Connecticut's Invasive Aquatic Plant, Clam, and Mussel Identification Guide

3rd Edition

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The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875

The Connecticut Agricultural Experiment Station was founded in 1875. It is chartered by the General Assembly to make scientific inquiries and conduct experiments regarding plants and their pests, insects, soil and water, and to perform analyses for state agencies. Station laboratories or research farms are located in New Haven, Windsor, Hamden, and Griswold.

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Acknowledgements

The efforts of Dr. Robert Capers, Ms. Nancy Murray, Ms. Roslyn Reeps, Ms. Amy Weiss, Mr. Michael Cavadini, and Ms. Jennifer Fanzutti are gratefully acknowledged.

Bulletin No. 1056

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Introduction to Aquatic Plants

Aquatic plants are essential components of healthy ecosystems in lakes and ponds. They cleanse water and provide habitat for beneficial aquatic organisms. Because invasive species are not native, they have few natural enemies. Their dramatic growth rates can degrade native ecosystems, decrase recreational opportunities, and reduce local real estate values (Connecticut Aquatic Nuisance Species Working Group 2006, Fishman et al. 1998, Les and Mehrhoff 1999). Recent vegetation surveys of 227 lakes and ponds by the Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP) found invasive plants in nearly 60 percent of the waterbodies (CAES IAPP, 2018).

Approximately three-quarters of the invasive aquatic plant species in southern New England were introduced as cultivated plants (Les and Mehrhoff, 1999). These introductions come from dumping of aquariums and water gardening. Further spread is caused by recreational boating and plant fragments mixed with live bait used by fishermen (Couch and Nelson, 1985). Spread of invasive plants from one lake to another also occurs naturally by wildlife and downstream flow. Once established, eradication of invasive aquatic plants is extremely difficult. Preventing introductions by inspections, public education, early detection, and rapid response is critically important.

This guide is intended to provide information on the identification and distribution of the 22 aquatic plants listed as invasive or potentially invasive (Table 1) by the Connecticut General Statute (Sec. 22a-381d). The sale of these plants, with the exception of common water-hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*), is also banned by State Statute, and their transport is limited to activities associated with control and education. Fines of up to one hundred dollars can be imposed for each violation. Also included in this edition is information on the identification and distribution of invasive clams and mussels.

How to Use This Guide

Identifying Connecticut's freshwater aquatic plants is challenging. CAES IAPP surveys have found over 100 native species and 13 invasive species (Figure 1). We use many references when plant identification is questionable including; Crow and Hellquist (2000) and Fassett (1957), other recognized experts, and molecular identification using DNA sequencing. Some of the potentially invasive plants discussed here have never been documented in Connecticut and may be unfamiliar to readers. Certain invasive aquatic plants can be easily confused with native or other invasive plants so care must be taken to ensure accuracy. The places where plants are found are often related to their means of dispersal (Table 1), and sometimes this gives a clue to their identification.

This guide has many parts. Each plant has a summary page containing pictures, a list of key features, and a map of where the plant has been found by either CAES IAPP or the Invasive Plant Atlas of New England (IPANE, 2018). Other sources may have found some of the plants elsewhere, and the maps are not meant to suggest the plants are limited to the locations shown. There is a series of comparative pictures that help differentiate the invasive species from similar native plants, and there is a plant identification key that provides a step-by-step method for narrowing plants to their species. This key also includes native plants that are commonly mistaken for invasive species. A section is included on aquatic plant prevention and control. New to this edition is a section on invasive aquatic clams and mussels.

Table 1. Invasive and potentially invasive aquatic plants listed in the Connecticut General Statutes (Sec. 22a-381d).

#	Scientific Name	Common Name	Dispersal
1	*Butomus umbellatus*	Flowering rush	Water Gardening
2	*Cabomba caroliniana*	Fanwort	Aquariums, Boats/Trailers, Bait
3	*Callitriche stagnalis*	Pond water-starwort	Water Gardening
4	*Egeria densa*	Brazilian water-weed, Anacharis, Egeria	Aquariums, Boats/Trailers, Bait
5	*Eichhornia crassipes**	Common water hyacinth	Water Gardening
6	*Hydrilla verticillata*	Hydrilla	Aquariums, Boats/Trailers, Bait
7	*Iris pseudacorus*	Yellow iris, Yellow flag iris	Nursery Stock, Water Gardening
8	*Lythrum salicaria*	Purple loosestrife	Nursery Stock, Water Gardening
9	*Marsilea quadrifolia*	European waterclover, Water shamrock	Water Gardening, Boats/Trailers
10	*Myosotis scorpioides*	Forget-me-not, Water scorpion-grass	Water Gardening
11	*Myriophyllum aquaticum*	Parrotfeather	Aquariums, Boats/Trailers
12	*Myriophyllum heterophyllum*	Variable-leaf watermilfoil	Aquariums, Boats/Trailers
13	*Myriophyllum spicatum*	Eurasian watermilfoil	Aquariums, Boats/Trailers
14	*Najas minor*	Brittle water-nymph, Minor naiad	Boats/Trailers
15	*Nelumbo lutea*	American water lotus	Water Gardening
16	*Nymphoides peltata*	Yellow floating heart	Water Gardening
17	*Pistia stratiotes**	Water lettuce, Tropical duckweed	Water Gardening
18	*Potamogeton crispus*	Curlyleaf pondweed, Crispy-leaved pond-weed	Boats/Trailers
19	*Rorippa microphylla*	Onerow yellowcress	Water Gardening
20	*Rorippa nasturtium-aquaticum*	Watercress	Water Gardening
21	*Salvinia molesta*	Giant salvinia	Water Gardening
22	*Trapa natans*	Water chestnut	Water Gardening, Boats/Trailers

*Plants that are not banned

What to Do if You Find a Species Discussed in This Guide

Early detection and rapid response are important for preventing invasive aquatic species from becoming future problems. Before taking action, however, it is important that the plant be positively identified and the location accurately recorded. Latitude and longitude coordinates taken with a global positioning system (GPS) are best. Plant samples requiring further identification need to be mailed or taken to the CAES IAPP, 123 Huntington Street, New Haven, CT 06511, or another qualified entity such as the Connecticut Department of Energy and Environmental Protection (CT DEEP). You can call CAES IAPP at (203) 974-8512 with questions.

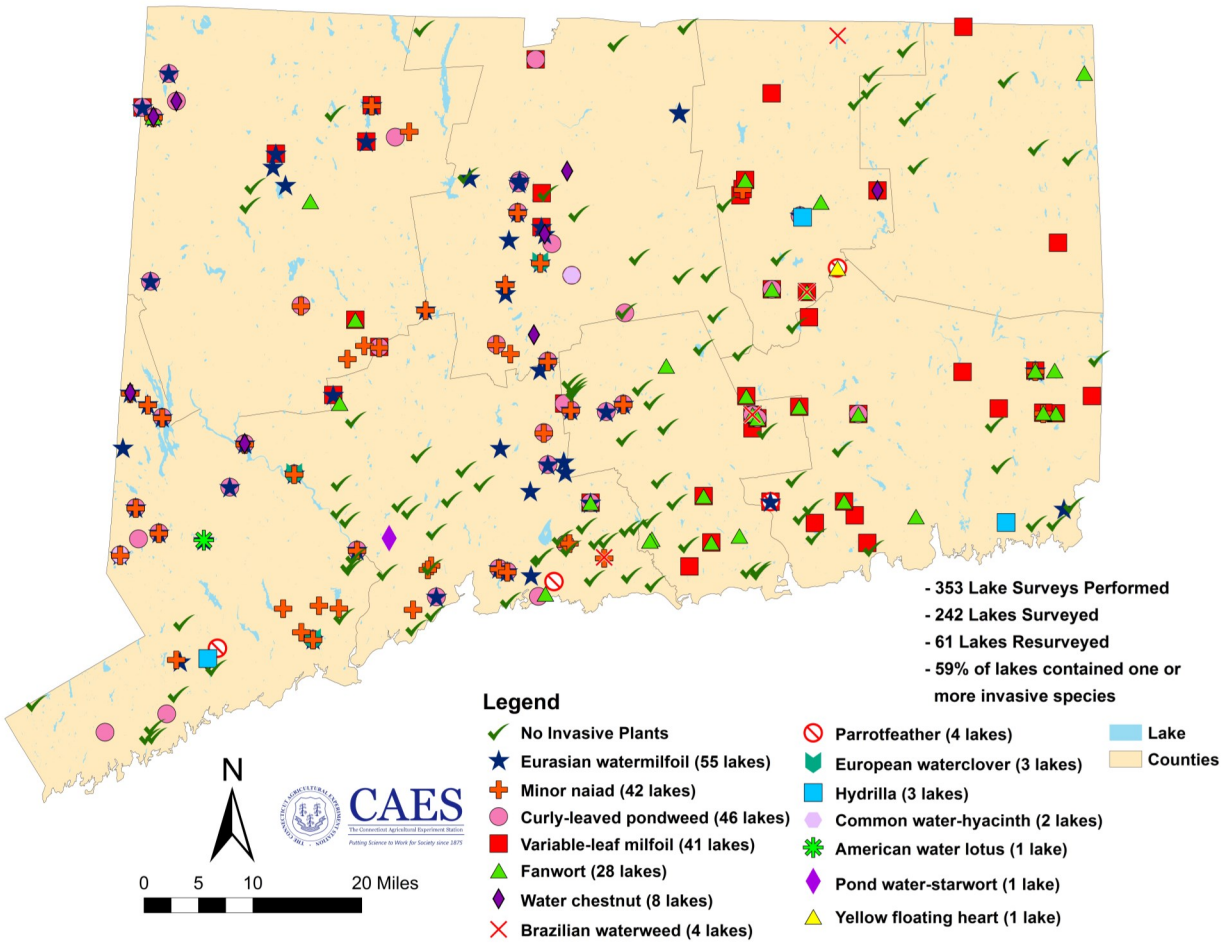


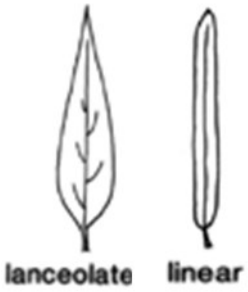
Figure 1. Locations of invasive aquatic plants found by CAES IAPP surveys from 2004-2018.

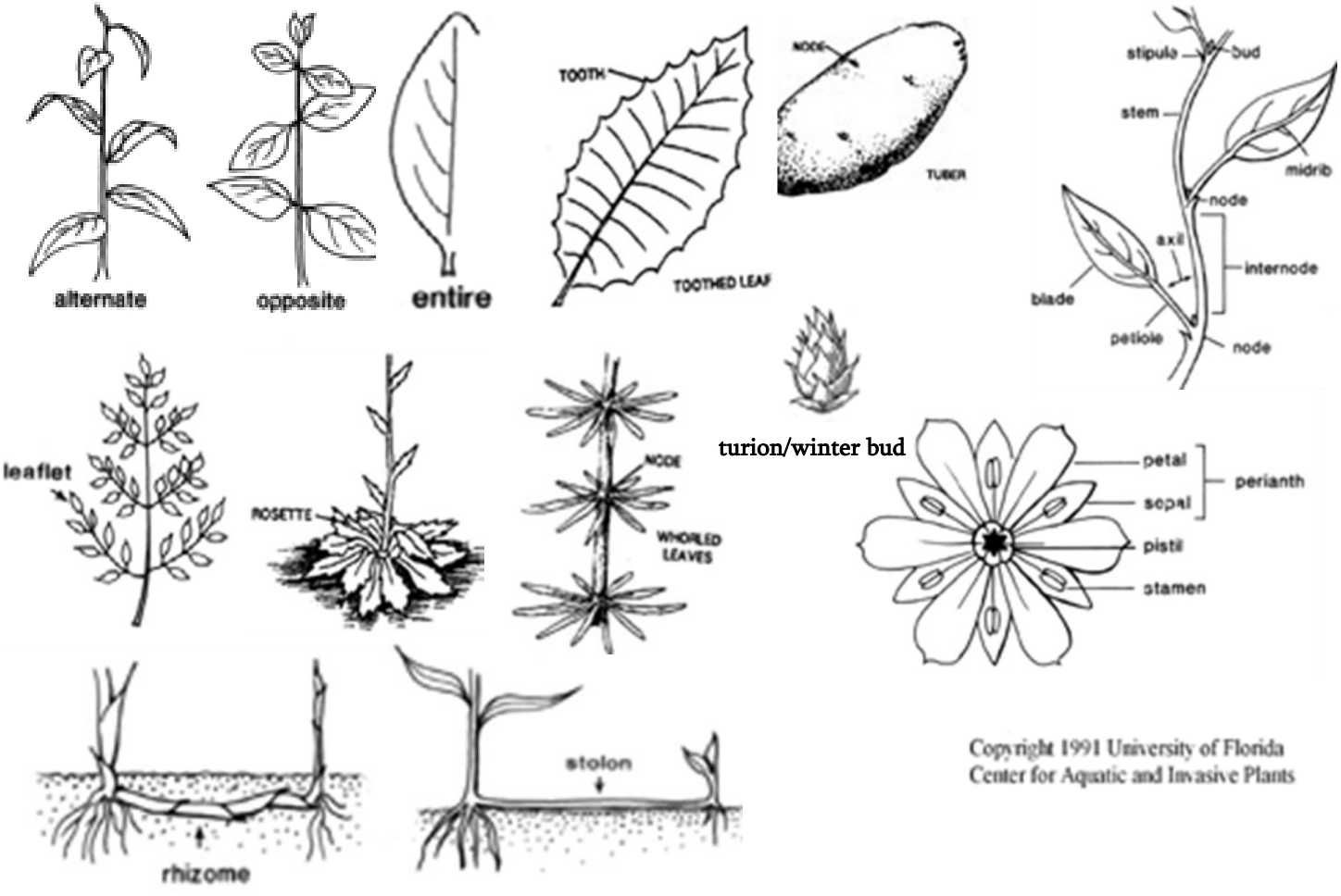
Additional Resources for Plant Identification

CAES IAPP web page, aquatic plant survey requests, online herbarium, and reprints of this guide
http://www.ct.gov/caes/IAPP
The Invasive Plant Atlas of New England
https://www.eddmaps.org/ipane/
Invasive Plants of the United States
http://www.invasiveplantatlas.org/
University of Florida, Center for Aquatic and Invasive Plants
http://plants.ifas.ufl.edu/
USDA National Invasive Species Information Center
http://www.invasivespeciesinfo.gov/

Definitions of Plant Terms

Alternate: leaves not directly across from each other on the stem
Dissected: leaf divided into many narrow segments; appear feathery, branched or forked
Entire: leaf not divided and margins not toothed
Forked: leaf divided into two or more equal segments
Lanceolate: lance-shaped, long, wider in the middle foliage
Leaflet: one of many leaf-like structures that make up a leaf
Margin: the edge or border of a leaf
Opposite: leaves are directly across from each other on the stem
Petiole: leaf stalk; stem-like structure that attaches a leaf to the stem
Pinnately compound: leaf containing many leaflets
Rhizome: underground stem often sending out roots and shoots from its nodes
Rosette: a dense cluster of leaves that are all at a single height, like petals of a rose
Stolon: above ground stem often sending out roots and shoots at nodes, also termed "runner"
Spike: unbranched continuation of the stem where flowers are located, usually located above the water
Tooth: points or lobes along a leaf margin
Tuber: modified, underground stem for starch storage and a form of vegetative reproduction
Turion: a modified leaf bud on a stem or shoot, a form of vegetative reproduction
Whorled: three or more leaves at the same node, forming a ring-like arrangement
Winter Bud: a modified leaf bud that survives the winter and facilitates vegetative reproduction





Butomus umbellatus

Common name:
Flowering rush

Origin:
East Asia

Key features:
Stems: Can be found along shorelines and into water 9 feet (3 m) deep

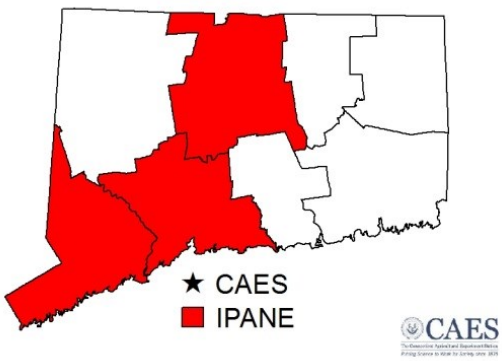
Leaves: Long, narrow, sword shaped leaves up to 3 feet (1 m) tall that originate at base. Leaves are fleshy with twisted ends, grass-like, cross section of leaves are triangular

Flowers: Inflorescence contains pink to white flowers 0.8-1.2 inches (2-3 cm) across with 3 petals and 3 sepals on a stalk that can be 3 feet (1 m) tall

Fruits/Seeds: Fruit is a follicle

Reproduction: Seeds and rhizomes

Easily confused species:
Bur-reeds: *Sparganium* spp.



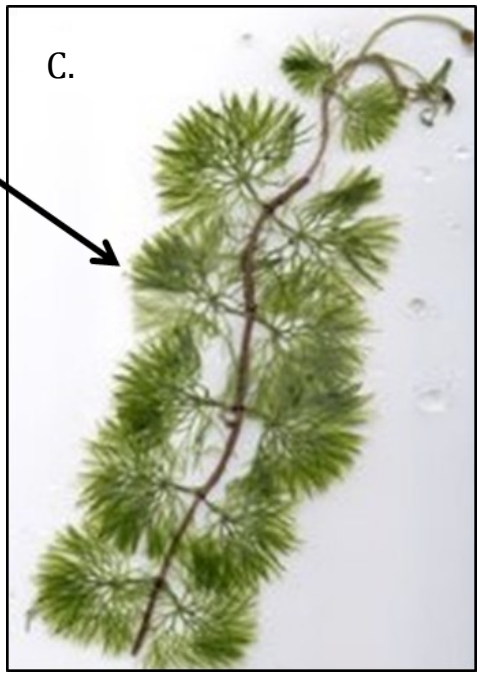
Cabomba caroliniana


Photo by CAES IAPP

Common names:
Fanwort
Carolina fanwort

Origin:
Southeast United States
South America

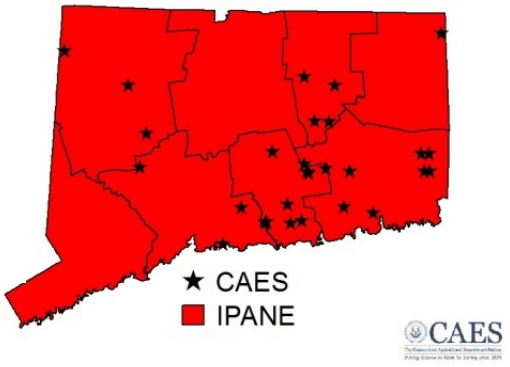
Key features:
Plants are submersed
Stems: Can be 6 feet (2 m) long
Leaves: Dissected, opposite leaves 0.8-2 inches (2-5 cm) are fan-like and made up of forked leaflets attached to the stem by a petiole. Floating leaves 0.2-0.8 inches (6-20 mm) wide are oblong and produced on flower shoots
Flowers: Small, solitary flowers are usually white to pinkish
Fruits/Seeds: Flask shaped
Reproduction: Seed and fragmentation



Easily confused species:
Watermilfoils: *Myriophyllum* spp.
White water crowfoot: *Ranunculus longirostris*
Water marigold: *Megalodonta beckii*

A.

A. Copyright 1991 Univ. of Florida, Center for Aquatic and Invasive Plants
B. Copyright 2002 Univ. of Florida, Photo by A. Murray
C. Photo by A. Smagula



Callitriche stagnalis


Photo by CAES IAPP

Common name:
Pond water-starwort

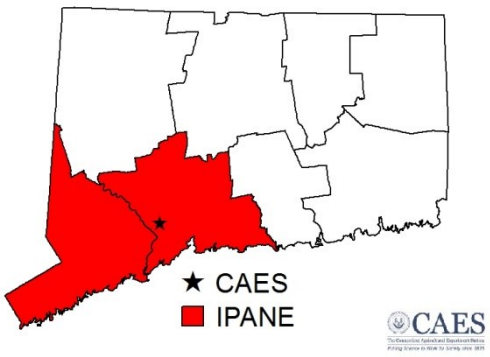
Origin:
Europe
North Africa

Key features:
Plants are submersed with floating rosettes
Stems: 4-12 inches (10-30 cm) long
Leaves: Floating leaves are opposite and oval or spoon shaped 0.8 × 0.1-0.3 inches (2 cm × 3-8 mm), submerged leaves are narrower and tend to be smaller
Flowers: Small with 2 small bracts at their base, flowers are close to each other at leaf bases for self-pollination
Fruits/Seeds: Round 0.06-0.08 inches (1.5-2 mm) thick forming 4 mericarps that have thin winged margins
Reproduction: Cloning and seeds


Photo by Clayton Antieau

Easily confused species:
Other *Callitriche* spp. (can only distinguish them by their fruit)


Photo by Leslie J. Mehrhoff



Egeria densa

Common names:
Brazilian waterweed
Brazilian elodea
South American waterweed

Origin:
South America

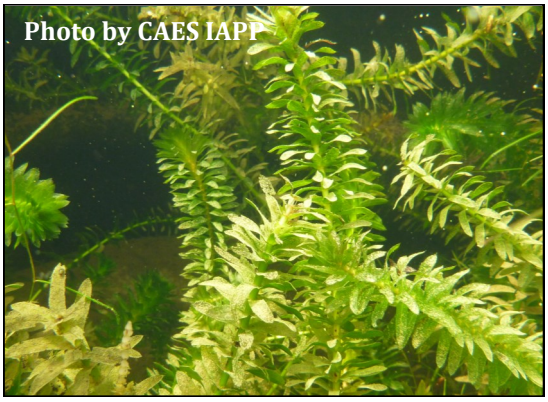
Key features:
Plants are submersed

Stems: Plant stems green, soft and typically 1-2 ft (0.3-0.6 m) long

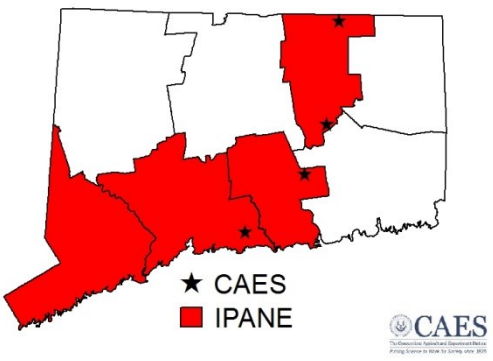
Leaves: Leaves entire 0.4-1.2 inches (1-3 cm) long by 0.2 in (5 mm) wide, leaves toothed (need magnification), leaves are whorled with typically 4 leaves per whorl

Flowers: Small white flowers with three petals, only staminate (male) flowers found in the US

Reproduction: Fragmentation



Easily confused species:
Waterweeds (Native): *Elodea nuttallii* and *E. canadensis*
Hydrilla: *Hydrilla verticillata*



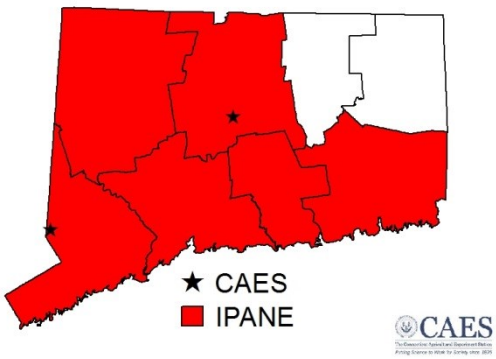
Eichhornia crassipes

Common names:
Common water-hyacinth
Floating water-hyacinth

Origin:
Brazil

Key Features:
Stems: Free floating plant
Leaves: Leaves are oval 1.6-4.7 inches (4-12 cm), thick, waxy and form a rosette, petioles are inflated which helps with floatation
Flowers: Flowers are light purple with one petal having a darker blotch with a yellow center 2.0-2.8 inches (5-7 cm)
Fruits/Seeds: Fruit is a capsule with ribbed seeds
Reproduction: Seeds and stolons

Easily confused species:
None



*Hydrilla verticillata**

Common name:
Hydrilla

Origin:
Asia

Key features:
Plants are submersed

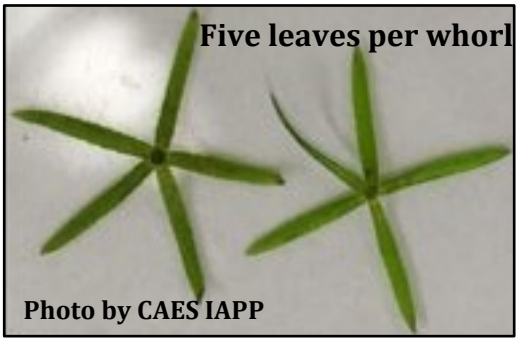
Stems: Slender, branched and up to 25 feet (7.5 m) long

Leaves: Whorled leaves approx. 0.7 inches (1.5 cm) long, whorls often have 5 leaves (range 4-8); leaf margins are visibly toothed

Flowers: Female flowers have three translucent petals that have reddish streaks; male flowers have three petals and can be white to red in color

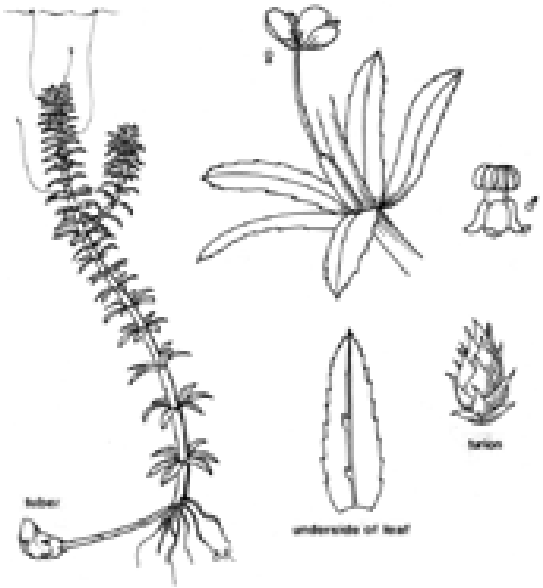
Fruits/Seeds: Small tubers (key feature) can be found in the sediment, turions form along the stem

Reproduction: Fragmentation, turions, tubers and seeds

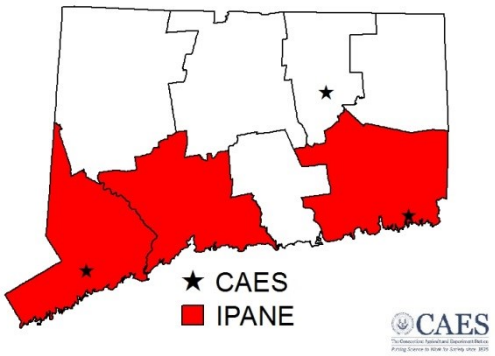


Easily confused species:
Waterweeds (Native): *Elodea nuttallii* and *Elodea canadensis*

Brazilian waterweed: *Egeria densa*



*This plant is extremely aggressive in the south-eastern U.S.. It is now established in the Connecticut and Silvermine river systems and is of great concern.



Iris pseudacorus

Common names:
Yellow iris

Yellow flag

Origin:
Europe
Western Asia

Northwest Africa

Key features:
Leaves: Sword shaped leaves are flattened with a raised mid rib and rise out of the soil, the tips of the leaves are pointed and arch over

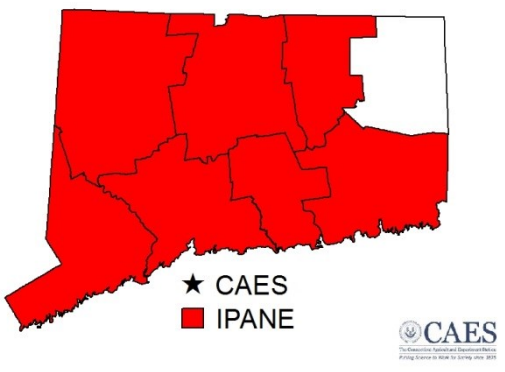
Flowers: Flowers are on peduncles 3-4 feet (1-1.3 m) tall. Several light to dark yellow flowers are on each stem with 3 small erect petals and 3 large downward sepals

Fruits/Seeds: Fruit is a capsule, seeds are brown

Reproduction: Seeds and rhizomes

Easily confused species:
Northern blue flag iris: *Iris versicolor*

Photo from Wikimedia commons



Lythrum salicaria

Common name:
Purple loosestrife

Origin:
Europe

Key features:
Stems: Plants have herbaceous stems and can grow 1.5-5 feet (0.5-1.5 m) tall

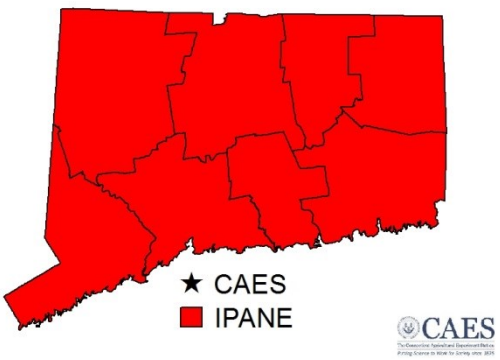
Leaves: Opposite, or in whorls of 3, 1-4 inches (3-10 cm) long, linear, or lanceolate in shape, leaves can be smooth or hairy

Flowers: Large, pink-purple flowers clustered on long terminal spikes 4-16 inches (10-40 cm) long, floral tube is twice as long as it is wide and typically has 6 petals

Fruits/Seeds: Fruit is a two cavity capsule with numerous reddish-brown seeds

Reproduction: Seed

Easily confused species:
Winged loosestrife: *Lythrum alatum*



Marsilea quadrifolia

Common names:
European waterclover
Water shamrock

Origin:
Europe

Key features:
Floating leaf plant

Stems: Smooth petioles 2-12 inches (5-30 cm)

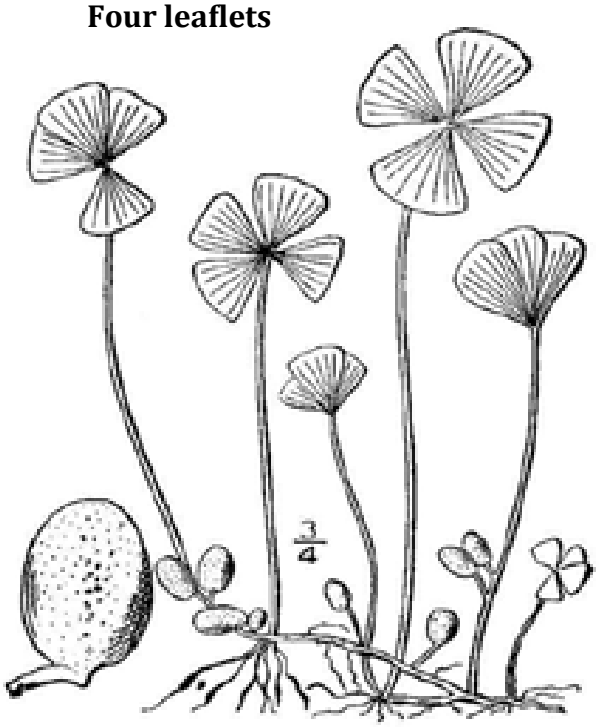
Leaves: Comprised of 4 fan-shaped leaflets (similar to a four-leaf clover)

Fruits/Seeds: 2 or 3 dark brown sporocarps 0.2 inches × 0.2 inches (4-5.5 mm × 3-4 mm)

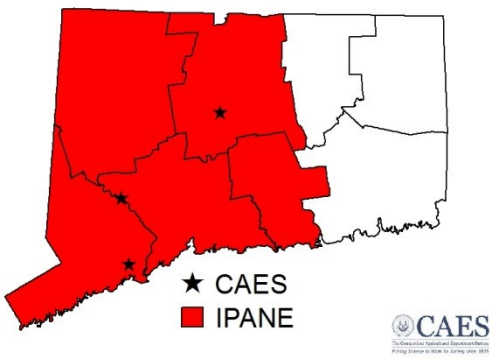
Reproduction: Cloning and sporocarps

Easily confused species:
None

Four leaflets



Britton, N.L., and A. Brown. 1913



Myosotis scorpioides


Photo by Stacey Leicht

Common names:
Forget-me-not
Yellow eye forget-me-not
Water scorpion-grass

Origin:
Europe
Western Asia

Key features:
Plants grow 8-24 inches (20-60 cm) in height

Stems: Stems are angled, often creeping

Leaves: Lower leaves are tapered to the base while the upper leaves are more oblong, leaves are alternate, with short hairs

Flowers: Flowers are flat and are typically blue with a yellow center, 0.2-0.4 inches (6-9 mm) wide, along a simple inflorescence with a common axis

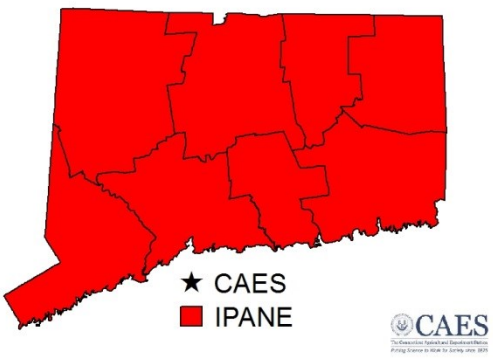
Fruits/Seeds: Seeds are contained in a nutlet that is angled and keeled on the inner side

Reproduction: Seeds

Easily confused species:
Bay forget-me-not: *Myosotis laxa*


From USDA – NRCS Plants Database


Photo by Stacey Leicht



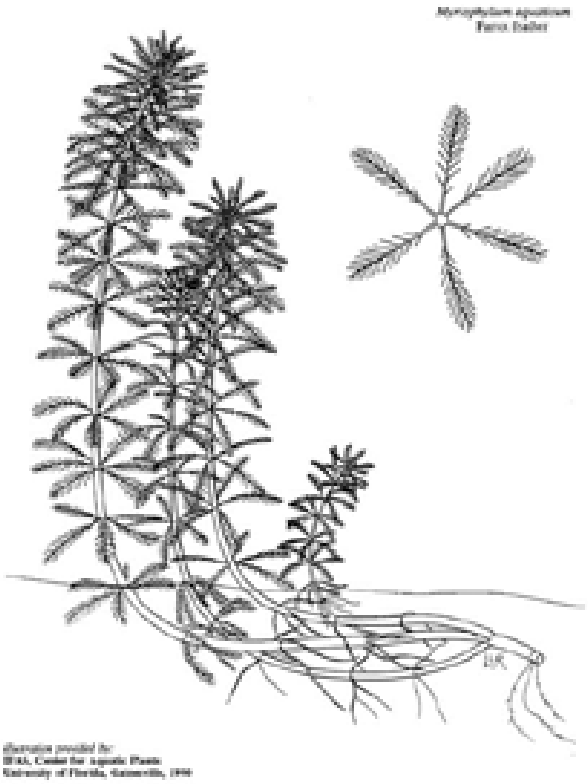
Myriophyllum aquaticum

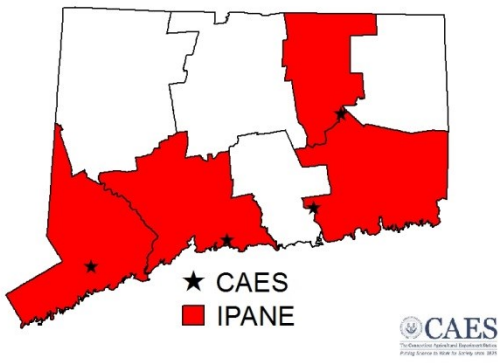
Common names:
Parrotfeather
Brazilian watermilfoil

Origin:
Amazon River basin

Key features:
Plants occur mostly above the water's surface
Stems: Thick red stems, sometimes green
Leaves: Leaves are a blue-green color and have a feathery appearance, leaves are whorled, dissected with rounded tips
Flowers: Flowers have white sepals and no petals (only females found in the US)
Fruits/Seeds: 0.06-0.08 inches (1.5-2 mm) long
Reproduction: Fragmentation

Easily confused species:
Eurasian watermilfoil: *Myriophyllum spicatum*
Variable-leaf watermilfoil: *Myriophyllum heterophyllum*





Myriophyllum heterophyllum

Common names:
Variable-leaf watermilfoil
Variable watermilfoil
Two-leaf watermilfoil

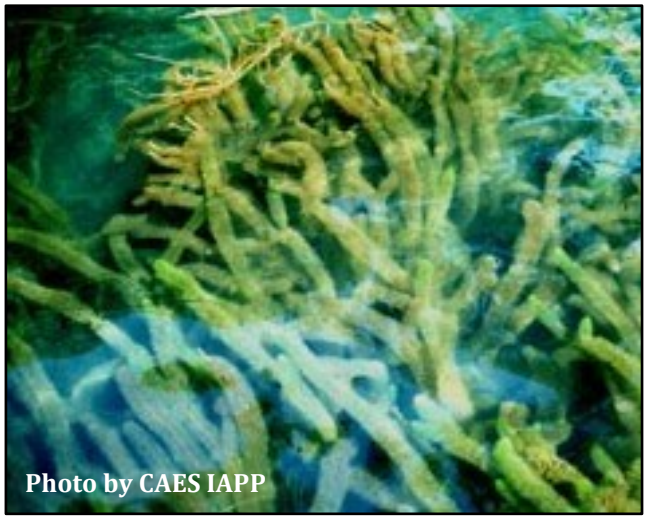


Photo by CAES IAPP

Origin:
Southern United States

Key features:
Plants are submersed

Stems: Dark brown stems extend to the water's surface and spread to form large mats

Leaves: Triangular with ≤ 11 pairs of leaflets. Leaves are dissected and whorled (4-6 leaves/whorl) resulting in a feathery appearance with leaf whorls < 1 inch apart giving it a ropy appearance

Flowers: Inflorescence spike 2-14 inches (5-35 cm) long extend beyond the water's surface with flowers in whorls of four with reddish petals

Fruits/Seeds: Fruits are almost round, with a rough surface

Reproduction: Fragmentation and seeds


Photo by D. Tenaglia
www.missouriplants.com

Easily confused species:
Eurasian watermilfoil: *Myriophyllum spicatum*
Low watermilfoil: *Myriophyllum humile*

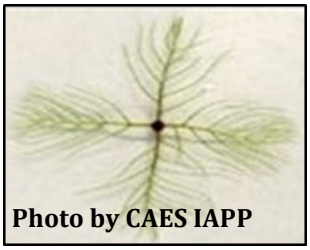
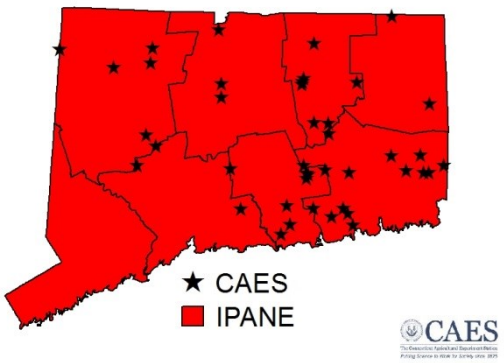


Photo by CAES IAPP


Leaves collapse out of water

Photo by CAES IAPP



Myriophyllum spicatum

Common name:
Eurasian watermilfoil

Origin:
Europe and Asia

Key features:
Plants are submersed

Stems: Stem diameter below the inflorescence is greater with reddish stem tips

Leaves: Leaves are rectangular with ≥ 12 pairs of leaflets per leaf and are dissected giving a feathery appearance, arranged in a whorl, whorls are 1 inch (2.5 cm) apart

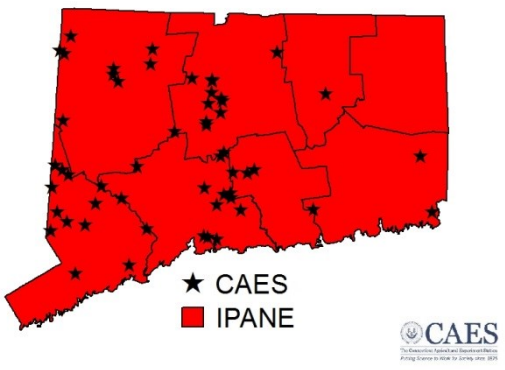
Flowers: Small pinkish male flowers that occur on reddish spikes, female flowers lack petals and sepals and have 4 lobed pistil

Fruits/Seeds: Fruit are round 0.08-0.12 inches (2-3 mm) and contain 4 seeds

Reproduction: Fragmentation and seeds

Copyright 1991 Univ. of Florida
Center for Aquatic and Invasive Plants

Easily confused species:
Variable-leaf watermilfoil: *Myriophyllum heterophyllum*
Low watermilfoil: *Myriophyllum humile*
Northern watermilfoil: *Myriophyllum sibiricum*
Whorled watermilfoil: *Myriophyllum verticillatum*



Najas minor

Common names:
Minor naiad
Brittle waternymph
Spiny leaf naiad
Eutrophic waternymph

Origin:
Europe

Key features:
Plants are submersed

Stems: Branched stems can grow up to 4-8 inches (10-20 cm) long

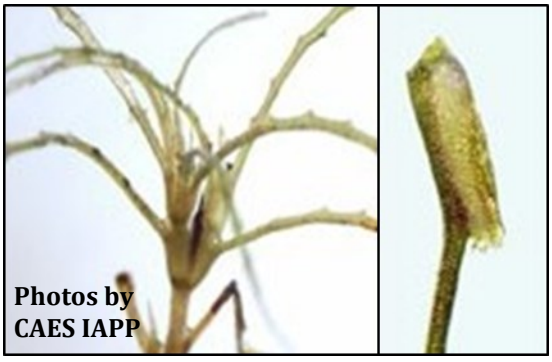
Leaves: Opposite and lance shaped on branched stems with easily visible toothed leaf edges and leaves appear curled under, basal lobes of leaf are also serrated, 0.01-0.02 inches (0.3-0.5 mm)

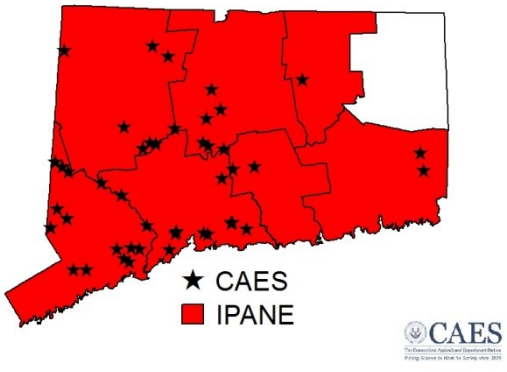
Flowers: Monoecious (male and female flowers on same plant)

Fruits/Seeds: Fruits are purple-tinged and seeds measure 0.03-0.06 inches (1.5-3 mm)

Reproduction: Seeds and fragmentation

Easily confused species:
Other naiads (native): *Najas* spp.





Nelumbo lutea

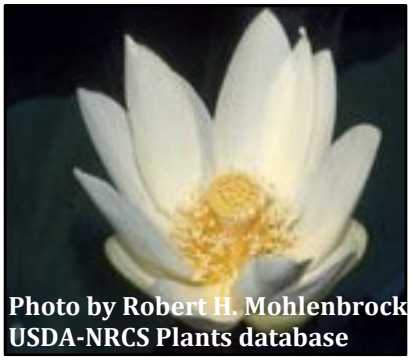


Photo by Robert H. Mohlenbrock
USDA-NRCS Plants database

Common name:
American water lotus

Origin:
Southeastern United States, Mexico, Honduras, and the West Indies


Photo by Anne Barkdoll

Key features:
Plants are on or above the water

Stems: Stiff stalk attaches to the center of the leaf

Leaves: Large, bluish-green, circular leaves with no "slit" like water lilies

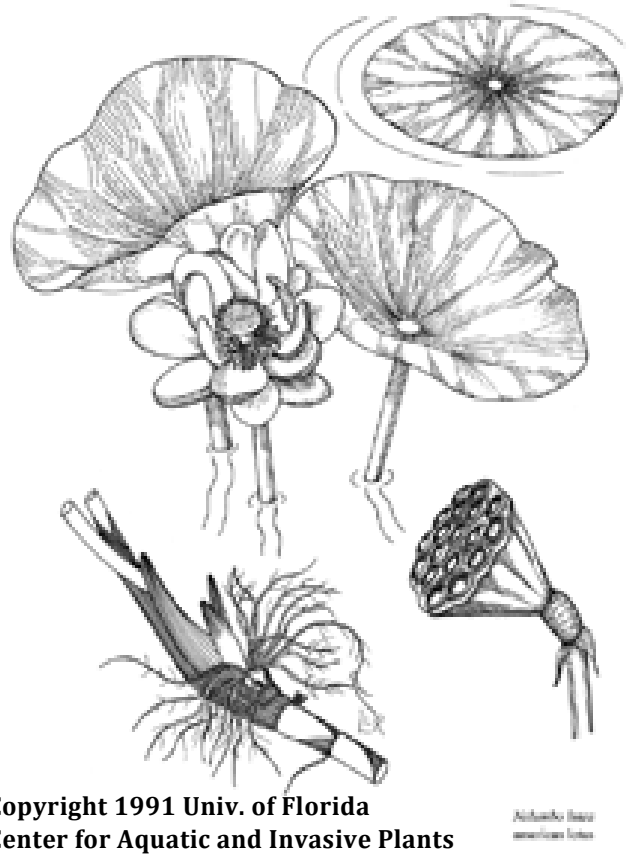
Flowers: White to yellowish flowers measure up to 8 inches (20 cm) wide

Fruits/Seeds: Seeds are nut-like and contained in a structure that resembles the top of a watering can

Reproduction: Seed


Photo by CAES IAPP

Easily confused species:
None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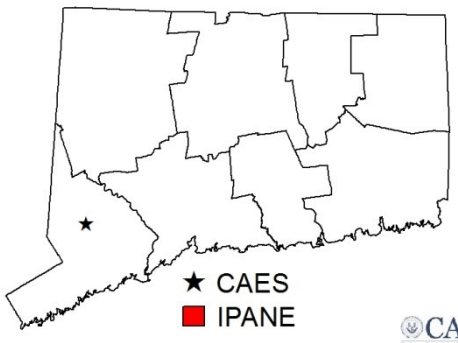


Nymphoides peltata

Common name:
Yellow floating heart

Origin:
Europe, Japan, China, and India

Key features:
Floating leaf plant

Stems: Branching stems spread over water's surface

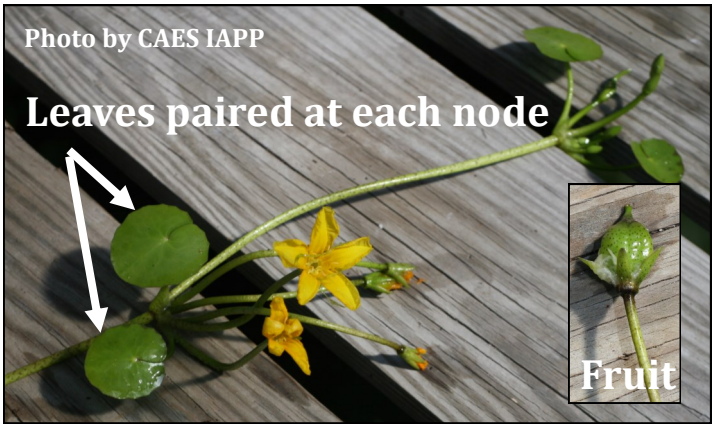
Leaves: Floating leaves are round and heart-shaped at base, paired at each node

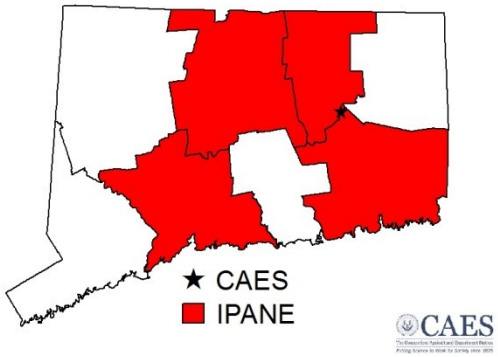
Flowers: Flowers are bright yellow on long peduncles with 5 fringed petals

Fruits/Seeds: Seeds are flat and oval and are in capsules

Reproduction: Seeds and rhizomes

Easily confused species:
Little floating heart: *Nymphoides cordata*
Yellow water lily: *Nuphar variegata*





Pistia stratiotes


Photo by Leslie J. Mehrhoff


Photo by Leslie J. Mehrhoff

Common names:
Water lettuce
Tropical duckweed

Origin:
Nativity unknown, but possibly
South America, Africa, Southeastern US

Key features:
Free floating plant that resembles a head of lettuce

Stems: Roots are long and feathery

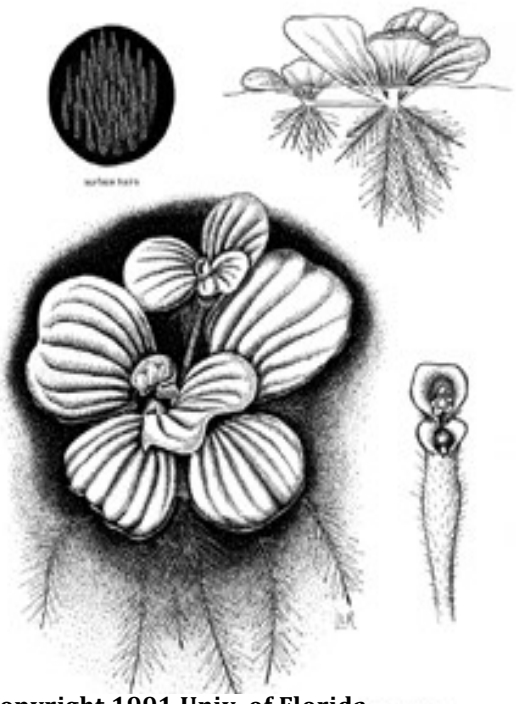
Leaves: Leaves are fleshy and covered with dense white hairs and have parallel venation

Flowers: Several male flowers form a whorl around a spike with one female flower below them

Fruits/Seeds: Fruit are light green berries that produce 0.04 inch (1 mm) brown seeds

Reproduction: Seeds and stolons

Easily confused with:
None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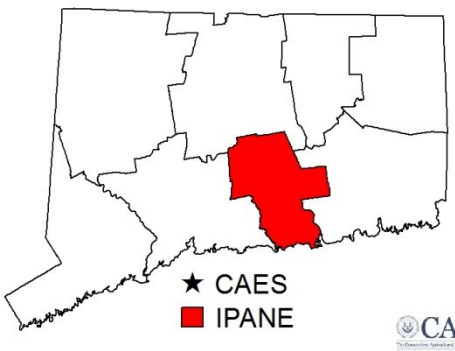


Potamogeton crispus


Photo by CAES IAPP

Common names:
Curly leaf pondweed
Crispy-leaved pondweed
Crisped pondweed

Origin:
Asia, Africa, and Europe

Key features:
Plants are submersed

Stems: Stems are flattened, can form dense stands in water up to 15 feet (5 m) deep

Leaves: Alternate leaves 0.3-1 inches (3-8 cm) wide with wavy edges (similar to lasagna) with a prominent mid-vein

Flowers: Brown and inconspicuous

Fruits/Seeds: Fruit is oval 0.1 inches (3 mm) long

Reproduction: Turions (right) and seeds

Easily confused species:
None

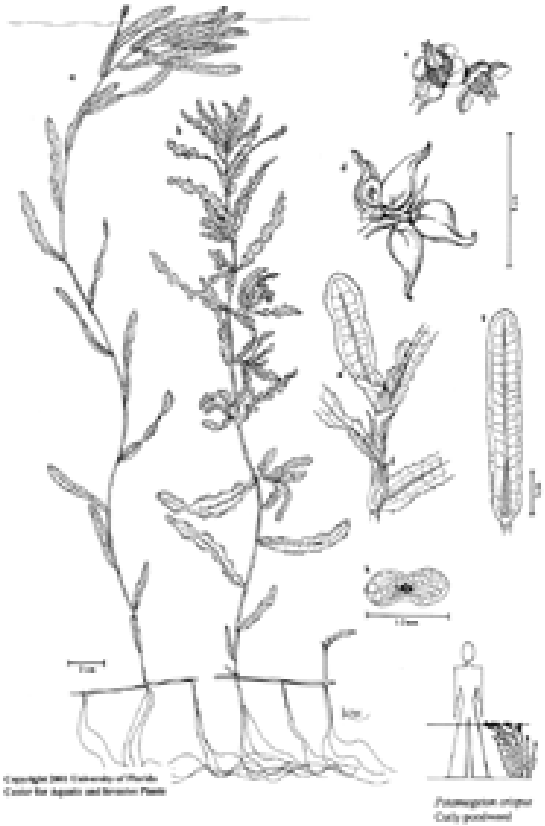
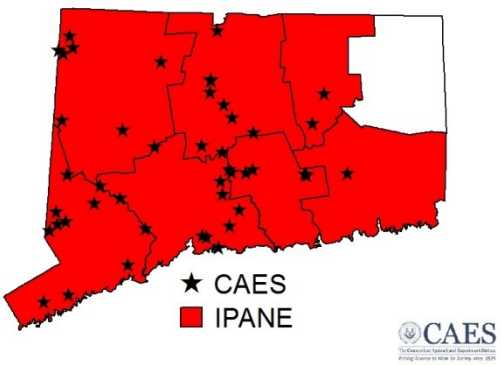



Photo by Leslie J. Mehrhoff



Rorippa microphylla

Common name:
Onerow yellowcress

Origin:
North Africa, Europe,
and the Middle East

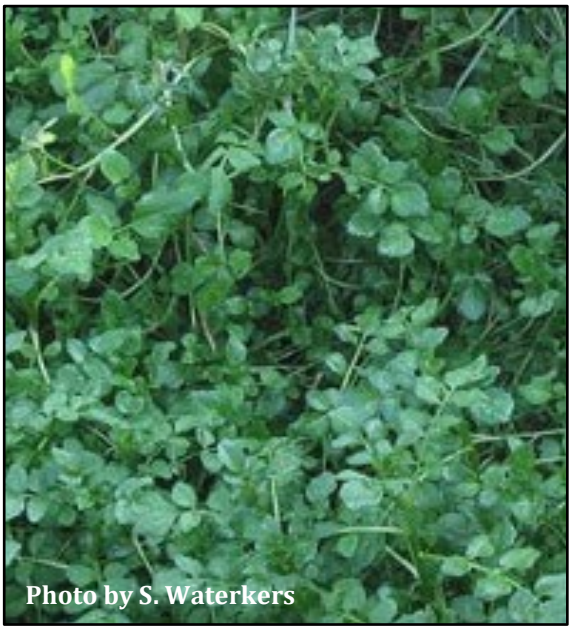
Key features:
Stems: Grows flatly across the ground and roots at nodes, forming large mats, can be fully to partially submerged

Leaves: Pinnate leaves with 3-9 segments and the terminal leaf is the largest

Flowers: White petals with 4 part perianth

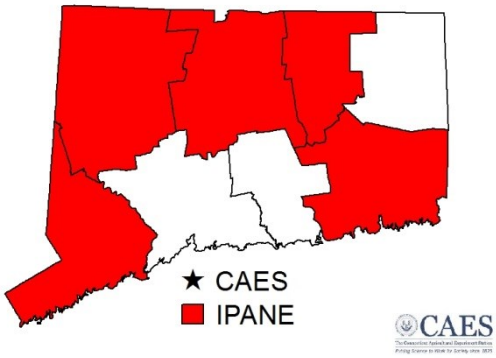
Fruits/Seeds: Fruit is a long and slender silique, up to 1 inch (25 mm) long, with seeds in one row on each side

Reproduction: Seed



Easily confused species:
Watercress: *Rorippa nasturtium-aquaticum*

Crow and Hellquist, 2000



Rorippa nasturtium-aquaticum


Photo by Christopher Christie


Photo by Jerry Drown

Common name:
Watercress

Origin:
North Africa, Europe, and the Middle East

Key features:

Stems: Hollow stems can grow flat on mud or be fully or partially submersed

Leaves: Leaves are pinnately compound have 3-9 segments and vary in shape, the terminal leaf is the largest in each segment

Flowers: Small white and green flowers; four white petals with four long and 2 short stamens

Fruits/Seeds: Fruit is pod-like silique, 0.4-0.6 in. (10-15 mm) long, with seeds in two rows per side

Reproduction: Fragmentation and seed

Easily confused species:
Onerow yellowcress: *Rorippa microphylla*

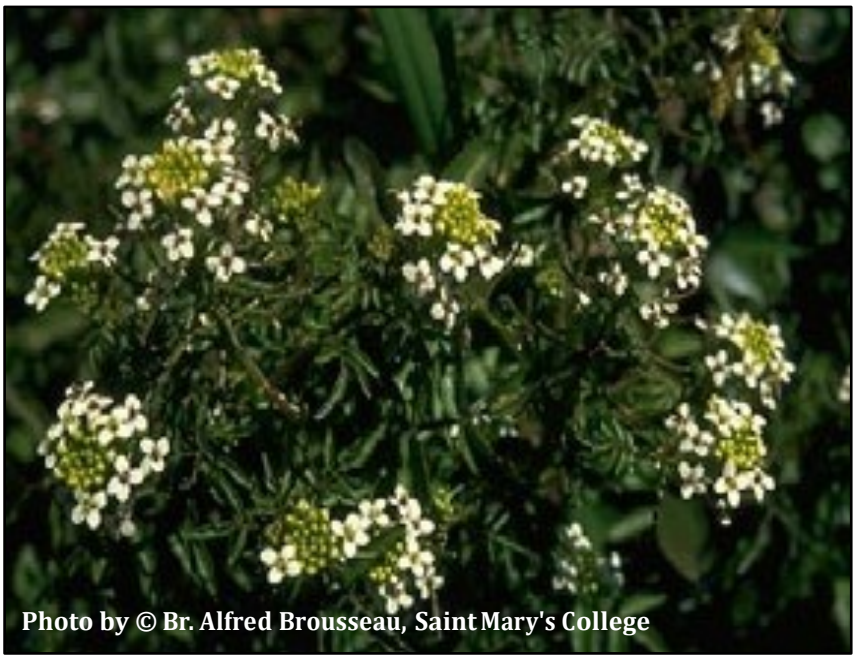
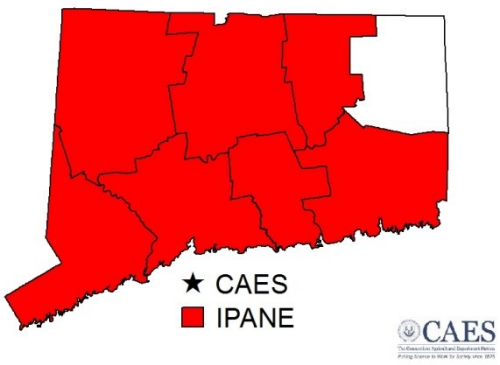


Photo by © Br. Alfred Brousseau, Saint Mary's College



Salvinia molesta

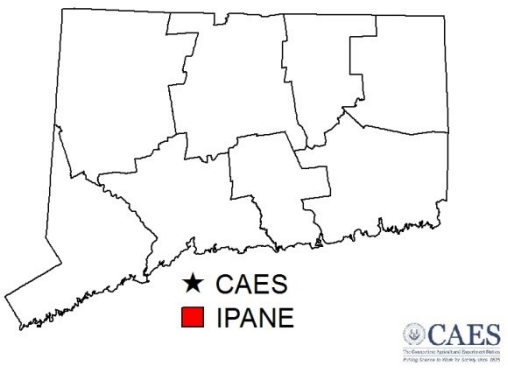
Common names:
Giant salvinia
Water fern
Salvinia
Kariba weed
Aquarium watermoss

Origin:
Brazil

Key features:
Free floating plant with no roots
Stems: Horizontal stems float below the surface
Leaves: Submersed leaves are brown and feather-like; surface leaves are folded at midrib and covered with many water repellent hairs that are split in the middle but rejoin at the tips; leaves become tightly packed into long chains as the plant grows
Fruits/Seeds: Egg shaped sporocarps
Reproduction: Fragmentation

Easily confused species:
None

Photo Credit A: Mic Julien, Commonwealth Scientific and Industrial Research Org., Bugwood.org



Trapa natans

Common names:
Water chestnut
European water chestnut

Origin:
Asia and Europe

Key features:
Plants are rooted to substrate and float

Stems: Stem is submersed, flaccid and can be up to 15 feet (5 m) long

Leaves: Leaves 0.8-0.16 inches (2-4 cm) long are triangular and toothed along the front edge with inflated petioles, leaves float in a rosette pattern

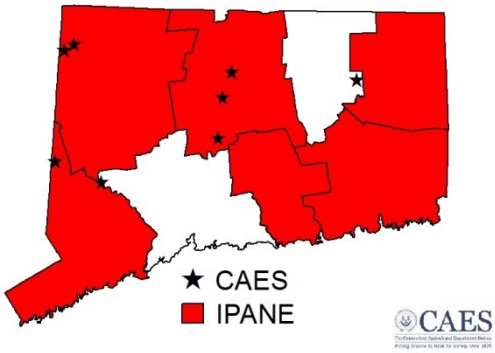
Flowers: Flowers are located in the center of the rosette and have four white petals

Fruits/Seeds: Fruit is hard and has four sharp spines

Reproduction: Seeds and fragmentation

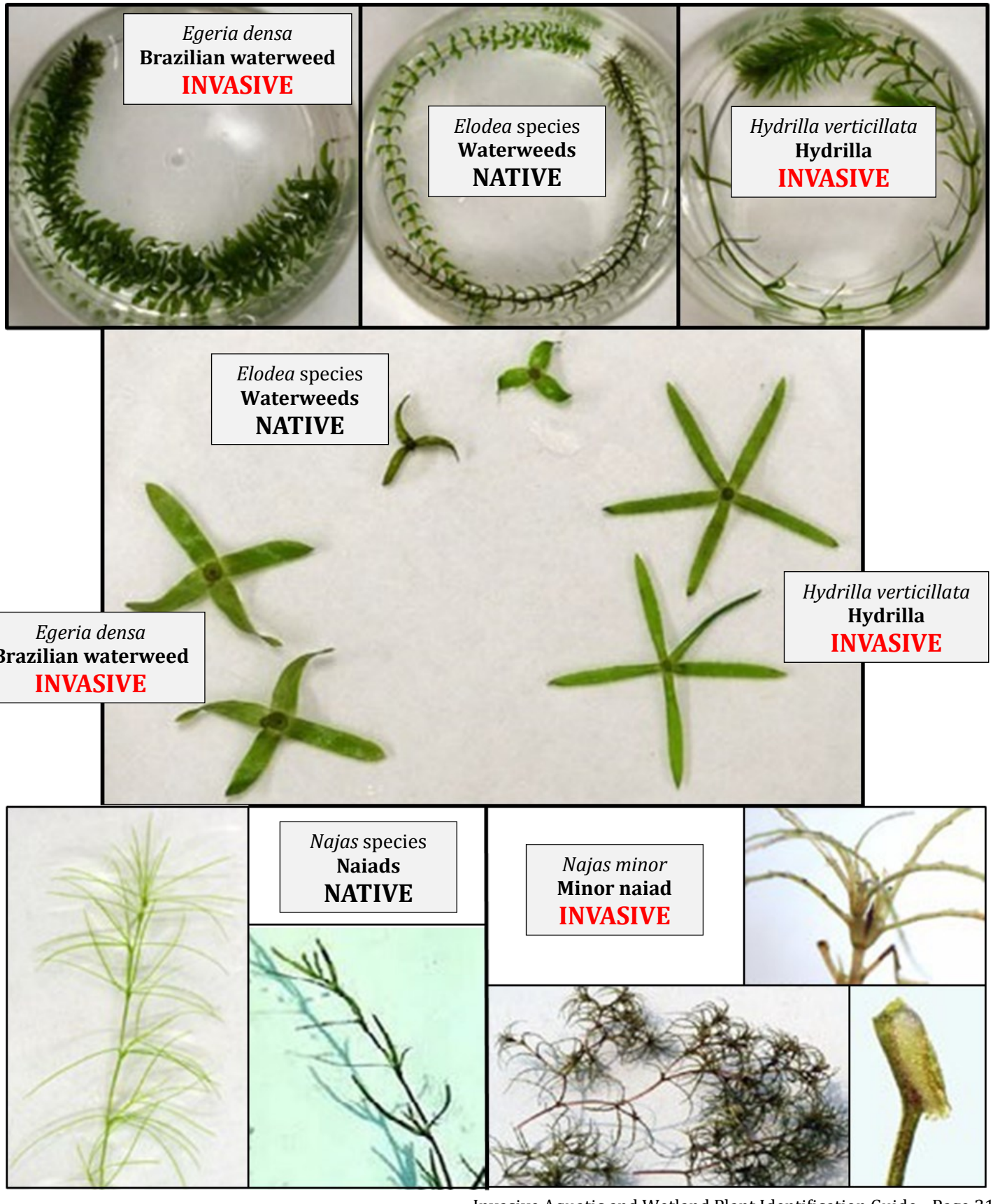
Easily confused species:
None

Fruit



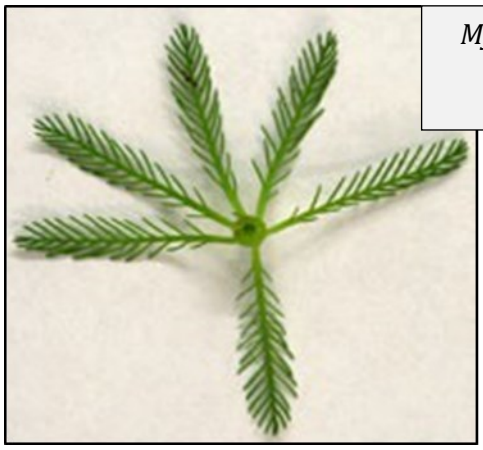
Commonly Confused Aquatic Plants
Submersed plants with non-dissected leaves

(all photos by CAES IAPP)

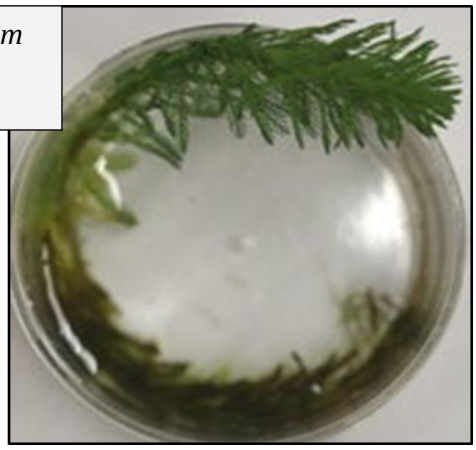


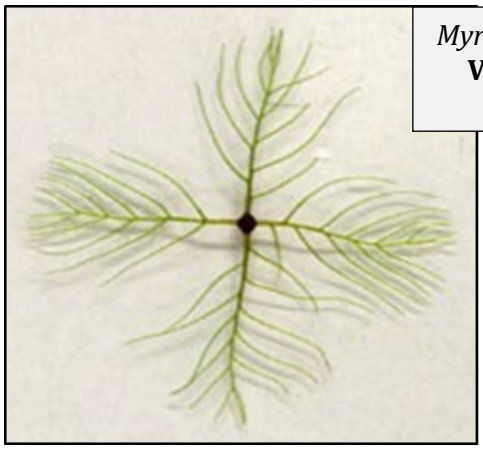
Submersed plants with feathery dissected leaves

(all photos by CAES IAPP)

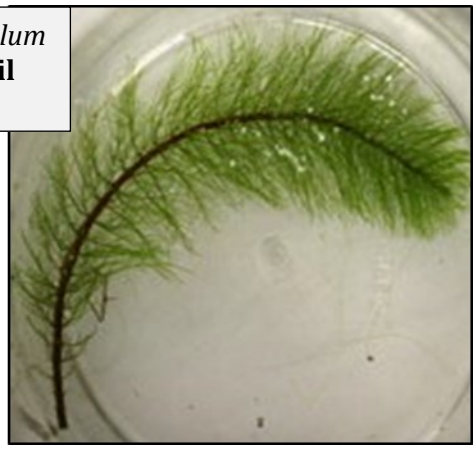


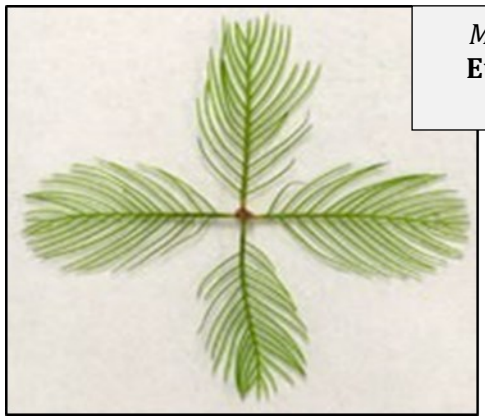
Myriophyllum aquaticum
Parrotfeather
INVASIVE





Myriophyllum heterophyllum
Variable Watermilfoil
INVASIVE



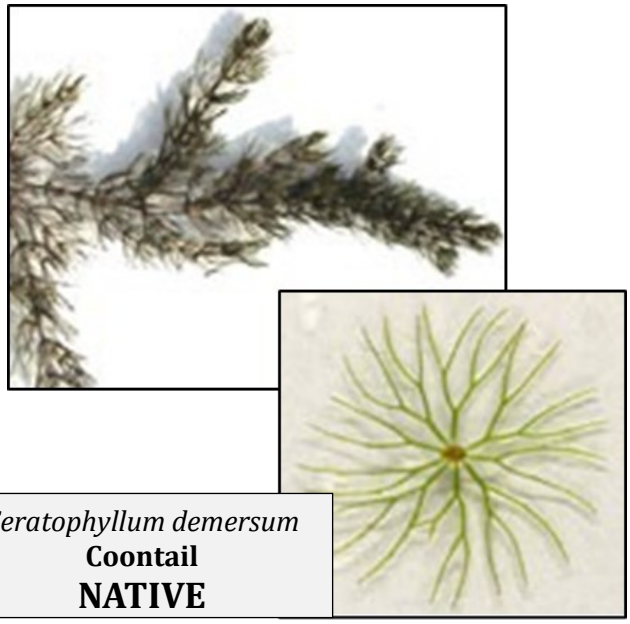


Myriophyllum spicatum
Eurasian watermilfoil
INVASIVE

NOTE: *Myriophyllum sibiricum*, Northern Watermilfoil, is a threatened native species that is easily confused with ***M. spicatum***. ***M. sibiricum's*** distinguishing features include less than 12 leaflet pairs per leaf, winter buds, and stem tips that are usually green instead of red.

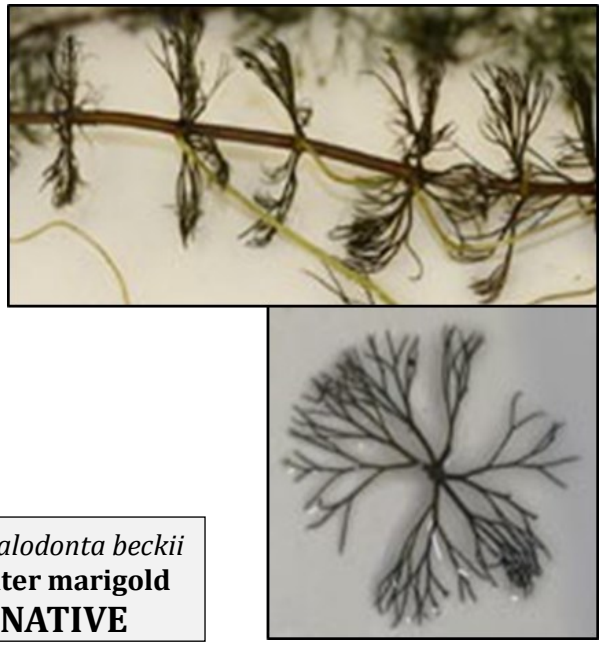
Submersed plants with forked and branched dissected leaves

(all photos by CAES IAPP except where noted)

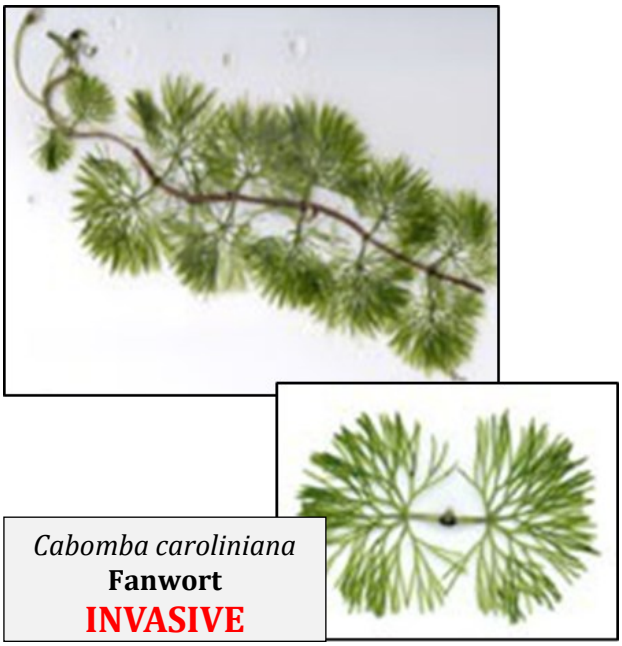


Ceratophyllum demersum
Coontail
NATIVE

Utricularia species
Bladderwort
NATIVE



Megalodonta beckii
Water marigold
NATIVE



Cabomba caroliniana
Fanwort
INVASIVE

Ranunculus species
Water-crowfoot
NATIVE

Key to Invasive or Potentially Invasive Aquatic Plants of Connecticut

Key also includes commonly confused native species

Floating-Leaf Plants (field characteristics)

1. Plants free-floating on water's surface, not rooted to the substrate*
   2. Leaves folded along midrib, surface covered with hairs……..***Salvinia molesta* (Giant Salvinia)**
   2. Leaves not folded, surface smooth
      3. Petioles inflated; oval leaves in a rosette; light purple flowers ……
      ……***Eichhornia crassipes* (Water Hyacinth)**
      3. Petioles not inflated; broad, fleshy leaves in a rosette, covered with dense white hairs.....
      ..... ***Pistia stratiotes* (Water Lettuce)**
1. Plants rooted in substrate
   4. Leaves forming a rosette; leaves triangular, toothed; petioles inflated; spiny fruit……..
   ..... ***Trapa natans* (Water Chestnut)**
   4. Leaves not forming rosette
      5. Leaves compound, cut into several leaflets
         6. Leaves comprised of four leaflets, like a four-leaf clover……
         ……***Marsilea quadrifolia* (European Waterclover)**
         6. Leaves pinnately compound with 3-9 leaflets, terminal leaflet is largest; hollow stems floating; small white and green flowers in clusters
            7. Pod-like fruit 0.4-0.6 inches (10-15 mm) long, 2 rows of seeds per side……
            ……***Rorippa nasturtium-aquaticum* (Watercress)**
            7. Pod-like fruit 0.7-1 inches (17-26 mm) long, 1 row of seeds per side……
            ……***Rorippa microphylla* (Onerow Yellowcress)**
      5. Leaves entire or lobed
         8. Leaves entire (no slit), circular, bluish green, on stiff stalk above water……
         ……***Nelumbo lutea* (Water Lotus)**
         8. Leaves lobed, heart shaped
            9. Yellow flowers
               10. Flowers with five, fringed petals……***Nymphoides peltata* (Yellow Floating Heart)**
               10. Flowers ball shaped, petiole flattened……***Nuphar variegata* (Yellow Water Lily)** (native)
            9. White flowers with five, fringed petals; roots close to the floating leaves, near the surface of the water……***Nymphoides cordata* (Little Floating Heart)** (native)

*Plants such as yellow and little floating heart and water chestnut can become free-floating when dislodged from sediment or detached from a rooted plant.

Submersed Plants (field characteristics)

1. Leaves entire, sometimes toothed
   2. Leaves alternate, with wavy edges (lasagna-like); turions may be present; prominent leaf mid vein..... ***Potamogeton crispus*** **(Curly Leaf Pondweed)**
   2. Leaves whorled, opposite, or clustered
      3. Leaf bases wider than the leaf blade, appearing opposite, whorled or clustered
         4. Toothed leaf edges visible without magnification..... ***Najas minor*** (**Minor Naiad**)
         4. Magnification needed to see toothed edge..... ***Najas*** **species** (**Other Naiads**) (native)
      3. Leaf base not distinct from rest of leaf blade, leaves strictly whorled
         5. Whorls of 3 leaves; leaf margins not toothed..... ***Elodea*** **species** (**Waterweeds**) (native)
         5. Whorls of 4 or more leaves; leaf margins toothed (magnification sometimes needed)
            6. Leaves 4 per whorl (rarely up to 6 leaves/whorl), 0.5-1.5 inches (1.2-4 cm) long, toothed leaf margins (need magnification)..... ***Egeria densa*** (**Brazilian Waterweed**)
            6. Leaves 5 per whorl (rarely 2-6 leaves/whorl), 0.2-0.7 inches (0.6-1.7 cm) long, toothed leaf margins; mid-vein may be toothed; tubers present; may have turions..... ***Hydrilla verticillata*** (**Hydrilla**)

1. Leaves dissected
   7. Leaves feathery in appearance (pinnate)
      8. Leaves concentrated above the water; thin, rounded-tipped, blue-green leaves..... ***Myriophyllum aquaticum*** (**Parrotfeather**)
      8. Leaves concentrated below the water, except for emergent flower spikes
         9. Leaf whorls less than 1 inch (2.5 cm) apart, giving the plant a ropy look; triangular shaped leaves, with less than or equal to 11 pairs of leaflets; thick spike with entire toothed leaves..... ***Myriophyllum heterophyllum*** (**Variable Watermilfoil**)
         9. Leaf whorls 1 inch (2.5 cm) apart; rectangular shaped leaves, with greater than or equal to 12 pairs of leaflets; thin spike with leaves smaller than flowers..... ***Myriophyllum spicatum*** (**Eurasian Watermilfoil**)
         9. Leaves rounded in whorls with less than 12 pairs of leaflets; winter buds..... ***Myriophyllum sibiricum*** (**Northern Watermilfoil**) (native, threatened)
   7. Leaves forked
      10. Leaves with numerous small bladders, not rooted... ***Utricularia*** **species** (**Bladderworts**) (native)
      10. Leaves lacking bladders
         11. Leaves alternate; petioles sheathing stem; flowers usually solitary..... ***Ranunculus*** **species** (**Water-crowfoot**) (native)
         11. Leaves opposite or whorled
            12. Leaves whorled; leaf divisions fork in pairs, forking a total of 1-4 times, leaves often toothed; no roots or flower spike..... ***Ceratophyllum*** **species** (**Hornworts**) (native)
            12. Leaves opposite, fan-shaped; leaf divisions fork into either 2 or 3 segments
               13. Leaves attached to the stem with petioles; small floating leaves; flowers white..... ***Cabomba caroliniana*** (**Fanwort**)
               13. Leaves not attached to the stem by a petiole, leaves opposite but appearing whorled; emersed leaves on spike entire to toothed; flowers yellow..... ***Megalodonta beckii*** (**Water Marigold**) (native, threatened)

Introduction and Dispersal of Aquatic Invasives

(all photos by CAES IAPP)

Aquariums and Water Gardens

Most of the invasive aquatic plants in Connecticut are thought to have been introduced via the release from aquariums or water gardens (Les and Mehrhoff, 1999). Although setting these plants "free" rather than disposing of them sounds like a good idea, it should be avoided. Because it is difficult to know what species you have and the designation of "non-invasive" is not always accurate, all aquarium and water gardening plants should be treated as invasive and disposed of properly. This includes, returning to a retailer, giving to well-informed aquarist or water gardener, or sealing in plastic bags for disposal in the trash. Also be aware that water gardens that are upstream from waterbodies are prone to releasing aquatic plants, fish and other species downstream during flooding events.

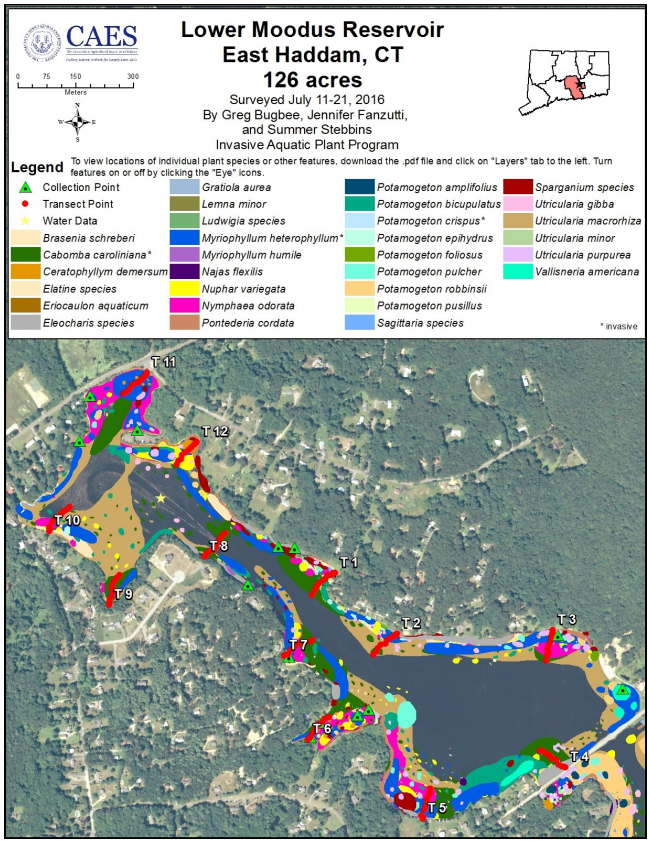
Clean, Drain, Dry

Proper boat and trailer cleaning is an important way to prevent the spread of aquatic invasive species. Many plants spread through fragmentation, so even a small piece stuck to a trailer can create infest a waterbody. Zebra mussels and other aquatic animals can also hitch a ride on boats and trailers to new locations. Best practices for boat and trailer cleaning include the Clean, Drain, Dry technique and disenfection. **Clean** all equipment, removing any visible mud, plants, fish or animals before leaving the launch site. **Drain** all water from boats and live wells at the launch site. **Dry** anything that comes into contact with water for a minimum of five days or wash with hot water that is at least 140 degrees F for a minimum of 30 seconds (preferably at high pressure). Boats, trailers, and equipment can be sprayed with a bleach solution (3 oz. per gallon) allowing ten minutes of contact time prior to rinsing. Equipment can also be dipped into 100% vinegar for 20 minutes. The CT DEEP has more information on aquatic hitchhikers (http://www.ct.gov/deep/cwp/view.asp?a=2696&q=322690&deepNav_GID=1630).

Managing Nuisance Aquatic Vegetation in Connecticut

(all photos by CAES IAPP)

Invasive Aquatic Plant Control



Aquatic vegetation proliferates in water with proper sunlight, chemistry, sediment and freedom from antagonistic organisms. Managing invasive aquatic plants usually requires a multifaceted approach. It is important to accurately identify the species present. This can be accomplished through an aquatic plant survey (top right). Sometimes nuisance plants, such as lily pads, are native. Although they may need to be managed, their removal could result in replacement with more problematic invasive species. In addition, certain native plants may be highly beneficial or rare and warrant protection. Combinations of management techniques that adapt to yearly changes are usually most effective. This discussion of invasive aquatic plant control is intended to be introductory in nature. The Aquatic Ecosystem Restoration Foundation (2014) has an online guidebook that details the subjects discussed below (http://www.aquatics.org/aerf_handbook.pdf).

Nutrient Reduction

Because nuisance aquatic vegetation is stimulated by nutrients, especially phosphorus and nitrogen, reducing the amount of these elements reaching a water body is an important part of any management program. Public education on preventing septic tank failures (bottom right) and use of fertilizers is important. Using soil tests to determine nutrient needs helps assure fertilizer is used at the proper rates and at the right time. Recent legislation in Connecticut has banned phosphorus from fertilizers used on established lawns unless substantiated by a soil test. CAES tests soil for citizens (www.ct.gov/caes). Unfertilized vegetated buffer zones along shorelines are effective in limiting the movement of fertilizer to ponds and lakes. The misapplication of fertilizer to pavement is of concern because storm drains often discharge into lakes and ponds.

Water Level Drawdown

Lowering the water level of a lake or pond can expose unwanted vegetation to lethal drying and freezing conditions. Where water level drawdown is feasible, this is a cost effective aquatic plant management technique. Non- target plants and other aquatic organisms, however, can be negatively impacted. Usually drawdowns are performed in the winter when recreational use is minimal. Warm winters, snow cover and groundwater seepage can prevent necessary freezing and drying. Minor naiad (*Najas minor*) seems tolerant to drawdown probably because it regrows from seeds each year. Care needs to be taken to properly assess the refill time. If the body of water is not filled by spring problem vegetation can expand into areas where plant growth is normally limited by light penetration. A side benefit of winter drawdown is docks and other shoreline structures are protected. CAES IAPP has been monitoring the effects of the annual drawdowns on Candlewood Lake (above) since 2007 and found good control of Eurasian watermilfoil (*Myriophyllum spicatum*) in the drawdown year (CAES IAPP, 2018). Drawdowns may require permits from local, state or federal agencies.

Herbicides

Managing invasive aquatic plants with herbicides is sometimes necessary. An aquatic herbicide must meet strict requirements of the United States Environmental Protection Agency and then be registered in the state where it is used. In Connecticut, aquatic herbicides may not be applied without obtaining a permit from the Connecticut Department of Energy and Environmental Protection (CT DEEP). Choosing the best herbicide requires proper plant identification, a sense for the non-target species you want to protect, the time of year you want to treat, potential water use limitations (i.e. drinking, swimming, irrigation etc.), and acceptance by stakeholders. There are two general types of herbicides, contact and systemic. Contact herbicides are usually quick acting but have little effect on roots and reproductive propagules such as seeds, turions and tubers. Regrowth, therefore, can be expected. Systemic herbicides are slower acting but have the capability of controlling the root system. Longer term control is possible but elimination of an invasive species is unlikely. The suppressive effect of herbicides often prevents further spread. Herbicides are available in liquid or granular forms (above). CT DEEP (2012) offers an online guide (http://www.ct.gov/dep/lib/dep/pesticide_certification/supervisor/aweeds.pdf) to the latest approved aquatic herbicides and their use.

Sediment Removal

Shallow areas of lakes and ponds with fertile sediment will promote plant growth. Removal of the sediment is a long term solution. Sediment removal is performed through various types of dredging and permits from local, State and Federal agencies are usually necessary. Dredging is performed either wet or dry. Wet dredging does not require lowering the water level and has the advantage of minimal disruption to recreational use. Dry dredging (right) involves lowering the water level, drying the sediment and using excavation equipment to facilitate removal. This method is efficient and sometimes the material can be sold to recoup some of the costs. The downside of dry dredging is its negative effects on the aquatic ecosystem and the inability to use the waterbody for long periods (often many years).

Biological Controls

Introducing an organism that feeds specifically on an invasive aquatic plant can provide targeted long-term control. Unfortunately, virtually no reliable target specific biocontrols are available for invasive aquatic plants in the northeastern USA. A biocontrol being tested for Eurasian watermilfoil is the milfoil weevil (*Euhrychiopsis lecontei*) (bottom). Although the larvae and adults feed on Eurasian watermilfoil and they are native to most lakes with the plant, neither the natural or introduced populations are currently considered a reliable control. The most common biocontrol in Connecticut is an herbivorous fish called grass carp (*Ctenopharyngodon idella*) (right). This fish was originally cultivated in China for food, but its propensity to eat vegetation brought it to Europe and the USA for aquatic weed control. Concerns over grass carp developing breeding populations have caused it to become regulated in many states including Connecticut. Prior to liberation, a state permit must be obtained, the fish must be documented to be sterile (triploid) and inlets and outlets usually must be screened to prevent the fish from escaping. Grass carp are usually considered more suitable for smaller waterbodies and are introduced at various rates depending on the amount of vegetated acres, the plants being controlled and other factors. Recently, however, these fish have been used in larger lakes including Candlewood Lake, Connecticut's largest lake. The fish take a year or two to obtain sufficient size to reduce vegetation and after about five years restocking is often necessary. Unfortunately grass carp may prefer native plant species and unforeseen damage to the aquatic ecosystem can occur. In addition, as plants are consumed and passed through the fish's digestive system nutrients are released into the water that may cause algal blooms. Because grass carp are sensitive to copper based algaecides, treating the algae can be challenging.

Harvesting

Probably the simplest means for controlling an area of invasive aquatic plants is removing them by hand pulling or mechanical cutting (above, left). Hand pulling is particularly effective in small areas and can reap tremendous benefits when used to remove new infestations. Sometimes SCUBA divers are employed. Unfortunately, many areas are too large for hand pulling to be practical and mechanical cutters (above, right), rakes or suction harvesters are needed. If the root systems are not removed rapid regrowth can occur, and the procedure may be considered an expensive mistake. Several lakes in Connecticut have dedicated weed harvesting boats that operate each year (above, right). To prevent new introductions, weed harvesters need to be thoroughly cleaned before moving from one waterbody to another.

Benthic Barriers

Benthic barriers are blanket-like materials that are spread over unwanted aquatic vegetation to prevent light from reaching the plants. They are particularly well suited to small areas but occasionally are used for larger areas. Although most benthic barriers are installed in the spring and removed in the fall, they can be installed for as little as several weeks and then moved. Work done by CAES IAPP has shown that benthic barriers can be effective when installed for as little as a month. More research is needed to document the level of control when this procedure is utilized. If benthic barriers are left in place for more than one growing season sediment settles on the surface and plants can take root.

Sources of further information on invasive aquatic plant management

Aquatic Ecosystem Restoration Foundation. 2014. Biology and Control of Aquatic Plants – A Best Management Practices Handbook. L. Gettys, W. Haller, D. Petty, eds. Retrieved March 3, 2018 from http://www.aquatics.org/bmp.html

CT DEEP. 2014. Nuisance Aquatic Vegetation Management - A Guidebook. Retrieved March 3, 2018 from http://www.ct.gov/deep/lib/deep/pesticide_certification/Supervisor/aweeds.pdf

Invasive Aquatic Clams and Mussels

Invasive freshwater Asian clams (*Corbicula luminea*) and zebra mussels (*Dreissena polymorpha*) are present in many Connecticut waterbodies. Quagga mussels (*Dreissena bugensis*) are in neighboring states and will probably spread to Connecticut. Like invasive aquatic plants, these bivalves can colonize rapidly and degrade natural ecosystems, fisheries, recreational opportunities, and real estate values. In addition, these organisms can threaten mechanisms used for hydroelectric power generation. Zebra mussels colonize hard surfaces including boats and docks, and soft surfaces such as aquatic plants (see figure below). Species identification for these three bivalves can be found on the following pages.

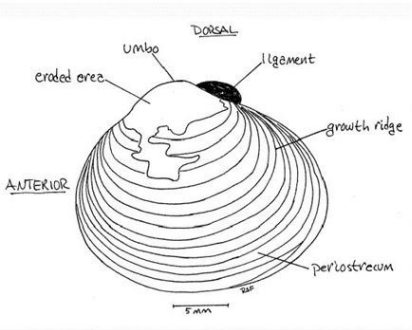
A variety of native freshwater mussels and clams are common in Connecticut. Generally, the native species are larger than the ones described in this guide. Refer to the CTDEEP guide to native mussels for further information (http://www.ct.gov/deep/lib/deep/wildlife/pdf_files/nongame/fwmusl.pdf).

Corbicula fluminea

Common names:
Asian clam
Asiatic clam
Golden clam
Good luck clam

Origin:
Asian
Africa
Australia

Key features:
At the sediment surface or slightly buried
Size: 0.5 to 0.75 inches
Shell: triangular shape (unlike most oval-shaped clams), beak is centrally located and high
Color: Yellowish brown to black
Reproduction: Hermaphroditic, self-fertilization



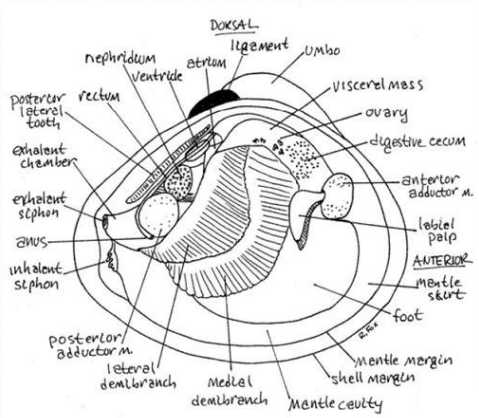
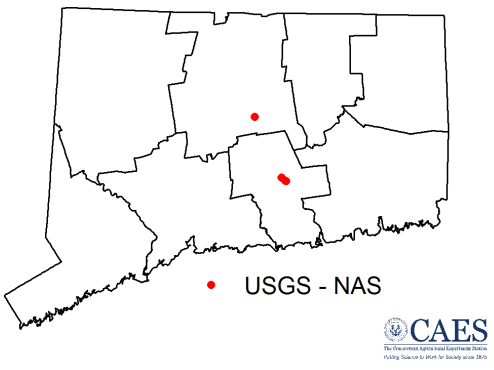


Image copyright: 2001 by Richard Fox, Lander University

Easily confused species:
Fingernail clams: *Sphaeriidae*

Asian clams. Photo: Crown Copyright 2009 - GB Non-Native Species Secretariat



Dreissena bugensis

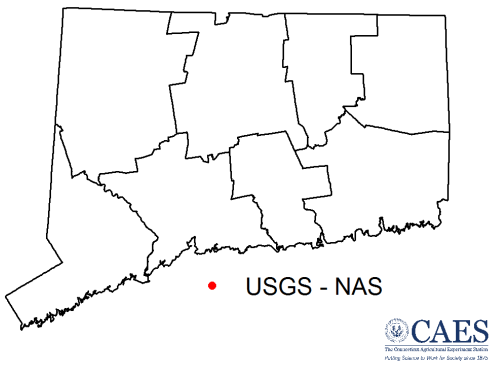
Common name:
Quagga mussel

Origin:
Dnieper River drainage of Ukraine

Photo by Amy Benson
U.S. Geological Survey

Key features:
Colonizes on hard surfaces
Size: up to 1.5 inches
Shell: unstable on edge (unlike *Dreissena polymorpha*), round shape, asymmetrical
Color: dark concentric rings, color is paler near the hinge , black, cream, or white bands

Easily confused species:
Zebra mussel: *Dreissena polymorpha*



Dreissena polymorpha


Photo by Amy Benson
U.S. Geological Survey

Common name:
Zebra mussel

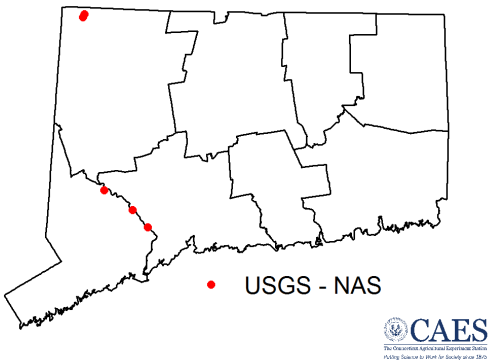
Origin:
Black, Caspian, and Azov Seas (Europe)

Key features:
Colonizes on hard surfaces
Size: less than one inch
Shell: conspicuous black stripes, stable on flattened underside (unlike *Dreissena bugensis*)
Color: color patterns vary, dark or light colored shells, most commonly with stripes

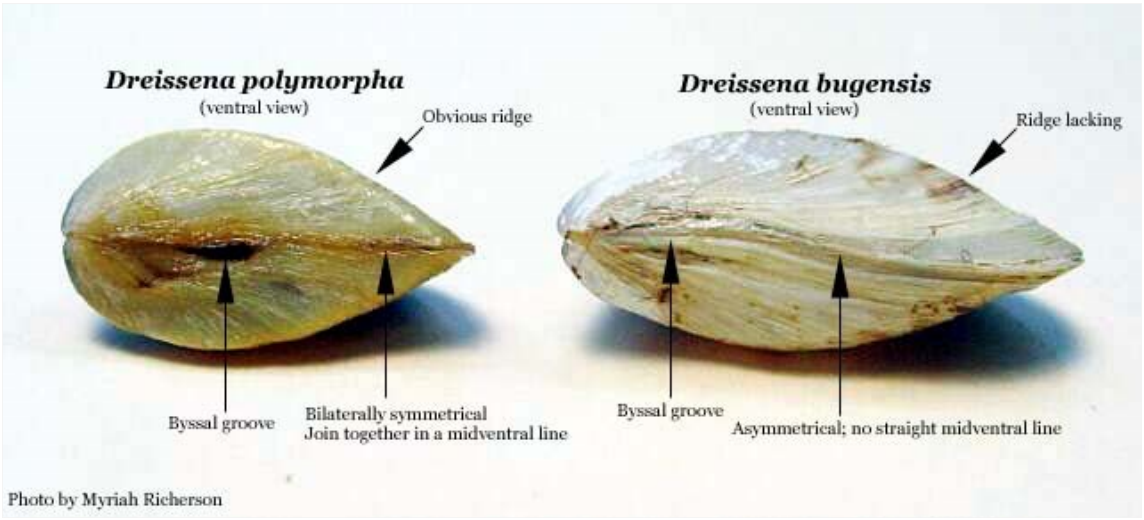
Easily confused species:
Quagga mussel: *Dreissena bugensis*

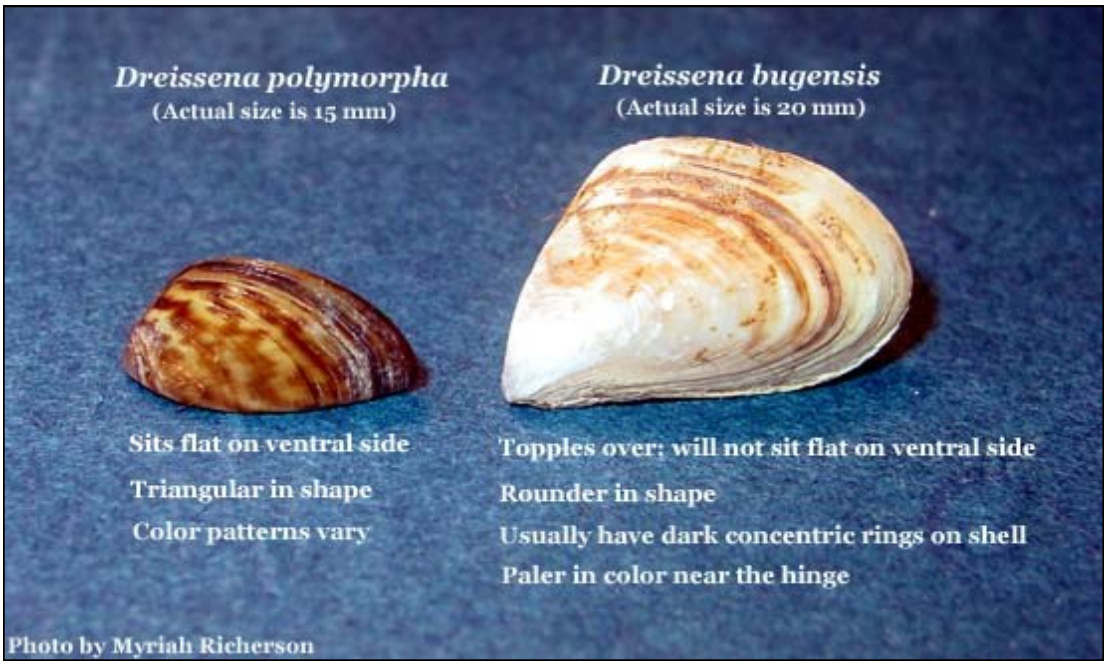

Photo by CAES IAPP


Photo by CAES IAPP



Commonly Confused Aquatic Mussels
Differences between Quagga and Zebra Mussels
(all photos by Myriah Richerson—USGS-NAS)





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Notes

Notes

The Connecticut Agricultural Experiment Station was founded in 1875. It is chartered by the General Assembly to make scientific inquiries and conduct experiments regarding plants and their pests, insects, soil and water, and to perform analyses for state agencies. Station laboratories or research farms are located in New Haven, Windsor, Hamden, and Griswold.

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