly pondweed) in North America. Bartonia 46: 22-42.

Tobiessen, P. and P. D. Snow. 1984. Temperature and light effects on the growth of *Potamogeton crispus* in Collins Lake, New York State. Canadian Journal of Botany 62: 2822-2826.

Potamogeton illinoensis Morong (Illinois Pondweed)



Synonym(s): *Potamogeton angustifolius* Bercht. & K. Presl

Potamogeton heterophyllus Schreb.

Potamogeton lucens auct. non L.

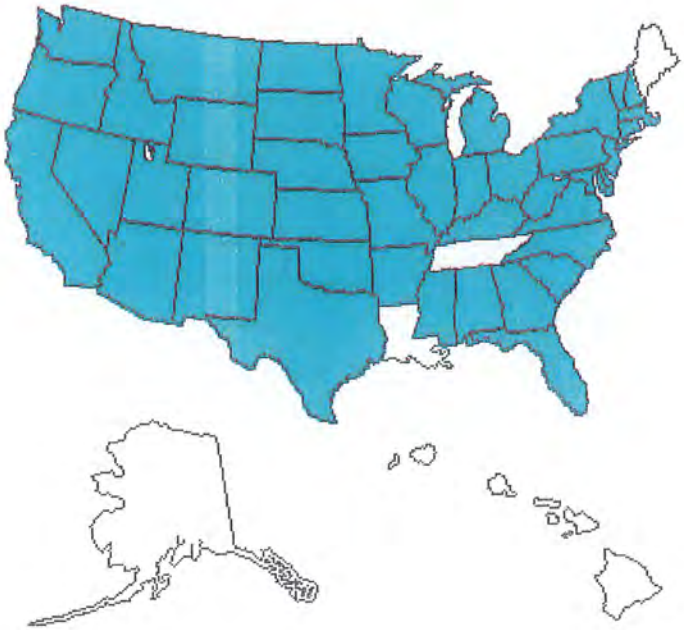
Family: Potamogetonaceae

Home Range/U.S. Introduction:

Illinois pondweed, *Potamogeton illinoensis* Morong, is a native species that has a widespread distribution in the United States (see distribution map). *Potamogeton illinoensis* and a few other species (e.g., *Potamogeton alpinus* Balbis, *P. amplifolium* Tuckerman, *P. nodosus* Poir., *P. pulcher* Tuckerman) have relatively large, floating leaves and broadened underwater leaves that are usually 1 cm or more wide. Keys, descriptions, distributions, and/or illustrations for these species and several others can be found in Ogden (1943) and Hellquist and Crow (1980).

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

Illinois pondweed is a perennial and has a network of slender horizontal rhizomes. The stem is often branched and up to 2 m long. Leaves are of two types; the submersed leaves are alternate, thin, the blades elliptic to lanceolate, 8 to 20 cm long and 2 to 5 cm wide, sessile or with short petioles up to about 5 cm long. Stipules are persistent and conspicuous, 4 to 10 cm long and have obtuse tips. Floating leaves are sometimes, but are not always present, and often transitional from the submersed leaves. Floating leaves are elliptic to oblong-elliptic, coriaceous, 3 to 19 cm long, 2 to 6 cm wide, with petioles up to 8 cm long. The inflorescence is a spike with 8 to 15 whorls of flowers and borne on peducles 4 to 20 cm long that arise from leaf axils. Fruits are greenish, 2.5 to 3.5 mm long and 2-3 mm wide and have a short, nearly erect beak.

Illinois pondweed and American pondweed are morphologically similar in many respects and are often confused. Characteristics commonly used to separate the two species include length of the petiole of the submersed leaves (sessile or less than 4 cm in *P. illinoensis* versus 2 to 13 cm in *P. nodosus*), size of the fruits (3.5 to 4.5 mm in *P. nodosus* compared to 2.5 to 3.5 mm in P. *illinoensis*), and the frequent lack of floating leaves in *P. illinoensis* that are usually present in populations of *P. nodosus.*

Habitat/Growth Characteristics:

Potamogeton illinoensis grows in streams, lakes, reservoirs, ponds, and canals, often in calcareous waters. It reproduces both from seed and from rhizomes.

Problems:

Dense colonies of Illinois pondweed may restrict lakeshore access, impede boat traffic, and reduce stream flow. The seed heads of Illinois pondweed are consumed by waterfowl, and as is the case with all submersed aquatics, underwater stems and leaves provide cover for fish (Tarver *et al.* 1986.).

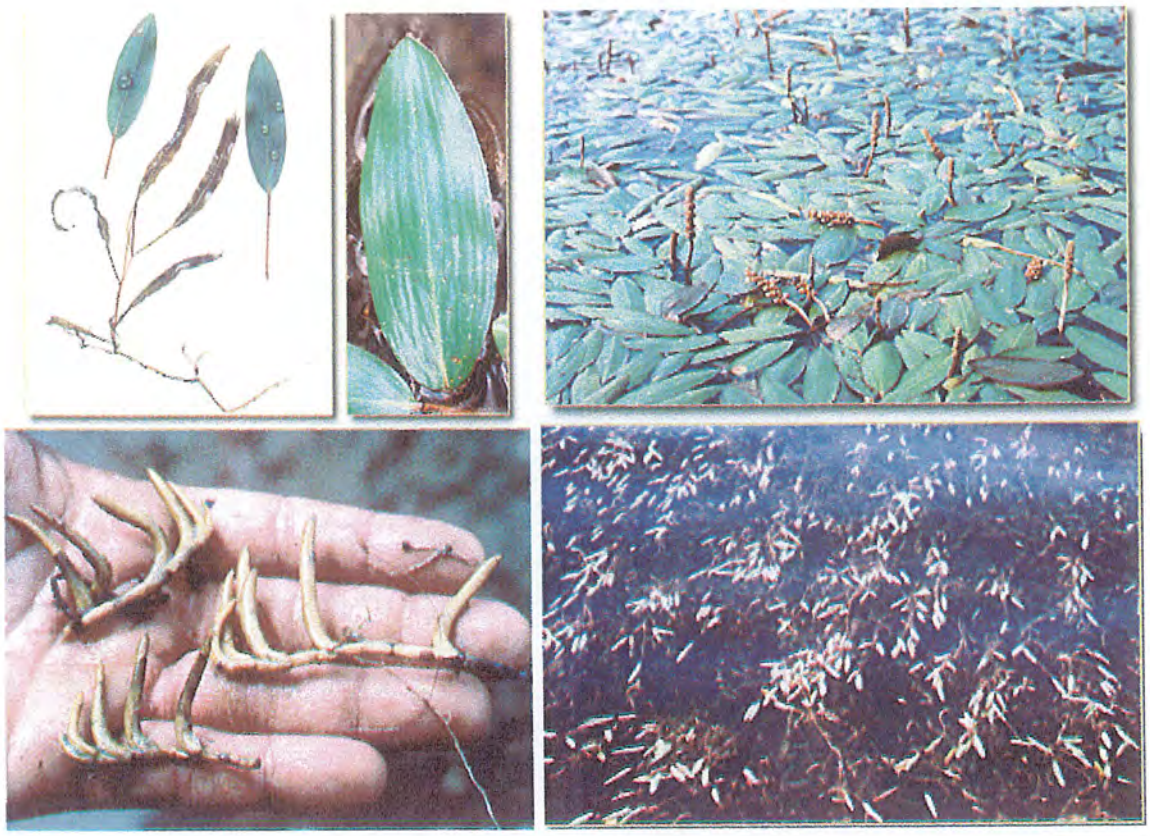
References:

Hellquist, C. B. and G. E. Crow. 1980. Aquatic vascular plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae. Station Bulletin 515. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire.

Ogden, E. C. 1943. The broad-leaved species of *Potamogeton* of North America north of Mexico. Rhodora 45: 57-105, 119-163, 171-214.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Potamogeton nodosus Poir. (American Pondweed)



Synonym(s): *Potamogeton americanus* Cham. & Schlecht.

Potamogeton fluitans Roth

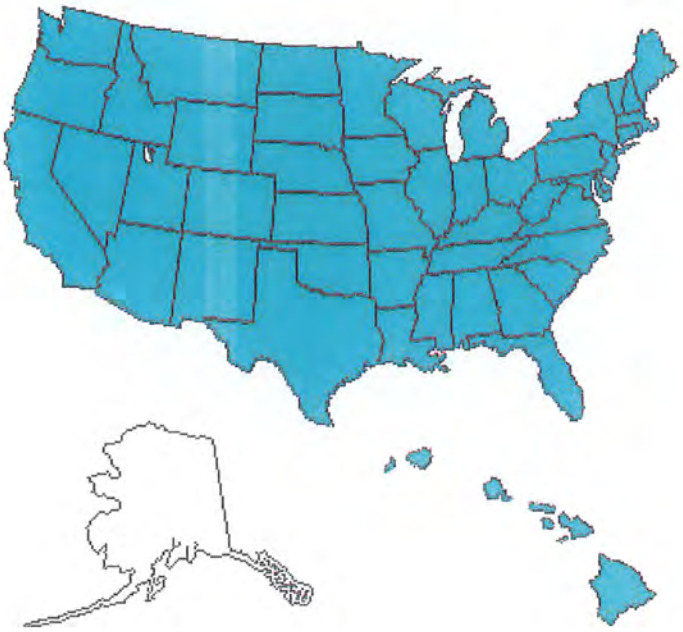
Family: Potamogetonaceae

Home Range/U.S. Introduction:

American pondweed, *Potamogeton nodosus* Poir., is native and one of the most common and widespread species of pondweed in the United States. *Potamogeton nodosus* and a few other species (e.g., *Potamogeton alpinus* Balbis, *P. amplifolius* Tuckerman, *P. illinoensis* Morong, *P. pulcher* Tuckerman) have relatively large, floating leaves and broadened underwater leaves that are usually 1 cm or more wide. Keys, descriptions, distributions, and/or illustrations for these species and several others can be found in Ogden (1943) and Hellquist and Crow (1980).

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

The rhizomes of American pondweed are whitish with reddish blotches. The stems are branched and up to 2 m long. The leaves are of 2 types; the submersed leaves are alternate, thin, the blades linear-lanceolate or sometimes broader, 8 to 20 cm long and 1 to 3 cm wide, and have petioles 2 to 13 cm long. Stipules are conspicuous, brownish, and 2 to 7 cm long. The floating leaves sometimes appearing opposite, thickened, coriaceous, lenticular to elliptic in shape, 3 to 12 cm long and up to 4.5 cm wide. The inflorescence is a spike, the flowers in whorls of 10 to 17, on erect peduncles 3 to 15 cm long that arise from leaf axils. The fruits are brownish or reddish, 3.5 to 4.5 cm long, 2 to 3 cm wide and have a short, erect beak.

American pondweed resembles and may be mistaken for Illinois pondweed (*P. illinoensis*). The diagnostic differences between the species are discussed in the section describing Illinois pondweed.

Habitat/Growth Characteristics:

American pondweed grows in lakes, reservoirs, ponds, canals, swamps, streams and small rivers. Although *Potamogeton nodosus* produces viable seed (Muenscher 1936), the role of seeds in the spread of the species and their importance in perpetuating indigenous populations apparently has not been investigated. A primary method of regrowth is from winter buds that are formed in the fall months at the ends of rhizomes. Winter buds may be collected and stored at about 4° C and planted to introduce or re-establish populations. Factors influencing germination of *P. nodosus* winter buds have been studied by Spencer and Ksander (1992).

Problems:

In shallow areas of lakes, ponds and reservoirs, colonies of *P. nodosus* may become dense enough to restrict access to shoreline facilities and restrict activities such as swimming and bank fishing. It also hinders water flow in irrigation canals in some areas of the western United States. However, it also provides benefits by providing shelter and structure for fish and is a food source for a variety of waterfowl and shorebirds (Brooks and Hauser 1978).

References:

Brooks, R. E. and L. A. Hauser. 1978. Aquatic vascular plants of Kansas I. Submersed and floating leaved plants. Technical Publication No. 7. State Biological Survey of Kansas, Lawrence, Kansas

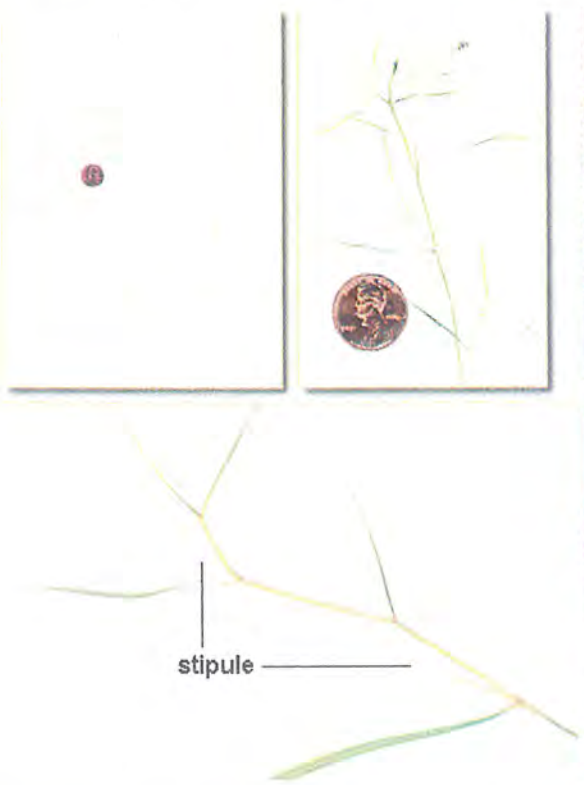
Hellquist, C. B. and G. E. Crow. 1980. Aquatic vascular plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae. Station Bulletin 515. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire.

Muenscher, W. C. 1936. The germination of seeds of *Potamogeton.* Annals of Botany 50: 805-821.

Ogden, E. C. 1943. The broad-leaved species of *Potamogeton* of North America north of Mexico. Rhodora 45: 57-105, 119-163, 171-214.

Spencer, D. F. and G. G. Ksander. 1992. Influence of temperature and moisture on vegetative propagule germination of *Potamogeton* species: Implications for aquatic plant management. Aquatic Botany 43: 351-364.

Potamogeton pusillus L. (Small pondweed)



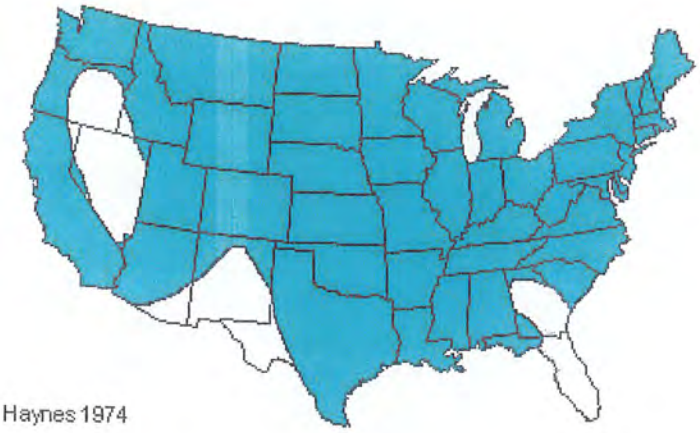
Synonym(s): *Potamogeton berchtoldii* Fieber

Family: Potamogetonaceae

Home Range/U.S. Introduction:

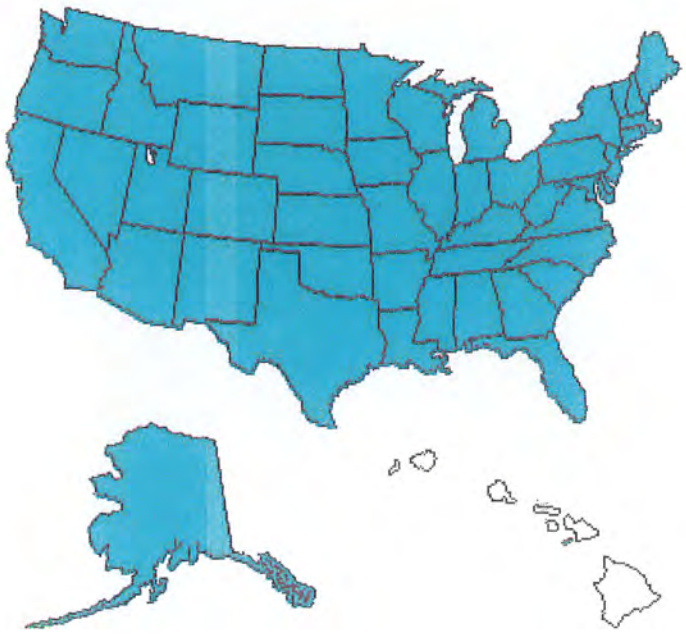
Potamogeton pusillus L. is native to the United States and is treated by Haynes (1974) as consisting of 3 varieties. Variety *pusillus* and var. *tenuissimus* Mert. and Koch are widespread across much of the United States, while var. *gemmiparus* Robbins is restricted to the northeastern United States. Separation of the varieties is based on combinations of vegetative and floral characters that may not be readily apparent unless one has had some experience in identifying species of pondweed having only narrow, submersed leaves. *Potamogeton pusillus* should be considered as an example of a much larger group of similar species that are not easily identified. Always look for and collect flowering and fruiting plants of narrow-leaved pondweeds. Even then, the final determination of a species may require access to herbarium specimens and the assistance of an "expert". Haynes (1974) and Hellquist and Crow (1980) contain excellent keys, distribution maps, and/or illustrations of several of the narrow-leaved pondweeds.

U.S. Distribution (Based on published data collected in 1997):



Haynes 1974

U.S. Range Map:



Species Description:

Potamogeton pusillus is a submersed perennial without any floating leaves. The stems are delicate, and sometimes 1 m or more in length. The leaves are mostly alternate, although leaves at the stem apex having flowering stalks may appear opposite. The leaves are linear, 1 to 3 nerved, 1 to 6 cm long and 0.2 to 2.5 mm wide. Stipules are brown, to green or white, surrounding the stem above each leaf node, and from 2 to 8 mm long. Peduncles (flowering stalks) are axillary or terminal, erect, and 0.5 to 6 cm long. The inflorescence is a spike, usually with 1 to 3 whorls of small flowers. Fruits are green to brown, rounded on the back and lacking a dorsal keel.

Habitat/Growth Characteristics:

Small pondweed is found in reservoirs, lakes, ponds, swamps, streams, canals and drainage ditches. *Potamogeton pusillus* and several closely related species are considered to reproduce to a large extent from winter buds. Muenscher (1936) has shown that *P. pusillus* produces viable seed, but the importance of seed in the spread and propagation of small pondweed apparently has not been investigated.

Problems:

Potamogeton pusillus may grow in mixed stands with *Najas, Chara,* other pondweeds, and several other submersed plants. Although it seems to rarely cause problems by itself, it is frequently part of a mixed community that may restrict swimming, bank fishing, and boat access to shoreline facilities. Pondweeds are considered to be one of the most beneficial groups of plants for waterfowl.

References:

Haynes, R. R. 1974. A revision of North American *Potamogeton* subsection *Pusilli* (Potamogetonaceae). Rhodora 76:564-649.

Haynes, R. R. 1978. The Potamogetonaceae in the southeastern United States. Journal of the Arnold Arboretum 59: 170-191.

Hellquist, C. B. and G. E. Crow. 1980. Aquatic vascular plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae. Station Bulletin 515. New Hampshire Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire.

Muenscher, W. C. 1936. The germination of seeds of *Potamogeton.* Annals of Botany 50: 805-821.

Ranunculus longirostris Godr. (Water Buttercup)

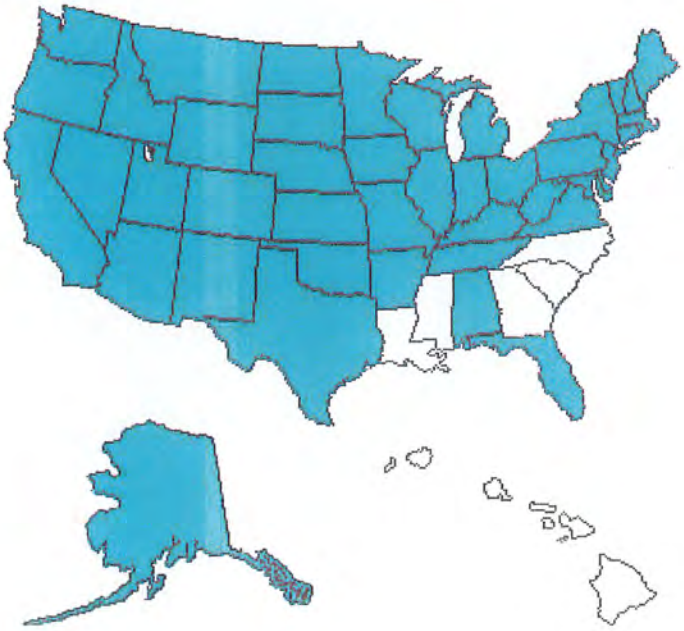
Family: Ranunculaceae

Home Range/U.S. Introduction:

Ranunculus longirostris Godr. ranges across much of the United States but is rare in the southeastern United States. It also occurs in Mexico, Canada, Eurasia, South America, and Australia. Plants in this taxonomically difficult group have white flowers and dissected underwater leaves. Some taxonomic treatments recognize a single species (*R. aquatilis* L.) with several varieties or subspecies, or as being composed of 3 or 4 distinct species that also have recognized subspecific or varietal taxa.. The white flowered species of *Ranunculus* also were segregated and included in the genus *Batrachium* in several late 19th and early 20th century floras. The flora of the northeastern United States and adjacent Canada by Gleason and Cronquist (1991) recognizes three species with the following names: *R. trichophyllus* Chaix, *R. subrigidus* W. Drew, and *R. longirostris* Godron.

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

White water-crowfoot is an annual or perennial species that grows up to about 1 m tall and has branching stems. Floating leaves are sometimes present, but more frequently, the plant only has submersed leaves. The floating leaves are entire, kidney-shaped or orbicular and usually have 3 to 5 lobes. Submersed leaves are 2 to 3 cm long, ternately or binately dissected into flaccid or stiff filiform segments. The stipule is adnate and encircles the base of each petiole. Flowers are borne on stalks from the leaf axils and have 5 white petals that sometimes have a yellow base.

After flowering, the stalks usually recurve into the water and produce a head-like cluster of beaked fruits that are 1 to 2 mm long.

Habitat/Growth Characteristics:

White water-crowfoot grows in shallow water of marshes, ponds, lakes, and slow streams. According to Cook (1966), species in this complex generally are pioneer species that are later replaced by pondweeds, water lilies, and other rhizomatous aquatic species. They also are usually found in slow moving water less than 1 meter deep and will not grow in deep shade. Seeds are dispersed by water, in mud, and perhaps by animals.

Problems:

In quiet water, white water-crowfoot can form dense mats and hinder access and restrict recreational activities. Nelson and Couch (1985) note that white water-crowfoot generally does not cause problems in large reservoirs in Oklahoma because wave action tends to break the brittle stems and prevent the formation of large colonies. Most problems caused by white water-crowfoot were in small ponds, lakes, and sluggish streams that often became choked by mid-summer.

References:

Cook, C. D. K. 1966. A monographic study of *Ranunculus* subgenus *Batrachium* (DC.) A. Gray. Sonderdruck aus den Mitteilungen der Botanischen Staatssammlung Munchen 6: 47-237.

Nelson, E. A. and R. W. Couch. 1985. Aquatic Plants of Oklahoma I: Submersed, Floating-leaved, and Selected Emergent Macrophytes. Oral Roberts University, Oral Roberts University Press, Tulsa, Oklahoma.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition. The New York Botanical Garden, Bronx, New York.

Stuckenia pectinatus (L.) Boerner (Sago Pondweed)

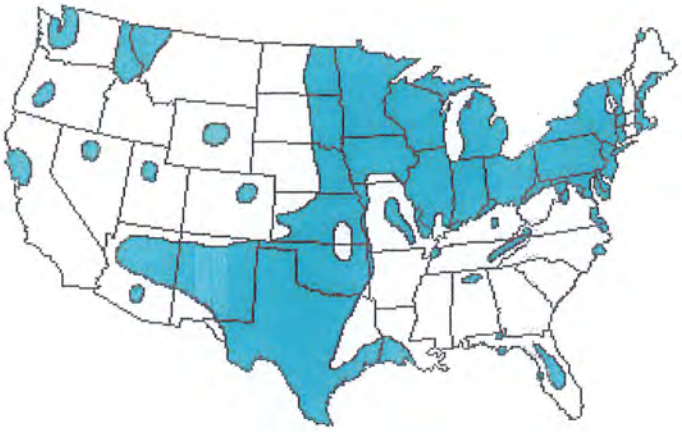
Synonym(s): *Potamogeton pectinatus* L.

Family: Potamogetonaceae

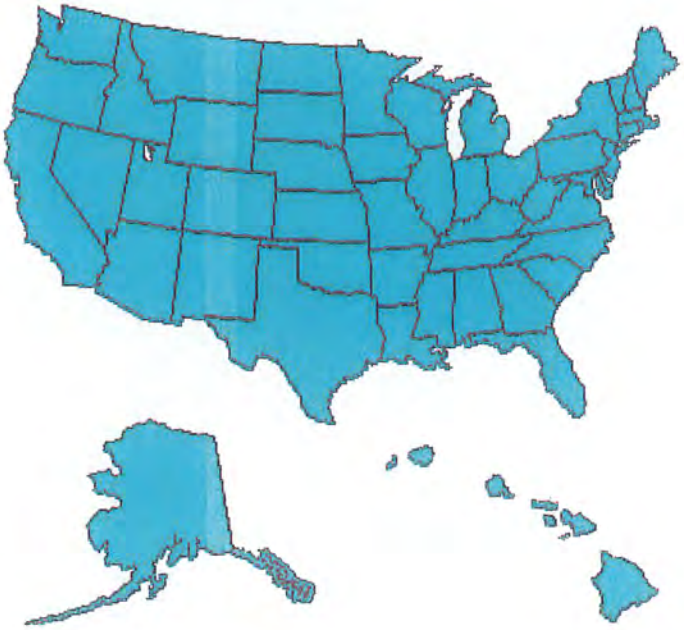
Home Range/U.S. Introduction:

Sago pondweed, *Stuckenia pectinatus*, is native and occurs throughout most of the United States. Sago pondweed lacks floating leaves and can be distinguished form other species of pondweed having only narrow underwater leaves by stipules that are adnate to the leaf blade for 90 percent of their length and by fruits that have an evident beak (Haynes 1978). This plant was formerly known as *Potamogeton pectinatus* L

U.S. Distribution (Based on published data collected in 1997):



U.S. Range Map:



Species Description:

Sago pondweed is a perennial and has thin, creeping rhizomes that are matted and often end in tuberous bulblets. The stem is slender, about 1 mm in diameter, simple at the base but much branched toward the summit. All the leaves are submersed, linear to filiform, 3 to 10 cm long, about 1 mm wide. Each leaf has one to three nerves and an acute to attenuate apex. The stipules are 2 to 5 cm long and are adnate to the leaf for approximately 90 percent of stipule length. Flowering stalks (peduncles) arise from the leaf axils and are from 3 to 10 cm long. The flowers are sessile, in whorls of 2 to 5 and on spikes 1 to 4 cm long. Fruits are plump, 2.5 to 4 mm long with a rounded dorsal keel and a short beak.

Habitat/Growth Characteristics:

Stuckenia pectinatus grows in fresh, alkaline, brackish, or saline waters of lakes, ponds, rivers, steams, irrigation canals and coastal marshes. Sago pondweed reproduces by seed and vegetatively by rhizome growth and from bublets (tubers). Environmental conditions influencing the formation and germination of tubers have been studied by several investigators (Spencer 1987, Madsen and Adams 1988, Spencer and Ksander 1992). Spencer and Ksander (1992) found that tubers collected from canals in California germinated in response to water-saturated substrate at temperatures of 15, 20, and 25 degrees C. These data suggest that flooding of canals could induce the germination of sago pondweed tubers during periods when ambient temperatures were within this range. After the removal of water, the "terrestrial" form of the plant would likely be produced and could be more easily controlled with other techniques (e.g., herbicides).

Problems:

Sago pondweed sometimes grows in dense colonies that can impede boating and interfere with other types of recreational activities (Tarver *et al.* 1986, Hoyer *et al.* 1996). Waterfowl consume the seeds, rhizomes, and bublets (tubers) of sago pondweed. Because sago pondweed is considered to be a valuable food plant for waterfowl, it has been widely planted beyond its original range (Muenscher 1944).

References:

Haynes, R. R. 1978. The Potamogetonaceae in the southeastern United States. Journal of the Arnold Arboretum 59:170-191.

Hoyer, M. V., D. E. Canfield, Jr., C. A. Horsburgh, and K. Brown. 1996. Florida Freshwater Plants - A Handbook of Common Aquatic Plants in Florida Lakes. University of Florida, Institute of Food and Agricultural Sciences, Gainesville, Florida

Madsen, J. D. and M. S. Adams. 1988. The generation of *Potamogeton pectinatus* tubers: Environmental control by temperature and light. The Canadian Journal of Botany 66: 2523-2526.

Muenscher, W. C. 1944. Aquatic Plants of the United States. The Vail-Ballow Press, Inc., Binghamton, New York.

Spencer, D. F. 1987. Tuber size and planting depth influence on growth of *Potamogeton pectinatus* L. American Midland Naturalist 118:77-84.

Spencer, D. F. and G. G. Ksander. 1992. Influence of temperature and moisture on vegetative propagule germination of *Potamogeton* species: Implications for aquatic plant management. Aquatic Botany 43:351-364.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Utricularia spp. (Bladderwort)

Family: Lentibulariacae

Home Range/Introduction:

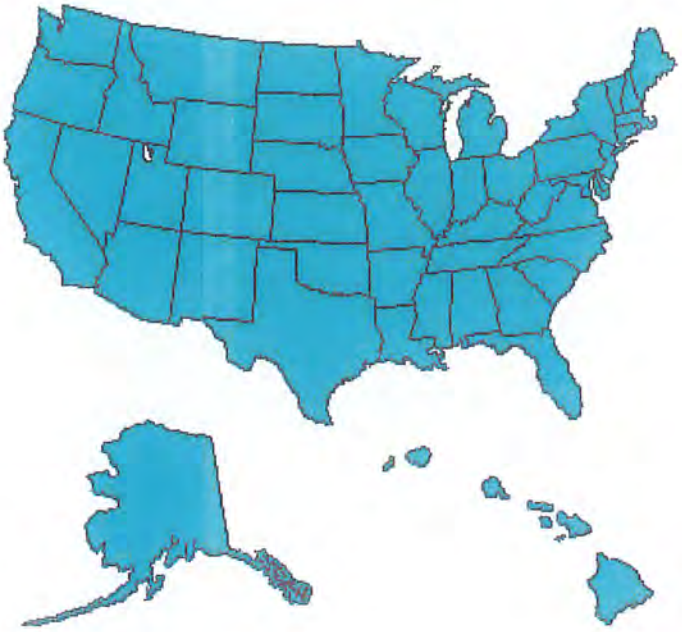
All of the 20 or so species of *Utricularia* in the United States are native. Species of *Utricularia* have highly specialized bladders that trap and digest small crustaceans. Most of the species grow in aquatic habitats and have an underwater portion that is branched and often forms a tangled mat. A few species are found in moist soil or along the margins of water and have subterranean vegetative branches (Godfrey & Wooten 1981).

U.S. Distribution (Based on published data collected in 1997):

U. gibba, U. inflata, U. purpurea

Utricularia spp.

U.S. Range Map:



Species Description:

Plants of bladderwort lack roots. The plant is comprised wholly of a stem system which bears bladders upon at least some of its parts. These bladders trap small animals which are therein digested. The plants of most species are submersed and free-floating or fixed by root-like appendages in the soil (thus appearing rooted). Stems are capillary-dissected, alternate or whorled. In a few species that grow within a soil substrate, emergent leaf-like branches are grass-blade-like or have a rosette of emergent obovate-spatulate to orbicular branchlets. The flowers are 1 to several on slender scapes that are above the water. In some species, the flowering scape has a whorl of inflated branchlets about midway its length. These float and hold the scape with its flowers above the water surface (*U. inflata* Walt., Floating bladderwort). The flowers are yellow (*U. inflata*, and *U. gibba* L., Cone-spur bladderwort), yellowish white, pink or purple (*U. purpurea* Walt., Purple bladderwort), often showy with a conspicuous projecting lower lip that is spurred at the base in front. A bract or a pair of bractlets sometimes are present on the flower stalks. The fruit is a capsule containing minute seeds.

Habitat/Growth Characteristics:

Plants may be found growing in ponds, lakes, on river shores, pools and ponds in woods, marshes, ditches, slow moving streams, and bogs. One species, *U. inflata,* is known to produce tubers. Some species form terminal winter buds or turions which are small, very crowded "leaves" by which the plants overwinter. Plants may also reproduce by seed and vegetatively by fragmentation (Tarver *et al.* 1986, Hoyer *et al.* 1996).

Problems:

In the southeastern United States, some species of Utricularia (e.g., *U. gibba*, *U. inflata*, *U. purpurea)* may form dense mats that interfere with boating and fishing, and in some instances, impede water flow in ditches and canals (Tarver *et al.* 1986).

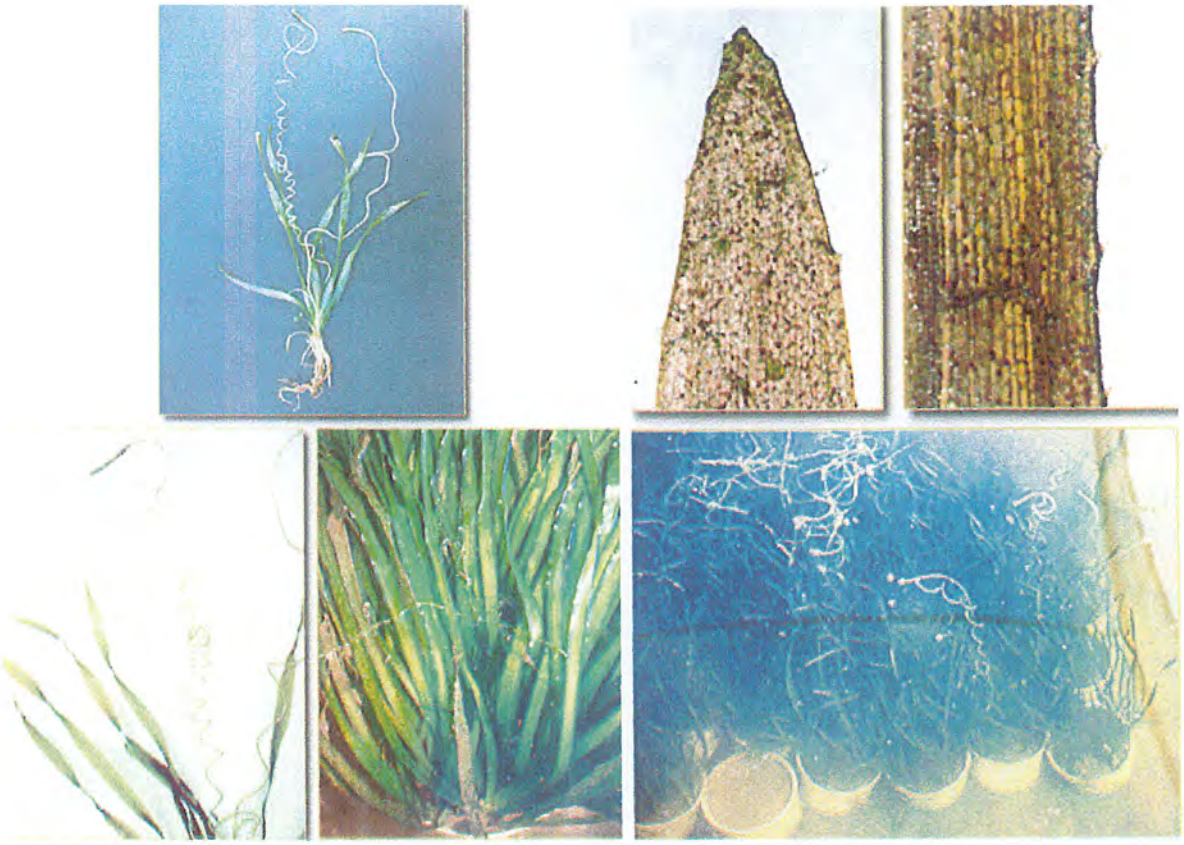
References:

Hoyer, M. V., D. E. Canfield, Jr., C. A. Horsburgh, and K. Brown. 1996. Florida Freshwater Plants - A Handbook of Common Aquatic Plants in Florida Lakes. University of Florida, Institute of Food and Agricultural Sciences, Gainesville, Florida.

Godfrey, R. K. and J. W. Wooten. 1981. Aquatic and Wetland Plants of Southeastern United States. Dicotyledons. The University of Georgia Press, Athens, Georgia.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Vallisneria americana Michx. (Eel-Grass)



Synonym(s): *Vallisneria asiatica* Michx.

Vallisneria neotropicalis Victorin

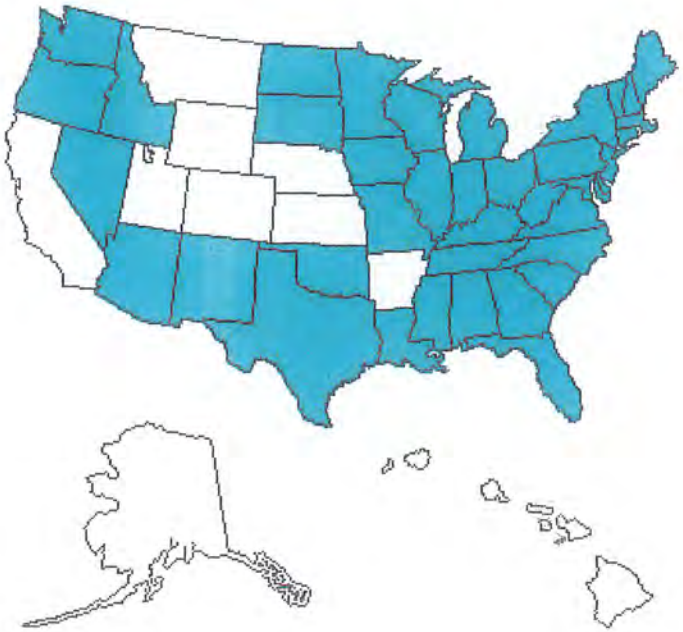
Vallisneria spiralis auct. non L.

Family: Hydrocharitaceae

Home Range/U.S. Introduction:

Vallisneria americana Michx. is thought to be native and is found in much of the eastern and midwestern United States. Robust plants from parts of Florida are sometimes considered to be a separate species (*Vallisneria neotropicalis* Marie-Victorin). Godfrey & Wooten (1979) question the distinctness of the latter species and attribute the difference in size to the constant water temperature of springs that allow for continuous growth over a longer time period than in more temperate areas of the United States. Eel-grass is sometimes sold as an aquarium plant.

U.S. Range Map:



Species Description:

Plants grow beneath the water surface, except for longer leaves which may have tips floating on the water surface. Plants are rooted in the substrate and produce stolons that have thickened tuber-like buds at the tips late in the growing season. Leaves are long and ribbon-like, 0.5 to 2.5 cm wide, arising close together (i.e., rosettes) from a short vertical stem and appearing basal. The leaves are thin and appear very fine lined with no midrib and with irregular darker green partial cross lines. Leaf margins are serrate, the tips obtuse. Plants are dioecious with the short stalked male inflorescence at the base of the plant. Female flowers have 3 sepals and 3 white petals and are borne singly from the axils of leaves on a stalk as long or longer than the leaves. After pollination, the flower stalk coils and pulls the fruit beneath the water surface. The fruit is a long-cylindrical capsule with 250 to 500 seeds. The seeds are shed in a mass of gelatinous material.

Habitat/Growth Characteristics:

Plants grow in quiet water of clear lakes and flowing water of springs and spring fed streams, clear streams and small rivers. Reproduction is by seed and rhizome fragmentation (Tarver *et al.* 1986). Plants also spread by stolons which give rise to new plants.

Problems:

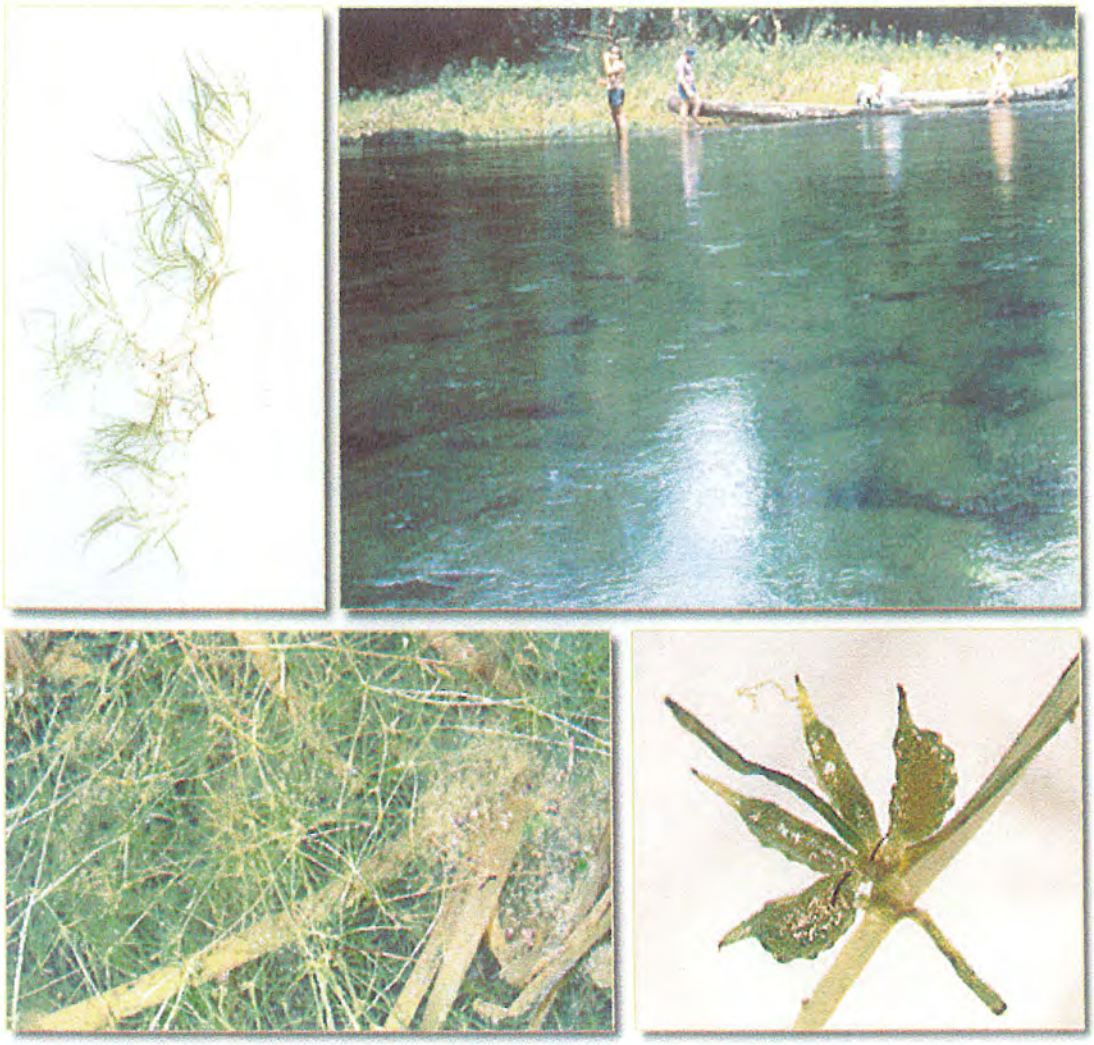
Large colonies of eel-grass sometimes interfere with boating and fishing. However, it is a valuable waterfowl food (Tarver *et al.* 1986) and is sometimes planted for wildlife and fish habitat.

References:

Godfrey, R. K. and J. W. Wooten. 1979. Aquatic and Wetland Plants of Southeastern United States. Monocotyledons. The University of Georgia Press, Athens.

Tarver, D. P., J. A. Rogers, M. J. Mahler, and R. L. Lazor. 1986. Aquatic and Wetland Plants of Florida. Third Edition. Florida Department of Natural Resources, Tallahassee, Florida.

Zannichellia palustris L. (Horned Pondweed)



Synonym(s): *Zannichellia major* (Hartman) Boenn. ex Reichenb.

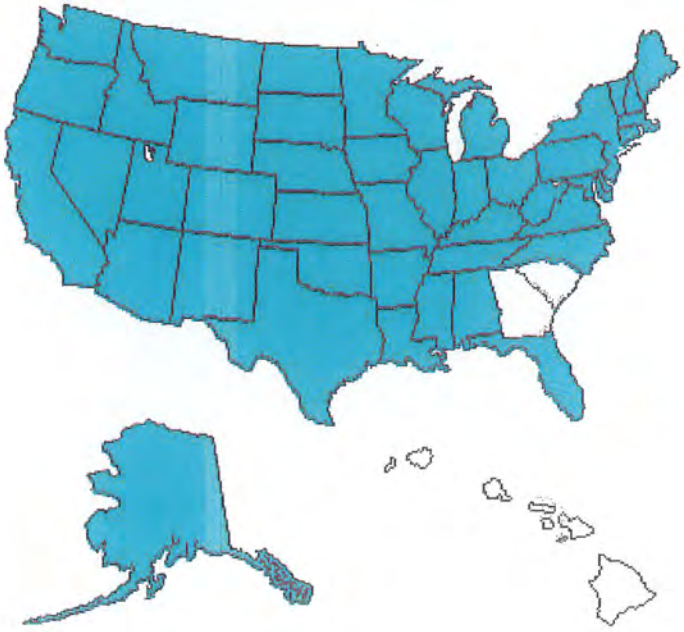
Family: Zannichelliaceae

Home Range/U.S Introduction:

Zannichellia palustris L. is native and widespread in the United States and has a near cosmopolitan distribution (Haynes and Holm-Nielsen 1987).

U.S. Distribution (Based on published data collected in 1997):

U.S. Range Map:



Species Description:

Horned pondweed is submersed with slender, creeping rhizomes (up to 6 dm long) and slender, upright stems. The opposite leaves sometimes appear whorled where branches depart are flat, filiform, about 0.5 mm wide and 2 to 10 cm long with sheathing stipules. The flowers are small, axillary, and lack sepals or petals. Mature fruits are on a short basal stalk, clustered, generally in groups of 2 to 6. Each fruit is slightly curved (2 to 4 mm long), with a short persistent style, and a keel that is entire or more frequently in the form of a toothed crest.

Habitat/Growth Characteristics:

Horned pondweed is found in both fresh (ponds, lakes, streams) and brackish water. Field observations in reservoirs of the Tennessee River system indicate that *Z. palustris* can overwinter as rhizomes that grow in the bottom sediments. Colonies appear to be somewhat localized and apparently spread from creeping rhizomes. Mature fruits are relatively common and presumably horned pondweed is dispersed and may regrow from seed. *Zannichellia palustris* is reported by Vierssen (1982) to have a predominantly annual life cycle in western Europe with the seeds requiring a stratification of two months at 4° C before germinating.

Problems:

Horned pondweed is not reported to cause major problems in the United States. However, it sometimes grows with other submersed species such as naiads and narrow-leaved pondweeds which cause problems in some areas. Brooks and Hauser (1978) indicate horned pondweed to be an important food for waterfowl in the early growing season (May).

References:

Brooks, R. E. and L. A. Hauser. 1978. Aquatic vascular plants of Kansas I: Submersed and floating leaved plants. Technical Publication No. 7. State Biological Survey of Kansas, Lawrence, Kansas.

Haynes, R. R., and L. B. Holm-Nielsen. 1987. The Zannichelliaceae in the southeastern United States. Journal of the Arnold Arboretum 68: 259-268.

Vierssen, W. V. 1982. Reproductive strategies of *Zannichellia* taxa in western Europe. In: Symoens, Hooper, and Compere (eds.), Studies of Aquatic Vascular Plants, Royal Botanical Society of Belgium, Brussels. pp. 144-149.