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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.

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Bulletin No. 1035
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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 rich communities of aquatic organisms. Because invasive species are not native, they have few natural enemies. Their dramatic growth rates can clog water intakes, decrease recreational opportunities, reduce local real estate values, and alter native ecosystems (Connecticut Aquatic Nuisance Species Working Group, 2006, Fishman et al. 1998). Recent vegetation surveys of 201 lakes and ponds by the Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP) found one or more invasive plants in over two-thirds of the water bodies (CAES IAPP, 2012).

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 recreational boating (Couch and Nelson, 1985), dumping of aquariums, water gardening, and plant fragments mixed with live bait used by fishermen. 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.

How to Use This Guide

Identifying Connecticut's freshwater aquatic plants is challenging. CAES IAPP surveys have found over 100 native species and 14 invasive species (Figure 1). These do not include many of the wetland plants in this guide because our surveys are limited to lakes and ponds. 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 three main parts. First, 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, 2012). 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. Second, there is a series of comparative pictures that help differentiate the invasive species from similar native plants. Third, 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.

What to do if You Find a Plant Discussed in This Guide

Before taking action, it is important that the plant be positively identified and the location of the plant is noted. 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 (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 2004-2012.

**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
http://nbii-nin.ciesin.columbia.edu/ipane/

Invasive Plants of the Eastern United States: Identification and Control
http://www.invasive.org/eastern/

State of Washington Department of Ecology Non-native Freshwater Plants

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

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Center for Aquatic and Invasive Plants
**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**

**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*
Callitriche stagnalis

Common name:
Pond water-starwort

Origin:
Europe and 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

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

![Photo by CAES IAPP](Photo by CAES IAPP)

![Photo by CAES IAPP](Photo by CAES IAPP)

![Photo by CAES IAPP](Photo by CAES IAPP)

![Photo by CAES IAPP](Photo by CAES IAPP)

Four leaves per whorl

![Map by CAES IAPP](Map by CAES IAPP)
**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*
**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*
**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

Sporocarps

Britton, N.L., and A. Brown. 1913
**Myosotis scorpioides**

**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
**Myriophyllum aquaticum**

**Common names:**
Parrotfeather
Brazilian watermilfoil

**Origin:**
Amazon River basin

**Key features:**
Plants occur mostly above the water’s surface
**Stems:** Thick green stems
**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

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

Easily confused species:
Eurasian watermilfoil: Myriophyllum spicatum
Low watermilfoil: Myriophyllum humile
**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 \( \geq 12 \) 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

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

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Photo by CAES IAPP
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**

**Common name:**
American water lotus

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

**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

**Easily confused species:**
None
**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**

**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
**Potamogeton crispus**

**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
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
**Rorippa nasturtium-aquaticum**

**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 siliqua, 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

Photo by Jerry Drown

Photo by Christopher Christie
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
**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

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Photo by CAES IAPP

Photo by Leslie J. Mehrhoff

Photo by Leslie J. Mehrhoff

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Invasive Aquatic and Wetland Plant Identification Guide - Page 29
Commonly Confused Aquatic Plants
Submersed plants with non-dissected leaves
(all photos CAES IAPP)
Submersed plants with feathery dissected leaves
(all photos CAES IAPP)

Myriophyllum aquaticum
Parrotfeather
INVASIVE

Myriophyllum heterophyllum
Variable Water Milfoil
INVASIVE

Myriophyllum spicatum
Eurasian Water Milfoil
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 CAES IAPP except where noted)

Ceratophyllum demersum
Coontail
NATIVE

Utricularia species
Bladderwort
NATIVE

Megalodonta beckii
Water Marigold
NATIVE

Cabomba carolinana
Fanwort
INVASIVE

Ranunculus species
Water-crowfoot
NATIVE

Photo by Amy Smagula
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 edges……………….. *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 rosy look; triangular shaped leaves, with less than or equal to 11 pairs of leaflets; thick spike with entire to 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…………….. *Cabiomba 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)
Managing Nuisance Aquatic Vegetation in Connecticut
(all photos CAES IAPP)

Invasive Aquatic Plant Control

Aquatic vegetation proliferates in water with proper sunlight, water chemistry, sediment and freedom from antagonistic organisms. Managing invasive aquatic plants usually requires a multifaceted approach. It is important to accurately identify the invasive and native plant species present. This can be accomplished through an aquatic plant survey (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 change from year to year are usually most effective. This discussion of invasive aquatic plant control is intended to be introductory in nature. The Aquatic Ecosystem Restoration Foundation (2009) has an online guidebook (http://www.aquatics.org/aerf_handbook.pdf) that details the subjects discussed below.

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 (right) and use of fertilizers is important. The utilization of 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 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 rapid regrowth of Eurasian watermilfoil (*Myriophyllum spicatum*) one year after drawdown (CAES IAPP, 2012). 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 and potential water use limitations (i.e. drinking, swimming, irrigation etc.). 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. 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/a weeds.pdf) to the latest approved aquatic herbicides.
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 by either wet or dry techniques. 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 water body 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). 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. As more research is performed this assessment may change. The most common biocontrol in Connecticut is an herbivorous fish called grass carp (Ctenopharyngodon idella). 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 (right), a state permit must be obtained, the fish must be documented to be sterile (triploid) and inlets and outlets must be screened to prevent the fish from escaping. Grass carp are usually considered more suitable for smaller water bodies and are introduced at various rates depending on the amount of vegetated acres, the plants being controlled and other factors. 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.
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. 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 (right).

Sources of further information on invasive aquatic plant management


Literature Cited


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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