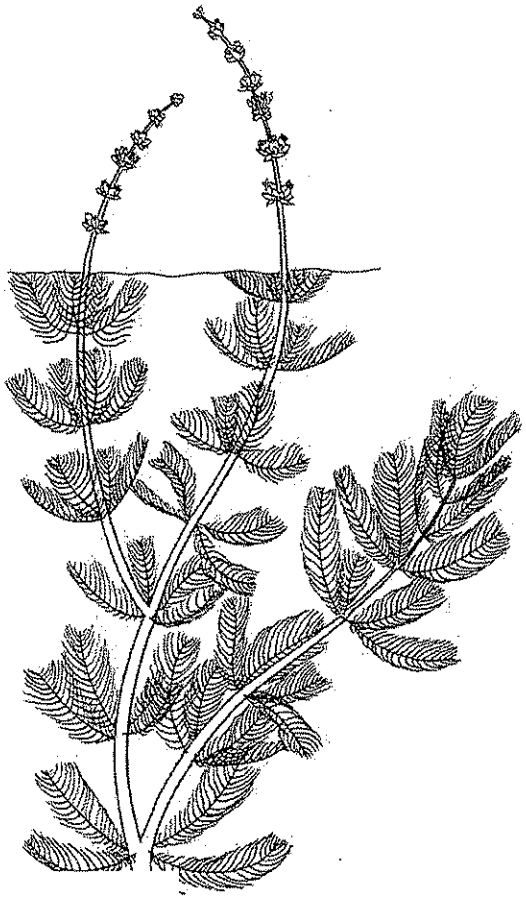


NUISANCE AQUATIC VEGETATION MANAGEMENT

A GUIDEBOOK

State Of Connecticut
Department of Environmental Protection
Pesticides Management Program
79 Elm Street
Hartford, CT 06106-5127

Gina McCarthy, Commissioner

CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
MANAGEMENT OF NUISANCE AQUATIC VEGETATION

INTRODUCTION

When present in small quantities, algae and other aquatic vegetation are beneficial to lakes and ponds. However, when these plants become overabundant, they can lower the recreational and aesthetic qualities in a body of water, and also alter some of the natural qualities such as fish community structure. It is hoped that this brochure will assist the pond owner or lake property association in becoming acquainted with the problems associated with, and materials used in, the control of nuisance aquatic vegetation and algae.

SHOULD I TREAT MY POND?

Before starting to control aquatic vegetation, pond or lake owners and managers need to assess the uses of the water, and develop a realistic goal for the water body. At this point control measures should be evaluated. For example, very few ponds in Connecticut are capable of supporting trout on a long term basis. Therefore, a management plan for fly fishing in one's backyard pond may be unrealistic. Similarly, swimming in clear water with a sandy bottom can be difficult to achieve, and may require continuing treatment to be possible. Ponds that attract wildlife however, are much easier to achieve.

Many chemical treatments for weeds in Connecticut ponds may be unnecessary or inadvisable. Without plant life in a pond, no fish or other animals can survive long. Most ponds in Connecticut are naturally eutrophic (full of nutrients, and very productive of plant material). Warm water, plentiful nutrients, and shallow depth combine to encourage luxuriant plant growth. Algal "blooms" in the spring and autumn are natural occurrences and sometimes clear themselves.

Recent publications from the Inland Fisheries Division of the Connecticut Department of Environmental Protection entitled "A Management Plan for Bass in Connecticut Waters and Recommendations for other Warm water Species" and "A Fisheries Guide to Lakes and Ponds of Connecticut" recommend the retention and maintenance of between 20% and 40% plant coverage in the ponds and lakes of the state. This recommendation is made to optimize the habitat, and improve the foraging and reproductive environment for warm and cold water fish.

"Cultural" eutrophication problems arise when plant nutrients are added to a pond in unnaturally large amounts by human activities. Nutrients such as nitrates and phosphates act as plant fertilizers for rooted plants and phytoplankton (tiny drifting plants), which turn them into food upon which the pond's animal life depends.

If too many nutrients are added, phytoplankton can reproduce at extremely fast rates, producing heavy persistent blooms that can shut off sunlight, killing submerged rooted plants. Algae produce oxygen during the day, but use it at night. Dense blooms can, on hot summer nights, rob the pond of enough oxygen to kill fish. In extreme cases, algae themselves die in masses, using even more oxygen as they decompose. This decomposition is even more likely to occur after the pond has been treated with an algicide, so

algicide treatments of heavy growth during hot summer periods should be avoided or carried out with extreme care.

In short, algae blooms are a symptom of a more basic problem of over-fertilization. Sources of nutrients commonly associated with human activities are:

- Septic tank leachate: even though household sewage may be broken down to non-infectious materials, nutrients such as nitrates and phosphates from the leaching field can enter surface or groundwater. Correction can be made by installing sanitary sewer lines or by keeping septic systems in good repair and well back from any stream or pond. Installation of sanitary sewers is the only sure way to eliminate this source of nutrients. Where sanitary sewers are not feasible, direct management of aquatic plants may be the only option.

- Turf and garden fertilizers: many are highly water soluble; their use near lakes and streams should be minimized or eliminated. Natural buffer areas along watercourses can help to prevent or reduce problems associated with fertilizers and pesticides.

- Waterfowl: bird droppings are very high in nutrients and bacteria, and can add significantly to pond nutrient levels. Feeding of ducks and geese also add nutrients and should therefore be avoided.

- Domestic animals: manure from cows or horses held in yards, barns, or stables near a watercourse can provide a source of nutrients. Dog manure should be controlled by local leash laws and removal ordinances.

- Erosion: activities that disturb the surface of the land will promote erosion, which contributes nutrients and sediments to a lake or pond. Construction sites are a particular concern.

Storm water drainage systems that drain to a water body without detention or treatment provide direct transport of pollutants that contain nutrients such as road sand, pet excrement, and organic debris. Additionally, deposition of sand and dirt conveyed to a lake or pond from roadway runoff will create shoal areas that can foster growth of nuisance aquatic plants. Storm water drainage systems should be designed not only to drain water quickly from roads, but also remove pollutants before discharging to a water body.

Once a pond is suffering from algal blooms, treatment is sometimes attempted. Although chemical treatment has become increasingly popular, merely killing the algae is only a temporary "cure." The vegetation decomposes, consuming oxygen and returning nutrients to the water to fertilize new blooms. Treatment may be required annually or even more frequently. It may be less expensive and more effective in the long run to reduce the flow of nutrients into the pond. In some cases, ponds will then proceed to clear themselves as excess nutrients leave via the outflow in springtime.

In small ponds, physical removal of floating algal scum or rooted vegetation provides immediate aesthetic improvement and can lessen the amount of available plant nutrients. The vegetation can be composted away from the water. As nutrients usually

tend to accumulate in bottom sediments, a small pond with a severe problem can be drained and the sediments removed. This action may, however, require a local inland wetland permit.

In contrast to algae, most rooted plants (macrophytes) obtain their nutrients from the sediments on the bottom of the pond. Reducing the nutrient influx may not result in a decrease of macrophyte growth, even though algae production is reduced. Ironically, the growth of rooted weeds may increase as algae are controlled, since the improvement in water clarity allows light to penetrate deeper, which in turn allows for greater macrophyte production.

Management for macrophytes should consider the quality as well as the quantity of vegetation. Native species, such as some pondweeds in the genus *Potamogeton,* tend to form clumps rather than mats, and provide fish and wildlife cover without taking over a pond. Mat forming exotic species such as Eurasian watermilfoil or curlyleaf pondweed, are more likely candidates for control, since they are much more invasive, and are more likely to completely take over a water body, forming impenetrable mats that make it difficult to use the water body.

The DEP Water Management Bureau distributes a book on lake management in Connecticut entitled Caring for our Lakes. This publication provides information on area-wide management of pond and lake problems and can be obtained from the Water Bureau by calling 860/424-3716.

In Summary:

1. Develop a plan for your water body and make sure your goals are attainable.
2. Be certain that your pond really has a severe algae or aquatic weed problem, keeping in mind that moderate levels of vegetation is beneficial. (i.e.; 20-40% vegetation coverage)
3. Investigate and eliminate controllable sources of nutrients if possible.
4. Consider non-chemical treatment procedures.
5. If chemical use is necessary, apply for an aquatic permit.
6. After receiving an aquatic permit, follow pesticide directions for use and application procedures carefully.

CHEMICAL TREATMENT

Policy. The control of aquatic plants and animals in the waters of the state by use of chemicals is governed by statute. (Chapter 441, Section 22a-66z of the Connecticut General Statutes) Permits are required for such control. The Pesticide Management Division may, after prior approval of the Branch of Environmental Conservation, issue permits for the introduction of chemicals into waters of the state for control of aquatic plants, animals or organisms. These chemicals must be registered by the state Department of Environmental Protection and the US EPA.

Certain water bodies or areas near them that may contain plants or animals that are threatened or endangered. (Connecticut General Statutes Section 26-303 to 26-315)

A map showing general locations of these species is included as Appendix II. Permits for ponds that have these species may have conditions designed to protect them or permits may be denied.

Public Water Supply Watersheds. About 17% of the land area in Connecticut is tributary to reservoirs used for public drinking water (map is appendix III). It is important that chemicals used in ponds, lakes and streams that lead into these reservoirs not contaminate the public drinking water supply. Accordingly, the use of aquatic pesticides is very tightly regulated in these areas. Currently, copper compounds may be approved for use in lakes or ponds located in public water supply watersheds. Sonar and Rodeo may be permitted for use in public water supply watersheds subject to certain conditions. The use of 2,4-D, light blocking dye, diquat and endothall is prohibited in public water supply watersheds.

Local Authority. You must send a copy of your permit application to your town Inland Wetlands Agency at the time you submit your application to this Department. Local Commissions do not have the authority to unilaterally deny a permit, but their input is sought by the DEP.

General Instructions. Information is provided in this guidebook to assist the pond owner in selecting an effective algicide or herbicide to be used at a recommended dosage rate for a particular nuisance aquatic plant. Permit applications may be obtained from the Pesticide Management Program of the Department of Environmental Protection. Permit application forms are also available on the DEP website. (http://www.dep.state.ct.us/pao/download.htm#Waste). The approved permit must be returned to the applicant before a chemical treatment of nuisance aquatic plants may be undertaken.

General Recommendations.

1. Use extreme care in handling any herbicide or algicide. Some of these materials *can cause blindness* and some *can cause death* if taken internally.

2. Follow the directions on the container, and make sure you use only the amount that the permit grants you. You must also adhere to conditions placed upon the permit.

3. Use extreme care in the application of any herbicide or algicide. Drift of the material from the treatment area should be avoided. Some of these materials will kill farm crops, fruit trees, flowers and ornamentals as well as nuisance aquatic vegetation.

4. Never increase the dosage or concentration of the chemical used for treatment unless prior approval for such an increase has first been obtained from the Pesticide Management Program.

5. Dispose of used containers in such a manner that children or animals cannot come into contact with them; many of these materials are lethal if taken internally. Containers must be triple rinsed to be considered "clean".

6. To avoid killing fish by suffocation, ponds that are heavily infested with weeds or algae should be treated one half at a time, two to three weeks apart. If the permit allows one treatment, you may split the treatment into two applications, each using half of the chemical over half of the pond.

7. Be extremely cautious about combining treatment chemicals. While some combinations such as Diquat and Cutrine increase effectiveness, others may work against each other or may be dangerous. Make sure you consult the label.

8. Make sure that your use of chemicals is not incompatible with other uses of the lake. For example, certain herbicides must not be used if the lake water is to be used for domestic purposes or irrigation. Also check if downstream uses are incompatible.

9. Make sure that you control enough of the water body to treat it legally. If other pond owners object to your treatment, you may be liable for trespass if you treat the water. Certain pesticides, such as Reward, require that the water body be under the total control of the pesticide applicator before treatment.

10. Carefully identify the type of vegetation that you have in your pond. The proper chemical and timing for control are important in achieving the desired results. The vegetation and/or chemical descriptions provided later in this guidebook are intended to give an indication of the proper timing and dose.

NON-CHEMICAL TREATMENTS

Winter Drawdown. Lowering the water level in the winter until the exposed bottom freezes can kill roots, vegetative parts, and susceptible seeds of certain rooted aquatic plant species. Although winter drawdowns can be relatively inexpensive to implement, unintended ecological consequences should be carefully considered before implementing a winter drawdown. The negative effects of winter drawdowns can include reductions in fish spawning and nursery habitat, reduced amphibians and invertebrate populations, loss of total aquatic habitat availability, and water quality impairments, including reduced dissolved oxygen levels. Winter drawdowns will not control certain plant species, and they have no direct control over algae levels. Drawdowns must be carefully controlled to prevent downstream flooding, damage to stream channels, fish kills, and altered well fields. In addition, the contributing watershed must be large enough to allow for refilling of the pond, and sufficient instream flows must be maintained during the refilling process.

A diversion permit from the Inland Water Resources Division may be required. In addition, Connecticut General Statute Section 26-138 requires that anyone draining a water body or watercourse to the point that fish and other aquatic life is endangered must provide the DEP with 48 hours notification. When issuing dam modification permits that result in drawdowns, the Inland Water Resources Division specifies the Inland Fisheries Division at 79 Elm Street, Hartford (860-424-FISH) as the DEP office that must be so notified.

Dredging and Excavation. By removing the bottom sediment you can remove plant nutrients and also increase the water depth to levels where some rooted plants will not grow. This can sometimes be usefully done in conjunction with a winter drawdown. Algae blooms and increased turbidity should be expected in the short term.

Permits may be needed from the town Inland Wetlands agency, the State Inland Water Resources Division, or the U.S. Army Corps of Engineers.

Weed Harvesting. Mechanical cutting and removal of aquatic weeds will give immediate relief to weed-choked areas but may have to be repeated at periodic intervals. Mechanical harvesters sometimes kill many small fish by harvesting them along with the weeds.

Mechanical methods do not require a state permit (but may require a local inland wetland permit) and are advisable in many situations. Pulling, cutting or raking weeds can provide immediate easing of weed problems in small areas. If weeds are cut, they should be brought to shore, since many species can spread via plant fragments. Aquatic weeds make good mulch or compost. Large mechanical weed harvesters can be used for larger areas.

Barley Straw. Barley straw has become an increasingly popular alternative for prevention and treatment of algae growth in ponds. It is thought that rotting barley straw in a well oxygenated environment produces the anti-algal activity. One or two bales of barley straw staked near the water inlet to a pond appear to be effective in preventing algal growth in a pond of one acre or less. An approximate application rate for barley straw is 0.5 to 1.5 ounces per 10 square feet of surface water area. The placement of the barley straw is best achieved by placing the barley straw in mesh bags. The duration of effective anti-algae activity is considered to be about six months. The bag of barley

straw should be removed at the end of the season to avoid inadvertent addition of nutrients to the water body. The barley straw can then be replenished.

Triploid grass carp - Sterile grass carp are herbivorous fish that can be introduced into some ponds on a restricted basis for controlling aquatic vegetation through a liberation permit issued by the Inland Fisheries Division. Contact the Inland Fisheries Division at (860) 424-FISH for a triploid grass carp information packet, which includes detailed information on permits, stocking rates, grass carp suppliers, governing regulations, and other related information. Although grass carp prefer certain species of aquatic vegetation over others, it is difficult to achieve selective control. In addition, grass carp may prefer desirable native plants over nuisance invasive species, thus they may not achieve the results desired by pond owners or lake managers. Stocking the proper number of triploid grass carp to achieve partial control can be difficult. Overstocking can lead to the total eradication of aquatic plants, and also lead to increased algae levels, which results when nutrients locked up in plants get released into the water as concentrated fish excrement.

Fountains - Aeration from the operation of a fountain does not limit the growth of algae or aquatic vegetation. It may, however, physically move algae to the side of the pond.

Nutrient Precipitation - This is actually a chemical method, but is not considered pesticidal, since the objective is not to directly kill the offending aquatic plant. Chemicals such as alum, the most commonly used precipitant, combine with phosphates in the water to form an insoluble precipitate that falls to the bottom. This makes these nutrients unavailable to algae, and often inhibits its growth. For further information and dosage rates contact the Water Bureau at the number below. Chemical nutrient precipitation does require the aquatic permit described in this booklet.

The Bureau of Water Management offers technical assistance and publications on non-chemical methods of aquatic plant and watershed management methods. The telephone number is 860/424-3716.

"Small Ponds in Connecticut - A Guide for Fish Management". The Inland Fisheries Division has published a booklet entitled "Small Ponds in Connecticut - A Guide for Fish Management". The booklet provides information on a wide range of pond management issues, including pond construction, fish management, aquatic plant control, watershed management, miscellaneous pond problems, and associated pond life. An order form is included in the back of this booklet.

FILLING OUT THE PERMIT FORM

In order for your permit to be processed quickly, it is important that you fill out the form accurately and completely. Make sure that you calculate the size of the pond accurately, since this information is used to calculate dosage. You will need to enclose a copy of a map with the pond highlighted. Topographic maps are available from many sporting goods stores or from DEP maps and publications store located at 79 Elm Street, Hartford, CT. Good weed identification is important since it allows us to determine the proper chemical and dosage rate. Simply putting "weeds" is not sufficient information. Use this booklet or obtain professional help in identifying weeds. Sources of information are listed in this booklet.

FEES: Effective July of 1993, a fee of $25.00 will be charged for each permit applied for. The fee is due at the time of application and is not refundable.

POSTING AND NOTIFICATION OF PESTICIDE APPLICATION

Regulations effective in 1991 require the posting of treated water bodies in certain situations. The signs, a sample of which is in the back of this booklet, must be posted at public access places when lakes with public access are treated by a government agency or commercial applicator. The signs must include information on the waiting periods before water use, and must remain posted until all such warning periods lapse. In addition, the commercial applicator or government agency must publish a newspaper notice of the impending pesticide application.

In cases where the pond is private, but has more than one owner or shoreline property owner, newspaper notice of impending treatment must be published if the pond is being treated with pesticides by a commercial applicator.

The actual text of the statute and regulation are included in appendix I along with the sign format.

AQUATIC PLANT DESCRIPTIONS

It is necessary to identify the nuisance species of aquatic plants so that an effective algicide or herbicide may be chosen. When considering aquatic plants, the two major categories are algae and vascular plants (macrophytes). Invasive vascular plants, or water weeds, are non-native plants that exhibit aggressive growth habits and can outcompete and displace native plant species, contributing to a loss of biological diversity and overall aquatic habitat degradation. Water plant identifications are often made easier by observing an intact specimen placed in a shallow pan of water. Diagrams and descriptions of algae and the more common species of nuisance water plants found in Connecticut follows. Native and invasive species are so indicated. For more detailed drawings and information, you may wish to study a botanical guide for aquatic plants. Your local library may have such a book.

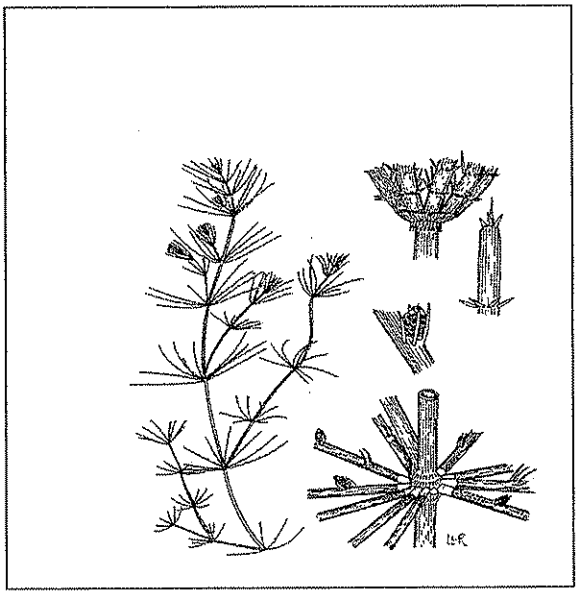
The plant illustrations in this booklet have been provided by the University of Florida, IFAS, Center for Aquatic Plants.

Unicellular Algae

Unicellular algae include many different species of microscopic single celled plants, or colonies of single celled plants, that are suspended in the water. Millions of these plants are normally found in ponds, and are the basis for all life in the pond. When they become over abundant, they can give the water a soupy green or brown color. This condition is known as an algal bloom.

Filamentous Algae

Filamentous algae include many different species of plants that consist of visible hair-like strands. These strands may be straight, branched, or even arranged in net-like structures. They may feel slimy, woolly or cottony. These algae begin their growth on the pond bottom, but may float to the surface due to entrapped bubbles produced during photosynthesis. There are no roots, and no recognizable plant structures such as stems or leaves. Floating filamentous algae can best be treated by spraying the algicide directly onto the mat.

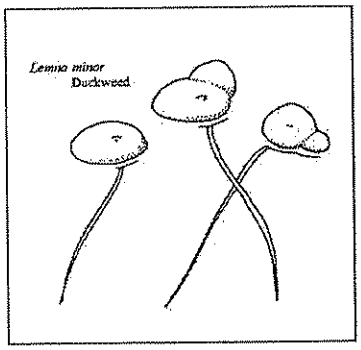


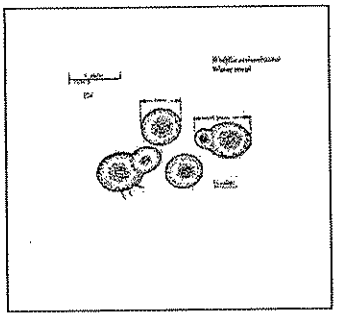
Stoneworts
(Chara spp. and Nitella spp.)

These advanced forms of algae have bristly stems and branches. Both grow on the bottom and are usually rather short. They have short, even-length branches clustered at a joint. *Chara* usually has a skunky odor, and feels rough due to encrusted carbonates. The accompanying picture is of *Chara*, but *Nitella* looks quite similar. These plants are usually not a nuisance. Treatment, if necessary, should be carried out early in the season since these plants become more resistant as the summer progresses.

Duckweed and Watermeal
(Lemna minor and Wolffia columbiana)
Native

Duckweed and Watermeal are the smallest of the flowering plants. They float on the surface of the water. Duckweed is about the size of oatmeal flakes, and is usually a light green color. It has tiny rootlets hanging down in the water. Watermeal has neither leaves or rootlets, and appears as minute green grains floating on the water. These plants often occur together. Frequently the growth of duckweed and watermeal can be so dense as to completely cover the pond surface. Both of these plants, but especially watermeal, can be extremely difficult to control. They are best treated on a calm day, with no ripple action which washes off herbicide. The use of surfactant with the herbicide can increase its effectiveness.





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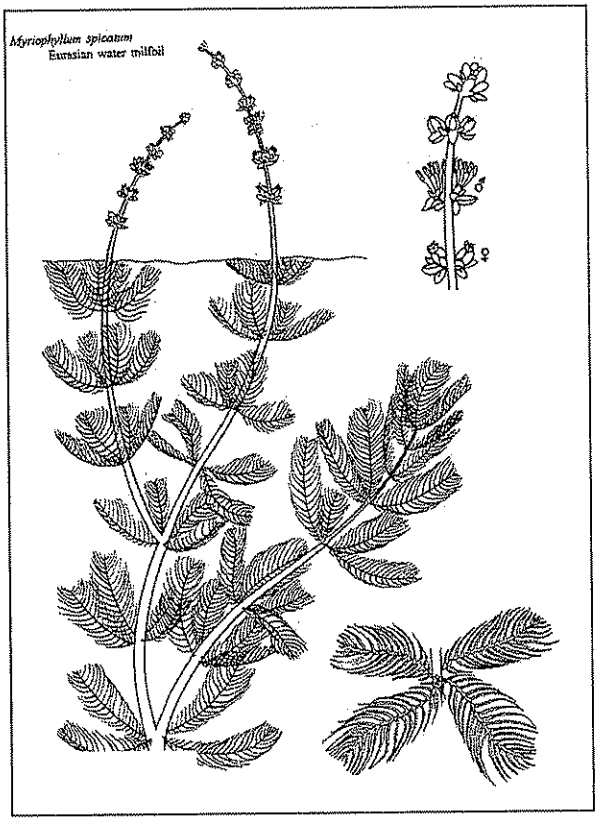
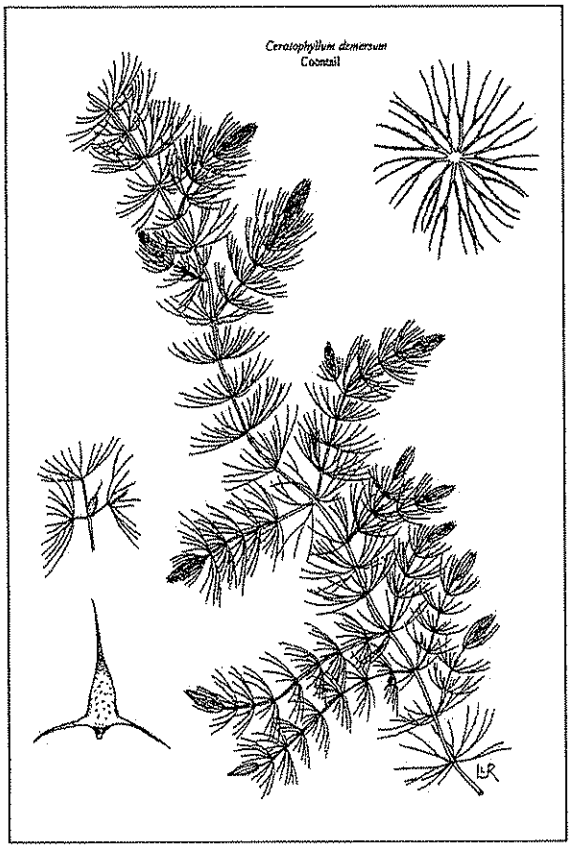


Water Milfoil
(Myriophyllum spicatum)
(Myriophyllum heterophyllum)
Invasive

There are several species of milfoil that occur in Connecticut, but Eurasian water milfoil is the most likely to be a nuisance in the western part of the state. This plant grows all year long, with the winter form creeping along the bottom. It often forms impenetrable mats. The stem is often a light reddish color and is hollow. The feather-like leaves often collapse when the plant is removed from the water. Variable leaf milfoil is likely to be found in eastern Connecticut. Milfoil can spread by fragmentation, so it should not be cut as a control measure. The most effective chemical controls are systemic herbicides applied at low dosages so the plant can absorb them and kill the roots and not just burn off the tops.

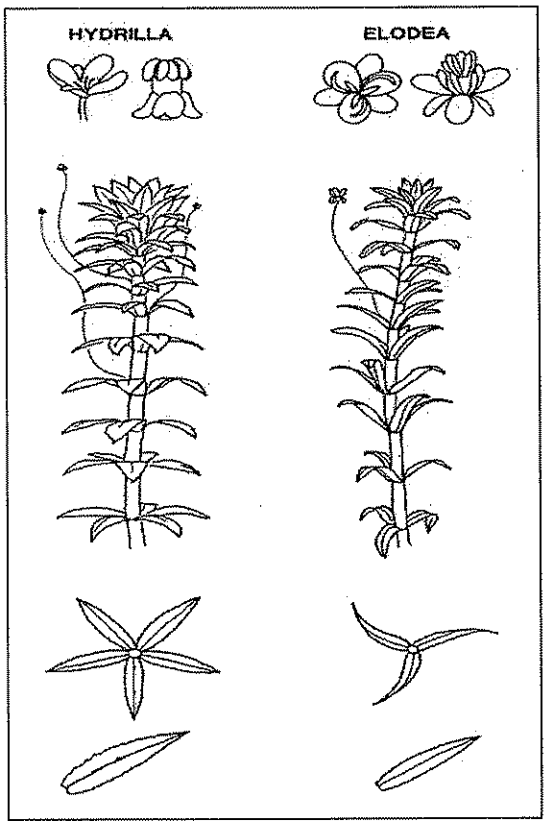


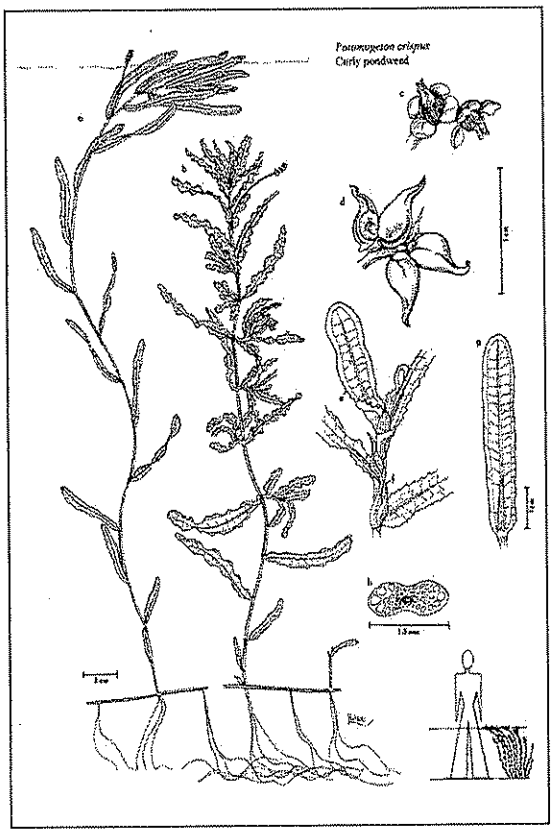
Coontail
(Ceratophyllum demersum)
Native

Coontail grows completely underwater. Stiff forked leaves growing out of a whorl are attached to a central stem and become more crowded toward the stem tip. The leaves have teeth at one side. The stems are usually green. Coontail can spread from fragmentation, so cutting should be avoided.

American Elodea
(Elodea canadensis)
Native

American elodea grows completely below the water surface and may form large masses near the bottom. The leaves, which are sometimes purple tinged, are bunched toward the tip of the stem and are grouped in threes at each joint. Leaves may vary in size and bunching in different ponds. This plant looks very similar to *Hydrilla*, which is a very serious pest of southern waters. *Hydrilla* has five leaves per group and the leaf margins are toothed. Anyone finding *Hydrilla* should report it to the DEP Pesticide Management Division at (860) 424-3326.



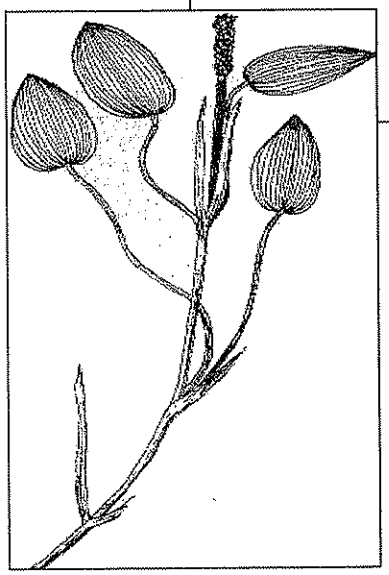


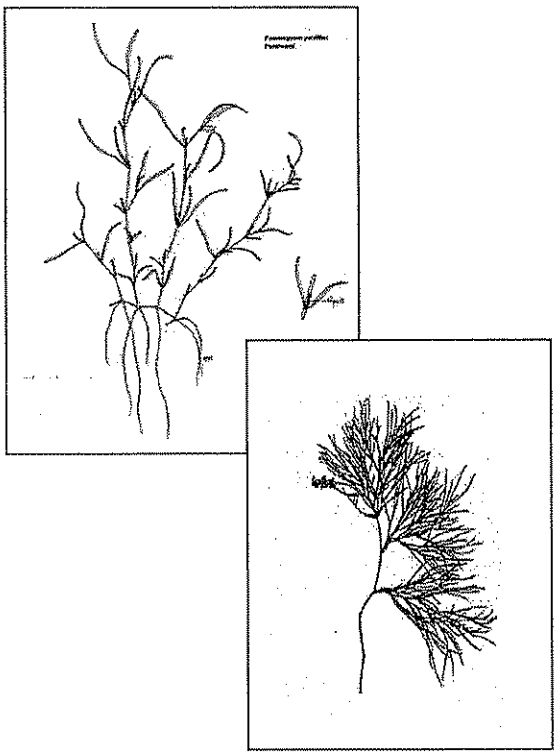
Curlyleaf Pondweed
(Potamogeton crispus)
Invasive

Curlyleaf pondweed is characterized by its curly or wavy membranous leaves, which have a row of small teeth along their edges. Flowers are borne on spikes. Curlyleaf pondweed may start to grow in the fall and dies back by the following midsummer. It is a pest of the spring and early summer. Any effective control must be done early in the season.

American Pondweeds
(Potamogeton spp.)
Native

There are several species of pondweed having widely variable forms. A few of the more common ones are displayed here. Many species have floating elliptical leaves and underwater leaves of a different shape. Flowers are borne on spikes, which usually rise above the water surface. These plants are native species, and are usually not nuisances. Early season treatment for milfoil or curlyleaf pondweed will often spare these plants, since they emerge somewhat later in the season.



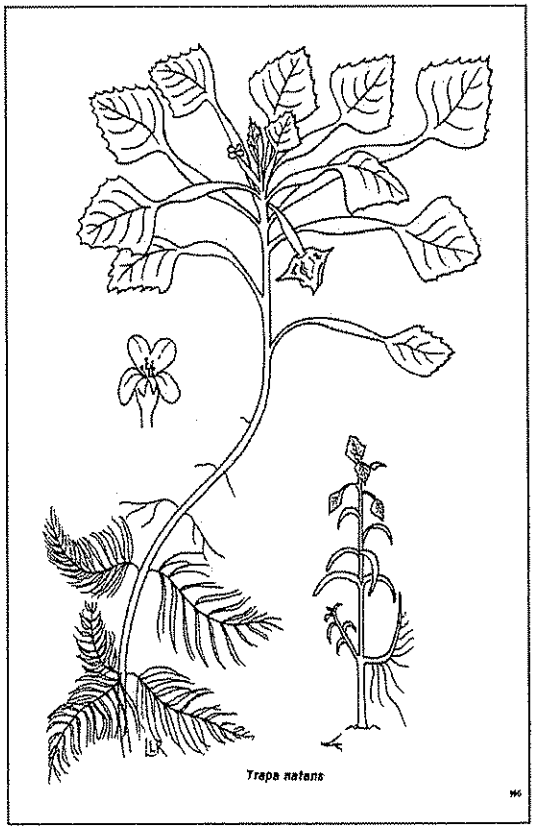


Narrowleaved Pondweeds
(Potamogeton spp)
Native

Narrowleaved pondweeds are perennials that have grass or hairlike submersed leaves that may or may not appear bushy in form depending upon species. Some species will grow along shoreline areas to depths of approximately 4 feet where others may grow only in areas where the water is 6 to 8 feet deep.

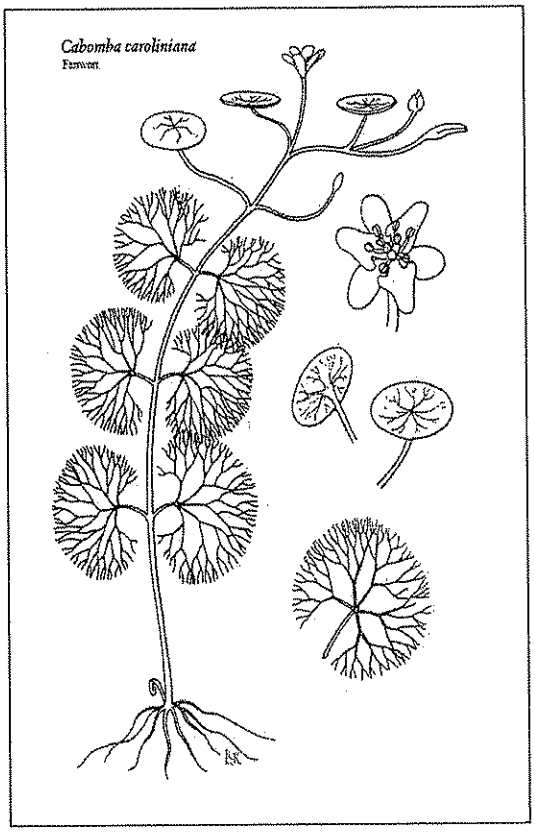
Water Chestnut
(Trapa natans)
Invasive

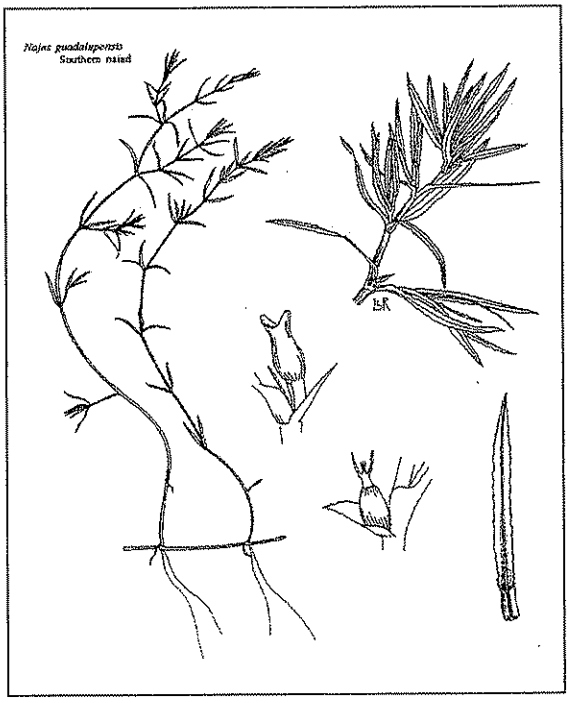
Each water chestnut plant has two types of leaves, submerged leaves that are feather-like and emerged leaves that float. The floating leaves are waxy, triangular in shape and form a rosette on the water surface. The plants begin to flower in mid to late July and continue into the fall when frost kills the floating rosettes. Single seeded horned fruits, or chestnuts, sink to the bottom of the water body where they may be viable for as many as 12 years. An individual seed can produce a plant with 10-15 rosettes, each of which can develop 15-20 seeds. Water chestnuts can reproduce quickly, covering entire bodies of water, negatively impacting native plants and animals and making the area unusable for recreation. Anyone finding water chestnut should report it to the DEP at (860) 424-3034.



Fanwort
(Cabomba aquatica)
Invasive

Fanwort is a non-native species beginning to make inroads in Connecticut lakes. It occasionally appears after herbicide treatments for other species. The stems are covered with a thin layer of jelly-like material.



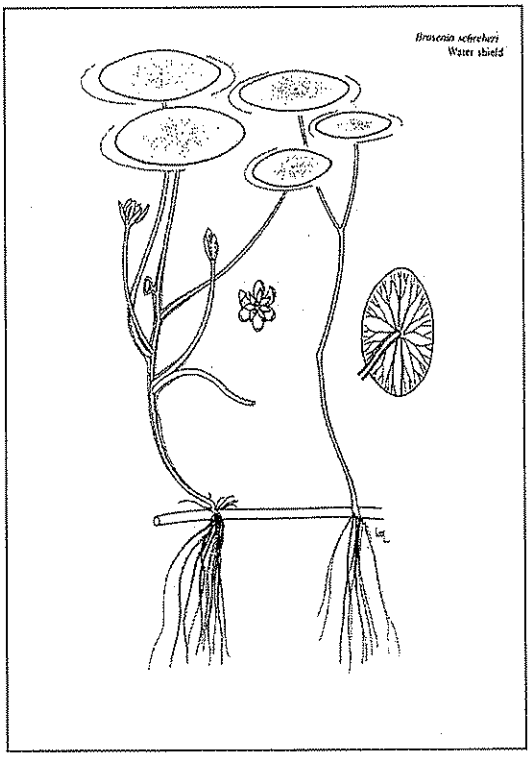


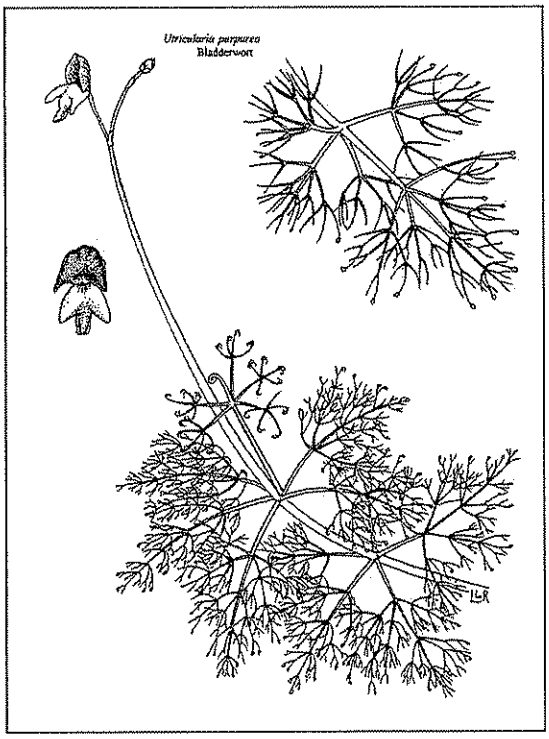
Naiad
(Najas spp.)
Native

Naiads are annuals, reproducing from seed every year. They appear in late summer due to this characteristic. The stems and leaves are very narrow. The leaves are joined to the stems in nodes. They need to be examined carefully to distinguish them from stoneworts. Any plant that appears before mid-summer is not a naiad.

Watershield
(Brasenia schreberi)
Native

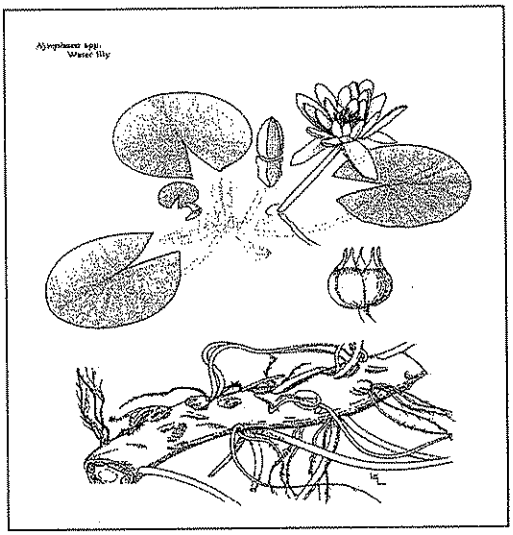
Watershield is a floating leafed plant whose roots are in the bottom of the pond. The stems and undersides of the leaves are coated with a jelly-like material. The stem attaches to the middle of the oval leaf, with no slit in the side.

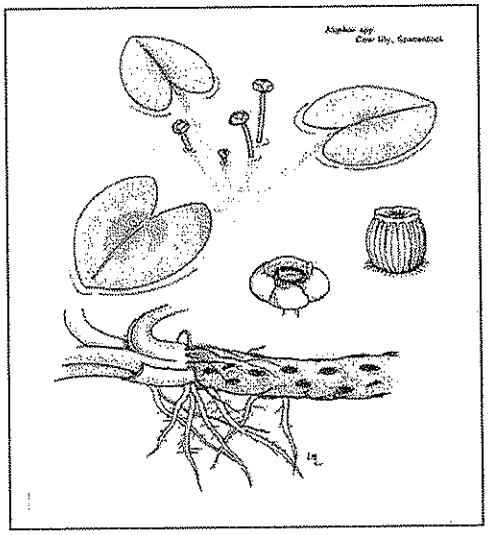




Bladderwort
(Utricularia spp.)
Native

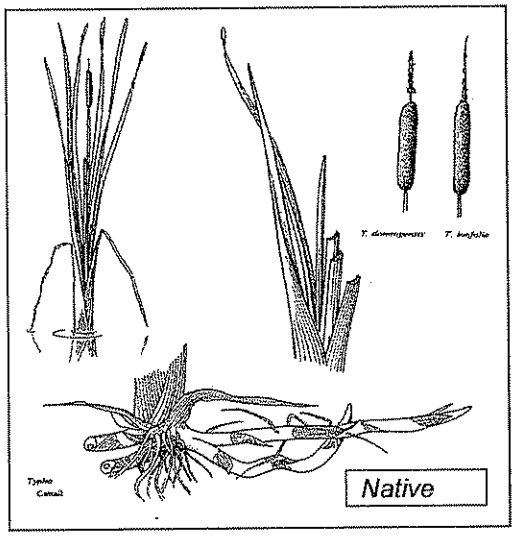
Bladderwort is characterized by the tiny bladders located on some of the underwater sections of the leaf segments. The leaves are thin, and divided many times. The flower extends above the water and is usually yellow or purple, and is present from July through August. Bladderwort is not often a pest species, but sometimes requires limited control.

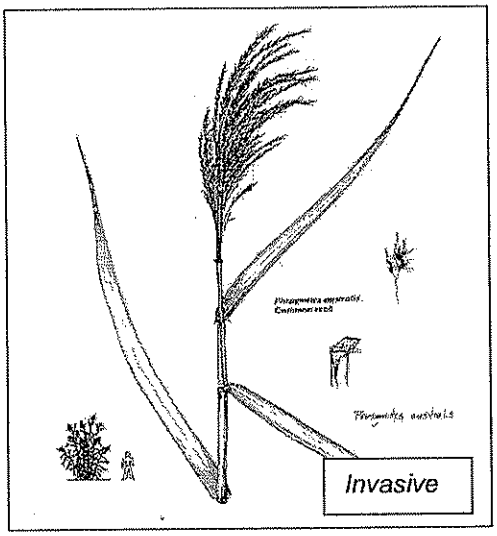




Waterlily and Spatterdock
(Nymphaea spp . and Nuphar spp.)
Native

Spatterdock (sometimes called yellow waterlily) and waterlilies have large tubers well rooted in the lake or pond bottom and large floating leaves. They are often attractive and desirable plants, but can crowd coves and other areas making access very difficult. Mechanical control should involve digging out the roots, since simple cutting of the stems will not have an effect on the future growth of the plant.





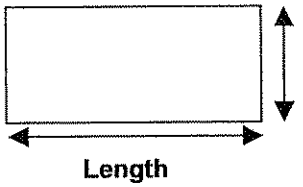
Cattails and Phragmites
(Typha and Phragmites australis)

Cattails and Phragmites are plants that can grow both in water and on land. They have tenacious root systems, and need a systemic herbicide for effective chemical treatment. Such treatment is more effective after the flower spikes have formed. Mechanical treatment should not neglect the root system if more than temporary control is desired.

DETERMINATION OF ACREAGE AND VOLUME

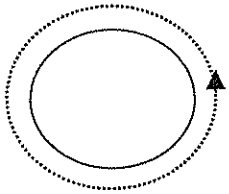
In order that the proper amount of herbicide or algicide is used it is very important that the surface area and volume are accurately calculated. Most ponds either approximate geometric figures, or can be divided into areas that approximate these shapes, and the areas added up. The units of measurement that are often most used, and upon which the dosage tables are based are acres for area, and acre-feet for volume. An acre is 43,560 square feet, and is approximated by a square of 209 by 209 feet. An acre-foot is simply the volume of water in an acre that is one foot deep.

Rectangular Ponds



$$\text{Surface Acreage} = \frac{\text{width in ft} \times \text{length in ft}}{43{,}560 \text{ sq. feet}}$$

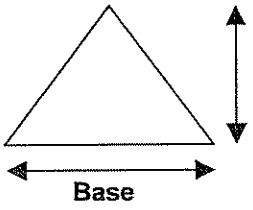
Circular Ponds



Total feet of shoreline

$$\text{Surface Acreage} = \frac{\left[\text{total ft of shoreline} \times \text{total ft of shoreline}\right]}{547{,}400 \text{ sq. ft}}$$

Triangular Ponds



$$\text{Surface Acreage} = \frac{\text{base in ft} \times \text{height in ft}}{87{,}120 \text{ sq. ft}}$$

Pond volume can be simply calculated (in acre feet) by multiplying surface acreage by average pond depth in feet. Average depth can be calculated by averaging several depth sounding of the pond. Alternatively, an estimate for ponds with uniformly rounded basins is one half of the average depth.

DOSAGE TABLES

The following tables are subject to change. Pesticide products and labels may change and new products and labels are frequently introduced. Before using any pesticide product, the specific product label should be consulted to determine the exact dosage rates. Labels contain the legal requirements for pesticide product use.

Listed below are the dosages recommended by the manufacturers of algicides and herbicides used for effective control of the aquatic plants described in this brochure.

Unicellular Algae	
CHEMICAL	DOSAGE
Copper Sulfate	0.7 - 2.8 lbs. per acre foot
Liquid Copper TEA	0.6 gal. per acre foot
Light blocking dye	0.25 gal. per acre foot
Dimethylcocoamine salt of endothall (Hydrothol)	0.6 - 2.2 pints per acre foot

Filamentous Algae	
CHEMICAL	DOSAGE
Cutrine Granular (for bottom growth)	60 lbs. per surface acre
Liquid Copper TEA	0.6 gal. per acre foot
Copper Sulfate	0.7 - 2.8 lbs. per acre foot
Diquat	1 - 2 gal. per surface acre
Light blocking dye	0.25 gal. per acre foot
Dimethylcocoamine salt of endothall (Hydrothol)	0.6 - 2.2 pints per acre foot

COPPER SULFATE DOSE TABLE: (Maximum Rates)		
Trout or Triploid Grass Carp Present	0.25 ppm	0.7 lbs. per acre foot
Warm water fish (Bass, sunfish, perch) present	0.5 ppm	1.4 lbs. per acre foot
No fish present	1.0 ppm	2.8 lbs. per acre foot

Stoneworts *(Chara, Nitella)*	
CHEMICAL	DOSAGE
Liquid Copper TEA	1.2 gal per acre foot
Granular Cutrine	60 lbs. per surface acre

Duckweed and Watermeal	
CHEMICAL	DOSAGE
Diquat	1 gal. per surface acre (diluted in 50-150 gal. of water) sprayed directly on plants
Weedtrine D diquat	5 gal. per surface acre
Fluridone Liquid	0.16 - .025 qts. per acre foot (dilute and spray directly on plants)

Water Milfoil	
CHEMICAL	DOSAGE
Granular 2, 4-D	100 lbs. per surface acre
Weedtrine D diquat	5 - 10 gal. per surface acre
Diquat	1 - 2 gal. per surface acre
*Fluridone Liquid	0.03 - 0.24 qts. per acre foot
*Fluridone Pellet	0.9 - 5 lbs. per acre foot
Liquid Potassium Endothall	1.25 - 2.0 gal. per acre foot
Granular Potassium Endothall	54 - 81 lbs. per acre foot

* Variable leaf milfoil is not controlled by fluridone

Coontail	
CHEMICAL	DOSAGE
Granular 2, 4-D	200 lbs. per surface acre
Fluridone Liquid	0.03 - 0.24 qts. per acre foot
Fluridone Pellet	0.9 - 5 lbs. per acre foot
Diquat	1 gal. per surface acre
Weedtrine D diquat	5 - 10 gal. per surface acre
Liquid Potassium Endothall	0.7 - 1.25 gal. per acre foot
Granular Potassium Endothall	27 - 54 lbs. per acre foot

American Elodea	
CHEMICAL	DOSAGE
Diquat	2 gal. per surface acre
Weedtrine D diquat	10 gal. per surface acre
Fluridone Liquid	0.03 - 0.24 qts. per acre foot
Fluridone Pellet	0.9 - 5 lbs. per acre foot

Curlyleaf Pondweed	
CHEMICAL	DOSAGE
Granular Potassium Endothall	13 - 40 lbs. per acre foot
Liquid Potassium Endothall	0.3 - 1.0 gal. per acre foot
Diquat	2 gal. per surface acre
Weedtrine D diquat	10 gal. per surface acre
Fluridone Liquid	0.03 - 0.24 qts. per acre foot
Fluridone Pellet	0.9 - 5 lbs. per acre foot

Floating Leaf Pondweeds *(Potamogeton spp.)*	
CHEMICAL	DOSAGE
Granular Potassium Endothall	27 - 54 lbs. per acre foot
Liquid Potassium Endothall	0.7 - 1.25 gal. per acre foot
Diquat	2 gal. per surface acre
Weedtrine D diquat	10 gal. per surface acre
Fluridone Liquid	0.03 - 0.24 qts. per acre foot
Fluridone Pellet	0.9 - 5 lbs. per acre foot

Fanwort	
CHEMICAL	DOSAGE
Fluridone	0.03 - 0.25 qts. per acre foot

Naiad	
CHEMICAL	DOSAGE
Granular Potassium Endothall	13 - 40 lbs. per acre foot
Liquid Potassium Endothall	0.3 - 1.0 gal. per acre foot
Diquat	1 gal. per acre foot
Weedtrine D diquat	5 gal. per surface acre
Light blocking dye	0.25 gal. per acre foot
Fluridone Liquid	0.03 - 0.24 qts. per acre foot
Fluridone Pellet	0.9 - 5 lbs. per acre foot

Spatterdock, Water Lily and Watershield	
CHEMICAL	DOSAGE
Glyphosate	6 pints per acre
Granular 2, 4-D	200 lbs. per surface acre
Fluridone Liquid	0.03 - 0.24 qts. per acre foot

Bladderwort	
CHEMICAL	DOSAGE
Weedtrine D Diquat	5 - 10 gal. per surface acre
Fluridone Liquid	0.03 - 0.24 qts. per acre foot
Fluridone Pellet	0.9 - 5 lbs. per acre foot
Diquat	1 - 2 gals. per surface acre

Cattails	
CHEMICAL	DOSAGE
Glyphosate	4.5 - 7.5 pints per acre
Diquat	1 gal. per acre in 100 gals. water
Fluridone Liquid	0.03 - 0.24 qts. per surface acre

Phragmites	
CHEMICAL	DOSAGE
Glyphosate	6 pints per acre
Fluridone Liquid	0.03 - 0.24 qts. per surface acre

Active Ingredient	Trade Names	Watershed Use
Copper Sulfate		possible w/copper concentrations up to 1.3 ppm
Copper TEA	Cutrine, K-TEA	possible w/copper concentrations up to 1.3 ppm
Dimethylcocamine salt of endothall	Hydrothol 191	NO
2, 4-D Ester	Aquakleen, Navigate	NO
Diquat	Reward, Weedtrine D	NO
Potassium Endothall	Aquathol K	NO
	Aquashade	NO
Glyphosate	Rodeo	possible w/conditions
Fluridone	Sonar, Avast	possible w/conditions

ALGICIDE AND HERBICIDE DESCRIPTIONS

The following is a brief discussion of some of the commonly used aquatic herbicides and algicides presently on the market and registered by the Department of Environmental Protection. It is by no means a complete list of chemicals discussed. These chemicals may be obtained with a Connecticut DEP issued aquatic permit from distributors of chemicals and agricultural supplies.

WARNING: A PERMIT FROM THE PESTICIDE MANAGEMENT DIVISION IS REQUIRED BEFORE ANY OF THE FOLLOWING CHEMICALS CAN BE LEGALLY PURCHASED AND INTRODUCED INTO ANY WATER.

Some of these products are classified for Restricted use, which means that the applicator must have certification (which involves an examination) as well as a permit in order to purchase and apply.

ALGICIDES

Copper Sulfate is a contact algicide and is marketed in crystalline form. The crystals should be first dissolved in water before treating filamentous algae. The solution may then be sprayed directly on algae mats. Copper sulfate treatment of unicellular algae is usually carried out by dragging a burlap bag containing the crystals through the water. Since copper sulfate is highly corrosive, the inside of any metal container holding a copper sulfate solution should be painted, enameled or copper lined.

Dissolved copper will combine with available carbonates in water and be precipitated to the bottom. Therefore, copper sulfate provides poor control in hard waters, except when applied at very high concentrations. In soft waters, some species of fish may be killed with applications greater than 0.25 parts per million. Trout and Triploid Grass Carp are quite susceptible to copper sulfate and if these fish are present, copper sulfate should be used only with extreme care.

As in all algal control work, the effects of copper sulfate may be short-lived and re-treatment once or more during a season may be necessary.

Copper compounds may be permitted for use in public water supply watersheds only up to 1.3 ppm.

Copper TEA (Cutrine or K-TEA) is available in both granular and liquid form. Liquid Copper TEA is best for filamentous and unicellular algae and should be diluted 9:1 in water before use. The diluted solution should be sprayed directly on filamentous algal mats. Granular Copper TEA is best for Chara and Nitella control. The granules should be spread directly over the nuisance vegetation.

Because Copper TEA is a chelated copper compound, dissolved copper does not become precipitated out of solution by combining with carbonates in water as does the copper from copper sulfate. By remaining in solution, the unused copper is able to prevent new growth after initial control is obtained. Copper TEA is also much less toxic to fish than copper sulfate. However, in soft water with a carbonate content of less than 50 parts per million, even Copper TEA may kill fish.

Dimethylcocamine salt of endothall (Hydrothol) may be purchased in either liquid or granular form. The liquid form is preferable for treating unicellular and filamentous algae. This is a contact herbicide and should be sprayed directly on the algae. This product is decomposed by microorganisms and breaks down into harmless non-toxic components. Due to its toxicity, liquid formulations are classified for restricted use - only certified applicators may use it. When using dimethylcocamine salt of endothall, some fish mortality may result at dosages in excess of 0.3 parts per million for an entire pond treatment.

Hydrothol may not be permitted for use in a public water supply watershed.

HERBICIDES

2, 4-D Ester (Aquakleen) is available in both granular and liquid form. In Connecticut, the granular form is more available and more widely used than is the liquid form. 2, 4-D kills aquatic weeds by disrupting the pattern of cell division in the actively reproducing sections of leaves, roots and stems. Therefore, applications of 2, 4-D should be made when weeds are actively growing, which is normally from the spring to early summer. Granular 2, 4-D is impregnated on clay granules that resist decomposition in water. When applied, the granules sink to the pond bottom, where the slow release of 2, 4-D maintains a continuous concentration of herbicide in the immediate vicinity of plant root and leaf intake. Granular 2, 4-D may give up to two years residual control on certain species of weeds. Being a systemic herbicide, 2, 4-D will require more time to effect a kill than will other contact herbicides. Four to six weeks may be required for weeds to die.

Weeds are difficult to control with 2, 4-D in ponds where water replacement is by bottom springs. Best results are obtained when granular 2, 4-D is spread evenly over weed beds. Spreading of the granules may be facilitated by the use of a hand-operated spreader, such as a Cyclone Seeder.

Since 2, 4-D is very toxic to certain plants such as tomatoes and grapes, water which is used for irrigation should not be treated with this chemical.

2, 4-D may not be permitted for use in a public water supply watershed.

Diquat (Weedtrine D, Reward) is a compound that penetrates plant tissue quickly, stopping photosynthesis. Because it is a contact herbicide, it is most effective on plants without extensive root systems. This water soluble chemical is inactivated on soil particles. However, because of this feature, plants in turbid water and plants coated with a deposit of silt cannot be successfully treated. Care should be taken not to disturb the bottom sediment when applying Diquat. Application of this herbicide can be made by spraying onto the water surface or by pouring into the water. Diquat should be applied before weed growth becomes dense. It reportedly is particularly safe to fish and fish food organisms. This material is very irritating to skin and eyes and should be used with care. Formulations of Diquat which are over 18% in concentration are classified for restricted use - only licensed applicators may use it. Syngenta Reward is so classified. Other formulations of diquat are available with lower concentrations of the active ingredient. While they are less poisonous, and may be used by unlicensed persons (with the permit!), the application rate must be altered to account for the lower concentration.

Diquat may not be permitted for use in a public water supply watershed.

Potassium Endothall (Aquathol K) is marketed in both liquid and granular form. A broad range of aquatic plants, particularly submerged species, are controlled by endothall. Endothall is a contact herbicide and should be used only when the nuisance weeds are present. Liquid potassium endothall can be sprayed onto the water surface or poured into the water evenly over weedy areas. Marginal or spot treatment of weeds can best be carried out with granular endothall by spreading the chemical directly over weedbeds. After treatment with endothall, plants die and settle to the bottom within three to five days.

There reportedly is a wide margin of safety between the recommended dosage for killing weeds and the concentrations that are toxic to fish and fish food organisms. Potassium endothall has a short active period in the water, but is quite toxic in its concentrated form. Protective clothing should be worn when applying it. Liquid formulations are classified for restricted use, meaning only licensed applicators may apply it.

Endothall may not be permitted for use in a public water supply watershed.

Light Blocking Dye (Aquashade) is a light opaque dye that does not directly kill weeds or algae. Its mode of action is simply to shade the weeds. Since plants need sunlight to grow, the weeds will then die out. It is most useful in shallow lakes where flow through time is relatively long. It is only effective when applied early in the season before weed growth has started.

Light blocking dye may not be permitted for use in a public water supply watershed.

Glyphosate (Rodeo) has been used successfully on land for several years. It is only to be used on emergent or floating vegetation such as cattails or spatterdock. It is a potent herbicide so great care must be taken not to let it contact valuable plants. This material has a reasonably short breakdown time in water, is not likely to leach through soils, and has a fairly low order of toxicity. It is systemic, killing the roots as well as the tops of plants. In order to do so effectively, it should be applied after flowers have formed, usually after midsummer. Occasionally, effects are not seen on the plant the year it is applied, but the plants do not appear the next season.

Glyphosate may be permitted for use in a public water supply watershed subject to certain conditions.

Fluridone (Sonar) is a chemical that has long lasting systemic effects. It has a very low order of toxicity to humans, fish and wildlife. It is slow acting, and needs to contact the vegetation for a fairly long period of time. Consequently it is not effective for treating small areas of large lakes, as it is diluted too quickly in these areas. Five acres is the minimum size that should be treated in a large lake. Fluridone may damage or kill shorebank vegetation that has roots extending into the water. It is available in either liquid or granular formulations. Fluridone may only be used once per year in a given application site. Since it is slow acting, it works best if applied early in the season. Fluridone may have adverse effects on all underwater plants, so it should be used at very low rates (less than 8 ppb) if selectivity is desired.

Fluridone is available in formulations with differing release rates.

Fluridone may be permitted for use in a public water supply watershed subject to certain conditions.

Recommended Amount of Time to Allow After Treatment of Herbicides and Algicides in Ponds or Lakes

CHEMICAL	DRINKING	IRRIGATION	SWIMMING	FISHING
Copper Sulfate	*	*	*	*
Copper TEA	*	*	*	*
Dimethylcocamine salt of endothall	7 days	7 days	24 hours	3 days
Diquat	3 days	3 days turf & ornamentals 5 days food crops	*	*
Granular 2, 4-D	refer to label	refer to label	*	*
Granular potassium endothall	7 days	7 days	*	3 days
Liquid potassium endothall	14 days	14 days	*	3 days
Glyphosate	do not use within 1/2 mile of water intake	*	*	*
Fluridone	do not use within 1/4 mile of water intake	30 days	*	*
Light Blocking Dye	do not use	*	*	*

* This information is taken from the pesticide product labels. If no specific time is noted, then the lake or pond can legally be used for the specific purpose as soon as the chemicals have dispersed. Caution, however, may indicate waiting at least one day before using the lake or pond.

Sources of Additional Information

Connecticut Department of Environmental Protection

http://www.dep.state.ct.us/pao/download.htm#Waste
Aquatic permit application forms are available on-line

Inland Fisheries Division - Hartford 860/424-FISH
Fish problems, identification of aquatic weeds, grass carp information

Regional DEP Fisheries Biologists
Eastern District - Marlborough 860/295-9523
Western District - Harwinton 860/485-0226
Fish kills, other fisheries problems

Bureau of Water Management
Lakes Management Program 860/424-3176
water quality surveys, non-chemical control, watershed management and weed identification and lake restoration grants

Inland Water Resources Division 860/424-3706
Maintenance, inspection or repair of a dam 860/424-3019
Dredging or drawdown of a pond or lake

State regulatory requirements for work in wetlands and watercourses, including ponds, lakes or flowing waters

Pesticides Management Program 860/424-3369
aquatic herbicide permits, commercial applicators, rates of herbicide application

Natural Resource Conservation Service, USDA - Windsor 860/688-7725
Construction of ponds, erosion control

U.S. Army Corps of Engineers - Concord, MA 978/318-8335
978/318-8338
Federal regulatory requirements for work in waterways or wetlands, including ponds, lakes or other waters

University of Florida - Center for Aquatic & Invasive Plants
http://aqua1.ifas.ufl.edu
Texas Agricultural Extension Service
http://wildlife.tamu.edu/aquaplant

Your Local Inland Wetland Commission
Regarding any modification or treatment of water within your town

Appendix I
Connecticut General Statutes

22a-66a(h) Any pesticide application business or department, agency or institution of the state or municipality prior to making a pesticide application in any lake or pond with any public access owned by the state or municipality shall cause to be published notice of the application in a newspaper of general circulation in each municipality in which the lake or pond is located and shall post a sign notifying the public of the application at each place of public access. Such sign shall comply with regulations adopted by the commissioner pursuant to subsection (g) of this section. Any pesticide application business prior to making a pesticide application on any private lake or pond with more than one owner of shoreline property shall cause to be published notice of such application in a newspaper of general circulation in each municipality in which the lake or pond is located.

REGULATIONS OF CONNECTICUT STATE AGENCIES

22A-66A-1(e) **Notice of pesticide applications to lakes and ponds.**
(1) In accordance with subsection (g) of section 22a-66a of the general statutes, any pesticide application business or department, agency or institution of the state or a municipality, prior to making a pesticide application in any lake or pond with any public access owned by the state or a municipality shal give newspaper notice to the public in accordance with subsection (g) of section 22a-66a, and shall post a sign in a conspicuous location at each place of public access owned by the state or a municipality.

(2) The bottom of each sign shall be posted a minimum of forty inches above the ground and the top no higher than sixty inches above the ground.

(3) No person shall remove or render difficult to read, in whole or in part, any information which is required by this subsection until the end of the longest waiting period specified in subparagraph (C)(v) of this subsection.

(4) Each sign required by subsection (g) of section 22a-66a of the general statutes shall conform to the following requirements:
(A) The sign shall be a minimum of eight and one half inches high by eleven inches wide.
(B) The sign shall be of a rigid material substantial enough to be easily read for at least the longest waiting period specified in subparagraph (C)(v) of this subsection.
(C) The sign shall contain the following information in black lettering on a bright yellow background in the format specified in appendix B:
(i) "CAUTION" in bold print of at least thirty-six point type, followed by, "LAKE TREATED WITH PESTICIDES" in bold print of at least twenty-four point type;
(ii) "Pesticide name(s): (the common name of each pesticide applied)" in bold

print of at least twenty point type;
(iii) "Date/time: (date and time each pesticide was applied)" in bold print of at least twenty point type;
(iv) "Applicator: (the name and telephone number of the pesticide application business or other person that applied the pesticide)" in bold print of at least twenty point type;
(v) The statement, "Do not us the water for the following purposes(s) until the date and time noted below:" in at least eighteen point type, followed by the dates and times that swimming and other water-contact activities, drinking, fishing, irrigation, livestock watering and other uses specified on the pesticide label or pesticide use permit may be resumed, according to the label and permit, whichever is more stringent. If the label and permit are silent as to when a certain activity may be resumed, the words "No Restriction" shall be used for that activity. Nothing in this subsection shall prohibit a pesticide application business, department, agency or institution from placing more stringent water use restrictions on the notice than are required on the label and permit.
(vi) The statement, "This sign must remain posted until at least the date above" in bold print of at least twenty-four point type.
(D) Except for the date and time of the pesticide application, the name and telephone number of the pesticide application business or other person that applied the pesticide, and the end of each waiting period, the information required on the sign shall be professionally printed. The remaining information may be handwritten, provided it is in permanent ink and in print that is easy to read.

(5) Any notice of pesticide application required to be published pursuant to subsection (g) of section 22a-66a of the general statutes regarding pesticide application to a lake or pond with any public access owned by the state or a municipality and pesticide applications to any private lake or pond with more than one owner of shoreline property, or required to be published or posted pursuant to subsection(l) of section 22a-66a of the general statutes regarding mosquito control, shall include but not be limited to the following information:
(A) The common name of each pesticide to be applied;
(B) the location of the pesticide application;
(C) the purpose of the pesticide application;
(D) the estimated date of the pesticide application, and the statement, "Information on the specific date of application may be obtained from the person named below."
(E) the name, address and telephone number of a contact person affiliated with the pesticide application business or department, agency or institution of the state or municipality making the pesticide application.
(F) the statement, "Do not use the water for the following purpose(s) until the date and time noted below:" followed by the dates and times that swimming and other water-contact activities, drinking, fishing, irrigation, livestock watering and other uses specified on the pesticide label or pesticide use permit may be resumed, according to the label and permit, whichever is more stringent. If the label and permit are silent as to when a certain activity may be resumed, the words "No Restriction" shall be used for that activity. Nothing in this subsection shall prohibit

a pesticide application business, department, agency or institution from placing more stringent water use restrictions in the notice than are required by the label and permit.

(6) A pesticide application shall not be made prior to the estimated date of application specified in a published notice. If the actual date of pesticide application will exceed the estimated date of application by more than three calendar days, the notice shall be republished.

CAUTION

LAKE TREATED WITH PESTICIDES

PESTICIDE NAME(S): **DATE/TIME:**

APPLICATOR: **PHONE:**

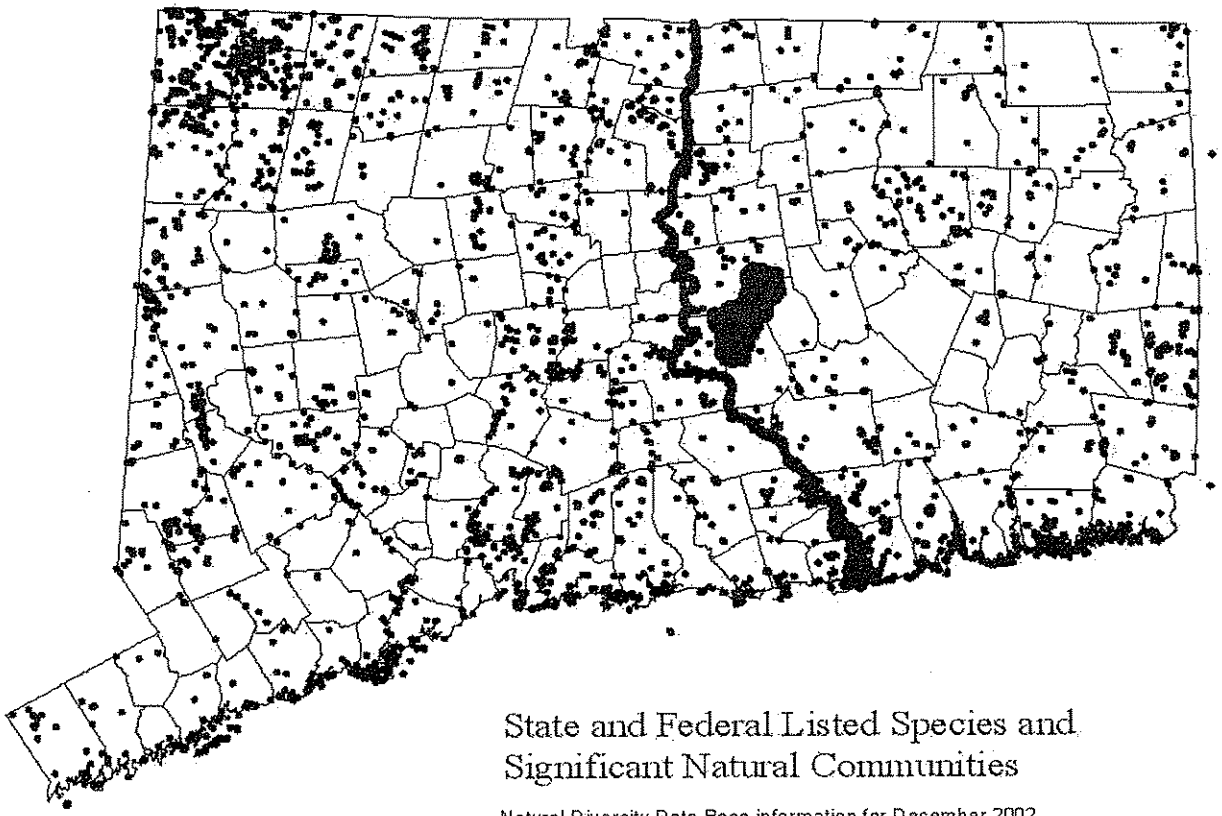
Do not use the water for the following purpose(s) until the date and time noted below:

Swimming or other Water contact: Fishing: Irrigation:

Drinking: Livestock watering: Other:

This Sign must remain posted until the latest date above

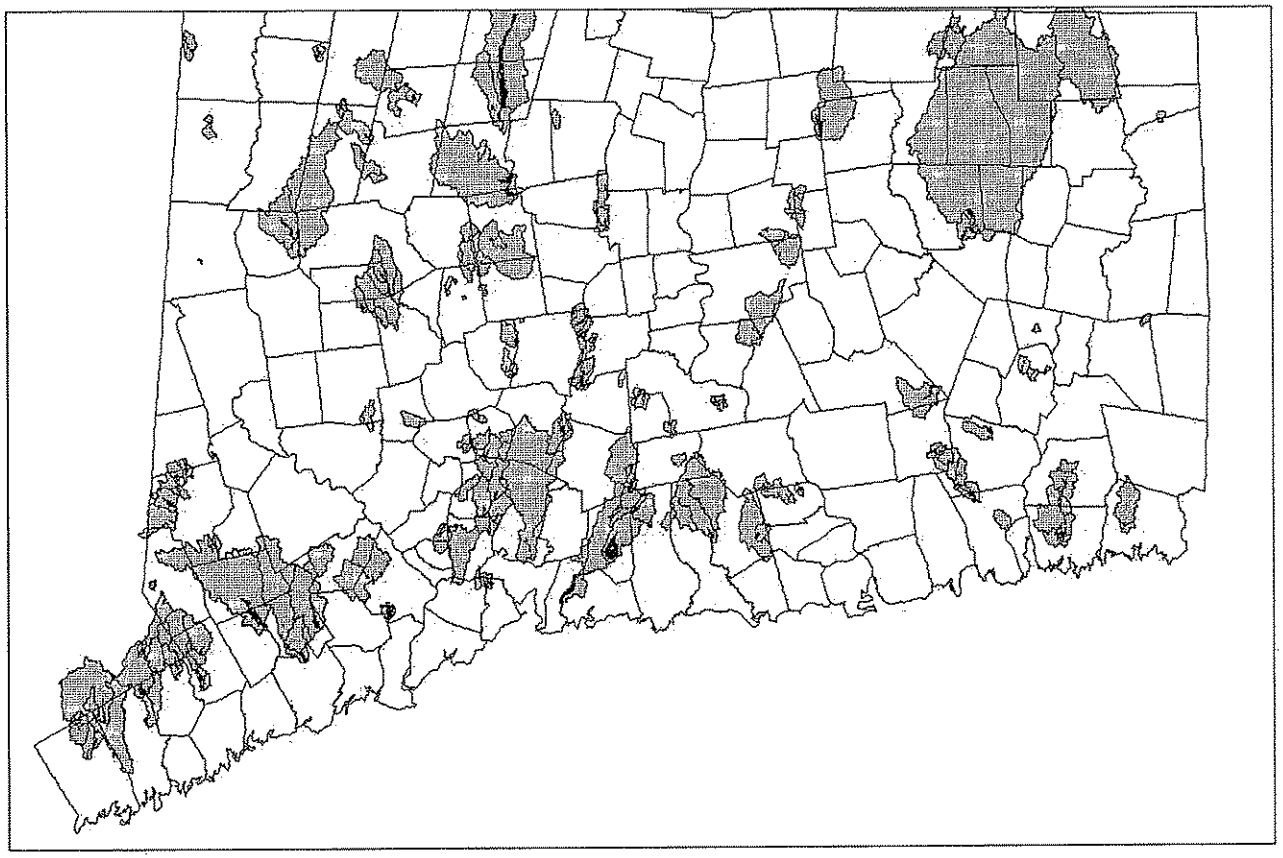
Appendix II



State and Federal Listed Species and Significant Natural Communities

Natural Diversity Data Base information for December 2002.
Contact NDDB for site specific reviews.

Appendix III



PUBLIC WATER SUPPLY
WATERSHED AND RESERVOIRS

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Map printed 1/9/2003

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NOTE: This map is for illustrative purposes only. Data may not be complete/current.

Appendix IV
Registered Commercial Pesticide Application Businesses
Aquatic Category

BUSINESS NAME	RESPONSIBLE INDIVIDUAL
ALL HABITAT SERVICES, LLC P.O. BOX 874 MADISON, CT 06443	DAVID P. ROACH PHONE: 203/245-1212
ALLIED BIOLOGICAL INC. 580 ROCKPORT ROAD HACKETTSTOWN, NJ 07840	GLENN P. SULLIVAN PHONE: 908/850-0303
AQUA CARE 26 HIGHLAND PARK ROAD NORTH HAVEN, CT 06473	ROBERT HANNON PHONE: 203/234-7207
AQUATIC CONTROL TECHNOLOGY,INC. 11 JOHN RD. SUTTON, MA 01590	GERALD N.SMITH PHONE: 508/865-1000
BCI INC DBA BUTLER COMPANY 848 MARSHALL PHELPS RD. WINDSOR, CT 06095	WILLIAM N. BUTLER PHONE: 860/688-8024
CONNECTICUT POND SERVICES 59 ROWLEDGE POND ROAD SANDY HOOK, CT 06482	RICHARD BOBOWICK PHONE: 203/452-1481
DEMARCO MILES & MURPHY PROPERTY SERVICES 117 MURPHY ROAD HARTFORD, CT 06114	MARIA L. DEMARCO PHONE: 860/951-9411
DIVERSIFIED PEST MGMT., INC. 231 WEST MAIN ST. CHESTER, CT 06412	JERRY WALDEN PHONE: 860/526-2277
ECOSYSTEM CONSULTING SERVICE 30 MASON STREET COVENTRY, CT 06238	ROBERT W. KORTMANN PHONE: 860/742-0744

GREEN HORIZONS, INC.
6980 OXFORD STREET
MINNEAPOLIS, MN 55426

CHRIS BEUTZ

PHONE: 952/939-0155

J & B EDUCARE
10 ALMAR DRIVE
BETHEL, CT 06801-1808

JOSEPH MAISANO, JR.

PHONE: 203/744-6894

JIM MARTURANO
25 WOODBINE CT
BERLIN, CT 06037

JIM MARTURANO

PHONE: 860/829-1974

LIMEWOOD FARM
83 TURKEY PLAIN ROAD
BETHEL, CT 06801

PAUL R. YOUNG

PHONE: 203/748-3787

LIMNOLOGY INFORMATION AND ECOLOGY,INC.

MARK ROLAND

19 SANDY PINES BLVD.
HOPEWELL JCT, NY 12533

PHONE: 845/227-8805

LYCOTT ENVIRONMENTAL, INC.
600 CHARLTON ST
SOUTHBRIDGE, MA 01550

LEE D.LYMAN

PHONE: 508/765-0101

NON-TOX PEST MANAGEMENT
26 HIGHLAND PARK ROAD
NORTH HAVEN, CT 06473

ROBERT HANNON

PHONE: 203/234-7207

NORTHEAST TREE, POND & TURF SERVICE, INC

ROBERT B.GAMBINO

4 OLD MILL ROAD
NEW MILFORD, CT 06776

PHONE: 860/354-3319

THIS LIST IS PROVIDED FOR THE CONVENIENCE OF THE PUBLIC AND DOES NOT IMPLY AN ENDORSEMENT OF ANY OF THE FIRMS LISTED ABOVE

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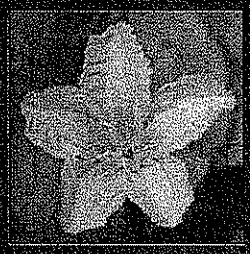
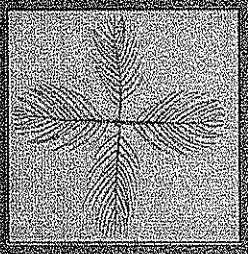
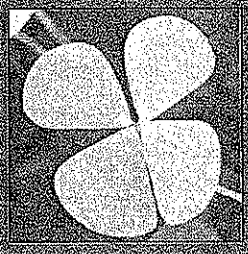
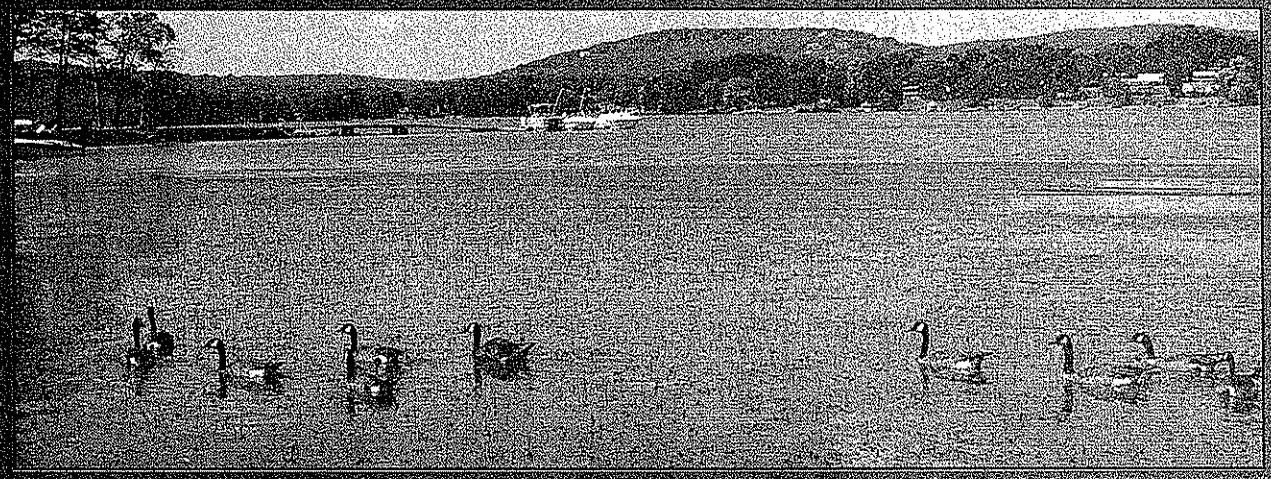
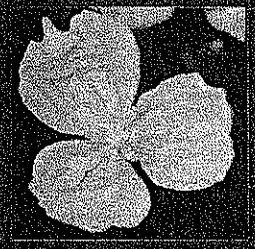
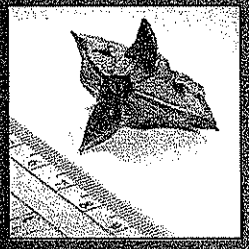
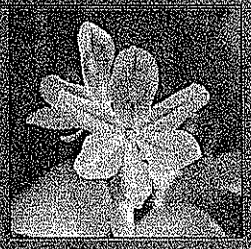
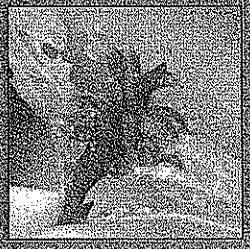
Connecticut's Invasive Aquatic and Wetland Plants

Identification Guide



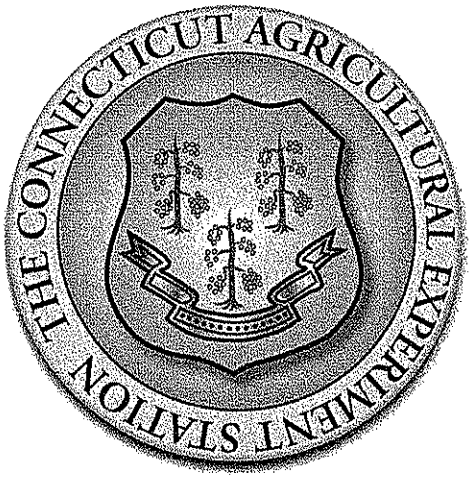








Gregory J. Bugbee

Martha E. Balfour

The Connecticut Agricultural Experiment Station
Department of Environmental Sciences
P.O. Box 1106
New Haven, CT 06504

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.



Acknowledgements

The efforts of Dr. Robert Capers, Ms. Nancy Murray, Ms. Roslyn Reeps, and Ms. Amy Weiss are gratefully acknowledged.

Bulletin No. 1027

Table of Contents

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 162 lakes and ponds, by the Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP), found one or more invasive plants in nearly two-thirds of the water bodies (CAES IAPP, 2010).

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 unwanted plants in 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, 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 General Statutes of Connecticut (Connecticut Public Acts 03-136, 04-203 and 09-52). 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

Identification of many of Connecticut's freshwater aquatic plants is challenging. CAES IAPP surveys have found nearly 100 native species and 13 invasive species (Figure 1). These do not include many wetland plants included in this guide because our surveys are limited lakes and ponds. We use many resources when plant identification is questionable including; books by 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 will be unfamiliar to most 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 you find plants is often related to how they are dispersed (Table 1) and sometimes gives a clue to their identification .

Table 1. Connecticut's invasive or potentially invasive aquatic plants listed in Public Act 09-52 and their most common means of dispersal.

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

*plants that are not banned

This guide has three main parts to help you identify aquatic invasive plants. First, each plant has a one page summary containing pictures, a list of the key features used for identification, and a map of where the plant has been found by either CAES IAPP or the Invasive Plant Atlas of New England (IPANE, 2009). Second, there is a series of comparative pictures that help differentiate 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 the native plants that the invasive plants are most commonly confused with.

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 that the location of the plant is noted. Latitude and longitude coordinates taken with a global positioning system (GPS) is 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 Environmental Protection. You can call CAES IAPP at (203) 974-8512 if you have questions.

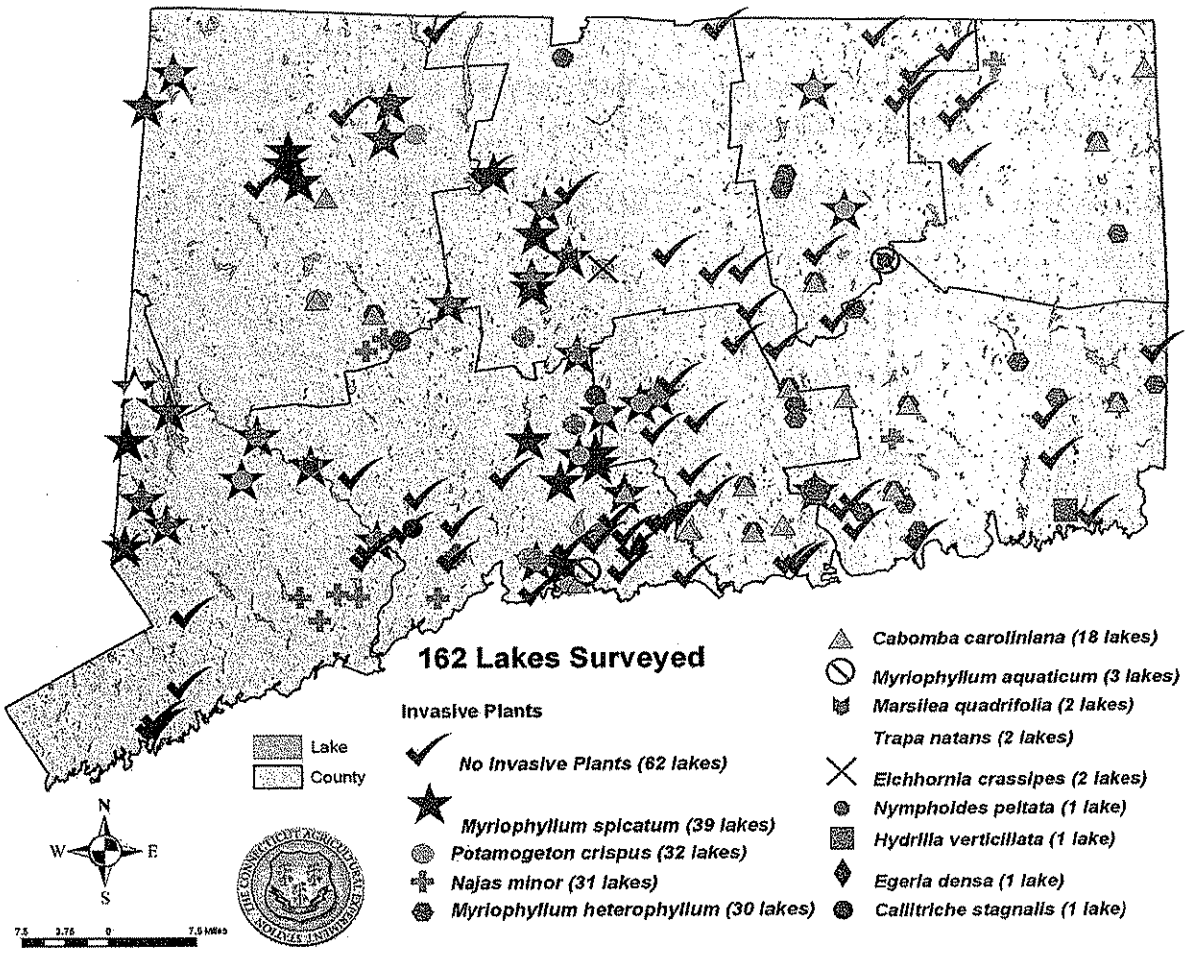


Figure 1. Locations of invasive aquatic plants found by CAES IAPP surveys from 2004-2009.

Additional Resources for Plant Identification

CAES IAPP web page, aquatic plant survey requests 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/

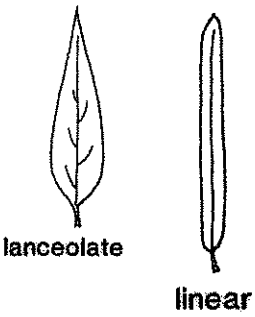
Invasive Plants of the Eastern United States: Identification and Control
http://www.invasive.org/eastern/

State of Washington Department of Ecology Non-native Freshwater Plants
http://www.ecy.wa.gov/programs/wq/plants/weeds/exotic.html

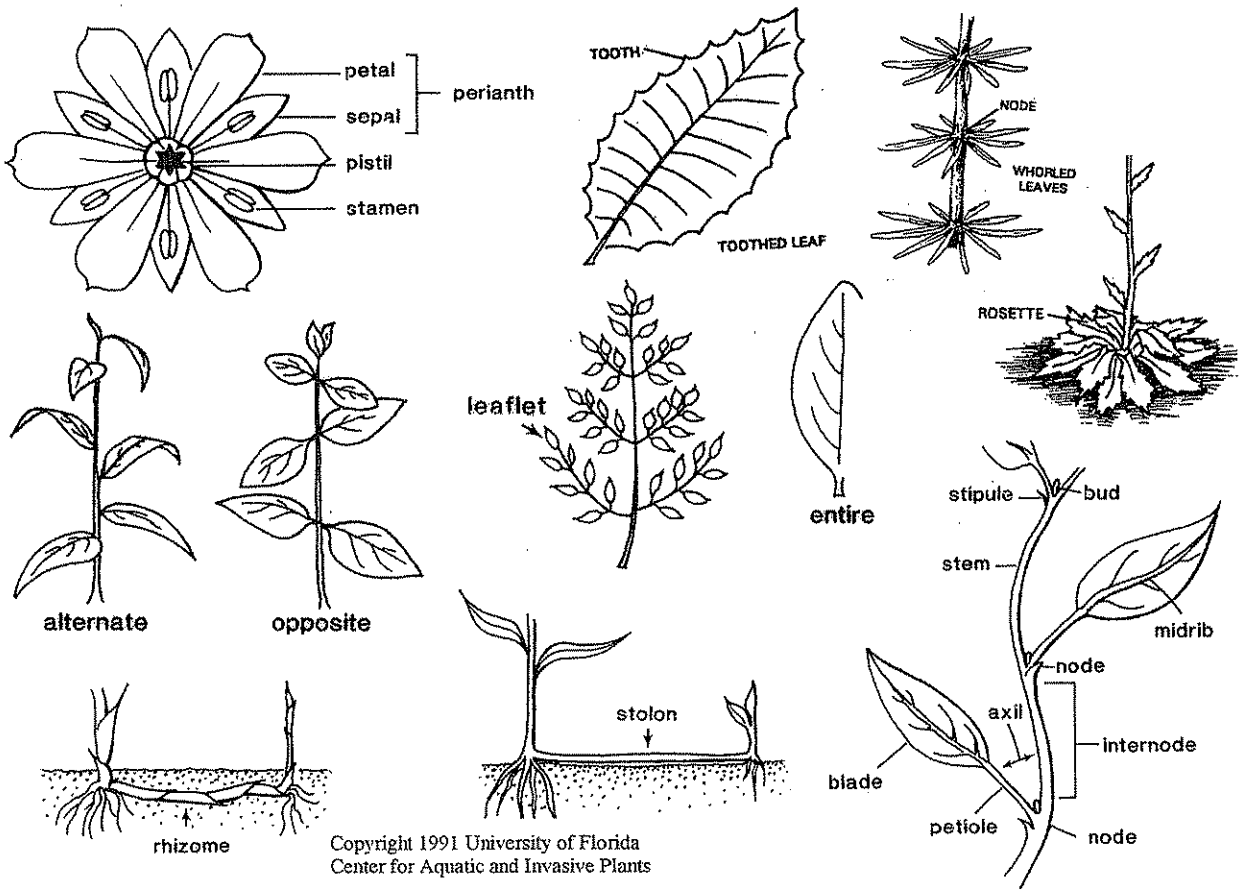
Center for Aquatic and Invasive Plants, University of Florida
http://plants.ifas.ufl.edu/

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
Stolon: above ground stem often sending out roots and shoots at nodes, also termed "runner"
Rosette: a dense cluster of leaves that are all at a single height, like petals of a rose
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

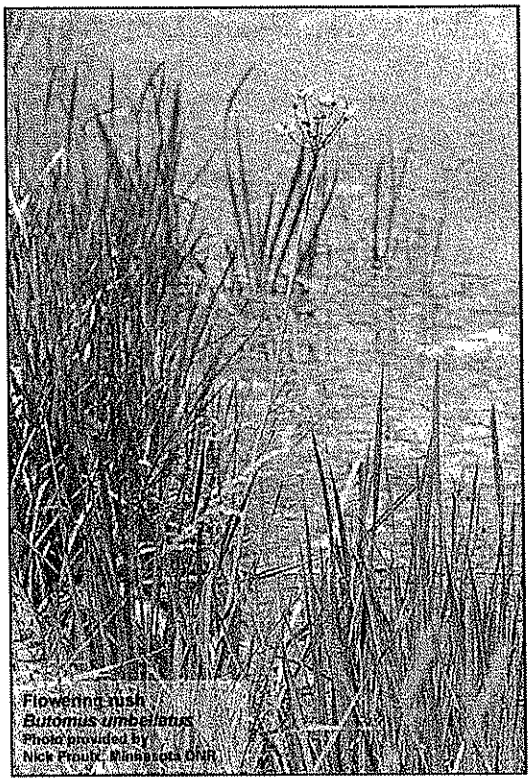


Butomus umbellatus

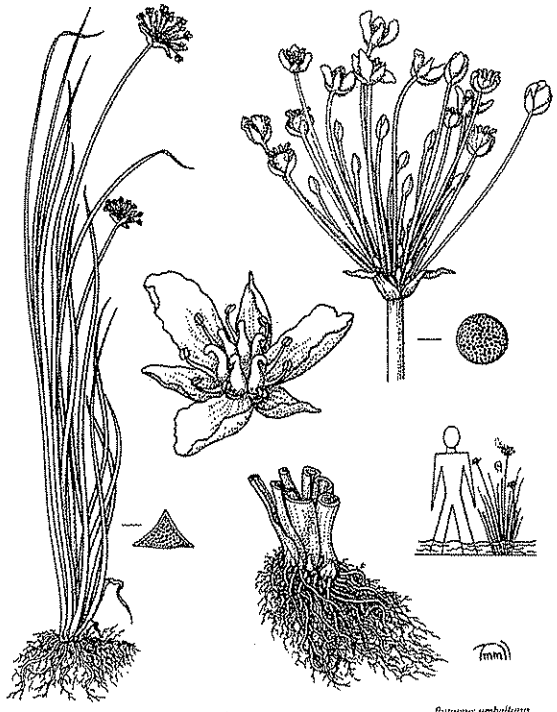
Common name:
Flowering rush

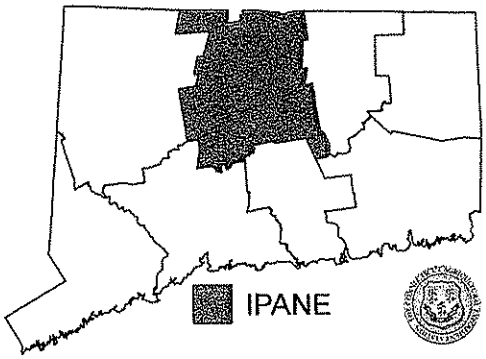
Origin:
East Asia

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

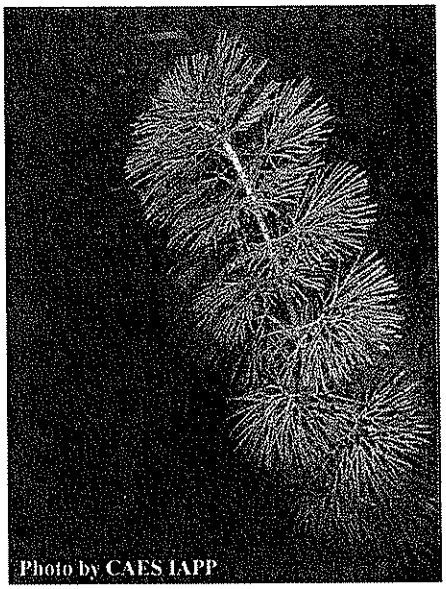


Easily confused species:
Bur-reeds: *Sparganium* spp.





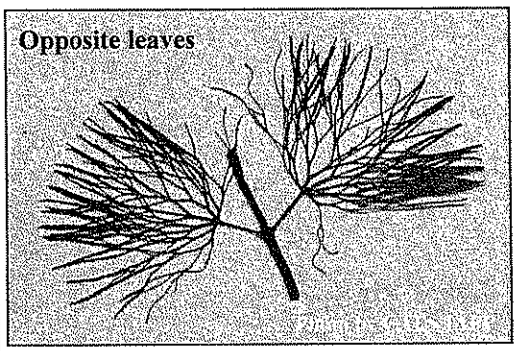
Cabomba caroliniana



Common names:
Fanwort
Carolina fanwort

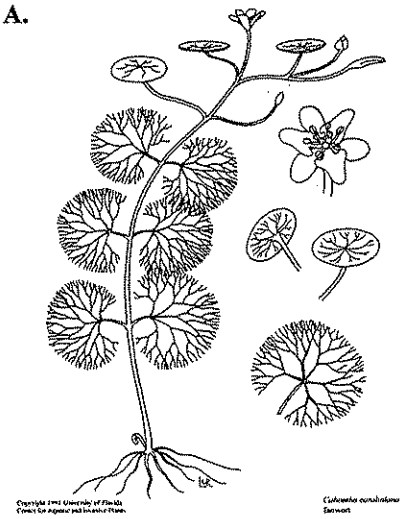
Origin:
Southeast United States
South America

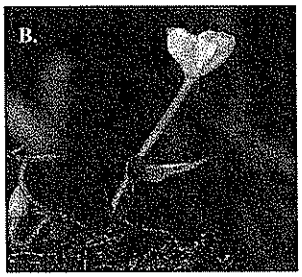
Key features:
Plants are submersed
Stems: Can be 6 feet (2 m) long
Leaves: Dissected, opposite leaves 0.8-2 inches (2-5 cm) are fan-like and made up of forked leaflets attached to the stem by a petiole. Floating leaves 0.2-0.8 inches (6-20 mm) wide are oblong and produced on flower shoots
Flowers: Small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

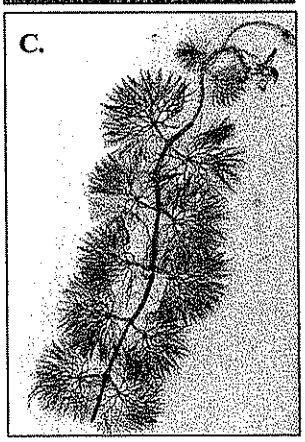


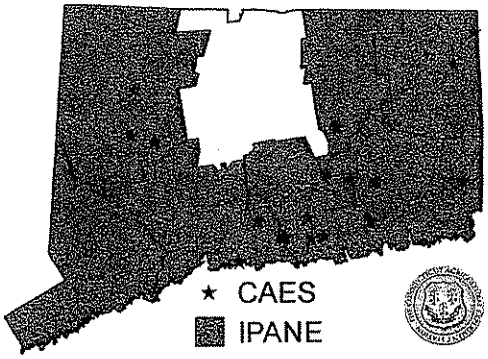
Easily confused species:
Watermilfoils: *Myriophyllum* spp.
White water crowfoot: *Ranunculus longirostris*
Water marigold: *Megalodonta beckii*

A.









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

Callitriche stagnalis

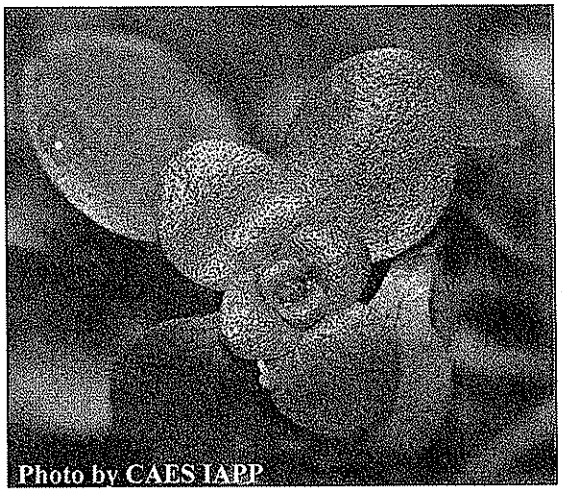


Photo by CAES IAPP

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)


Photo by Gordon Leppig & Andrea J. Pickart

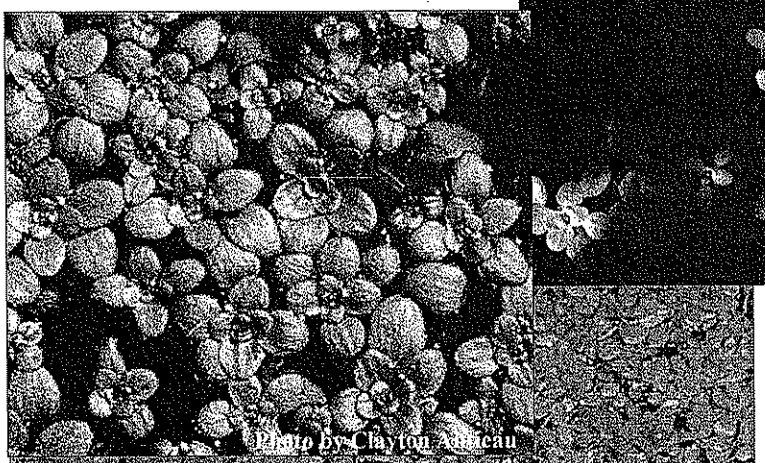


Photo by Clayton Antieau

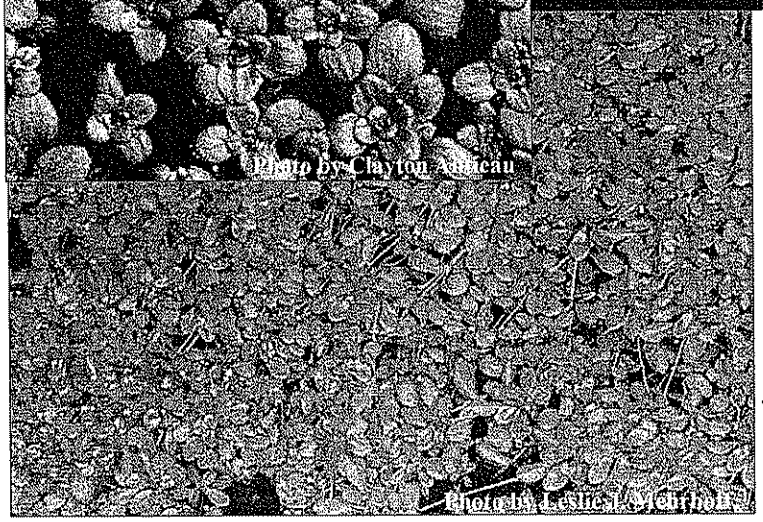
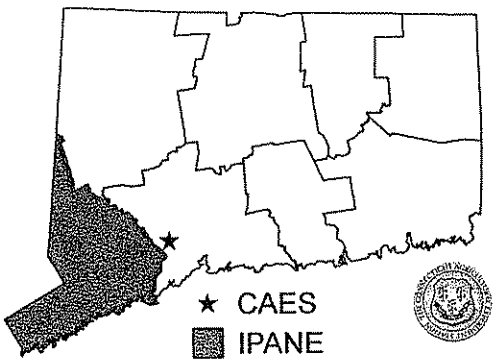
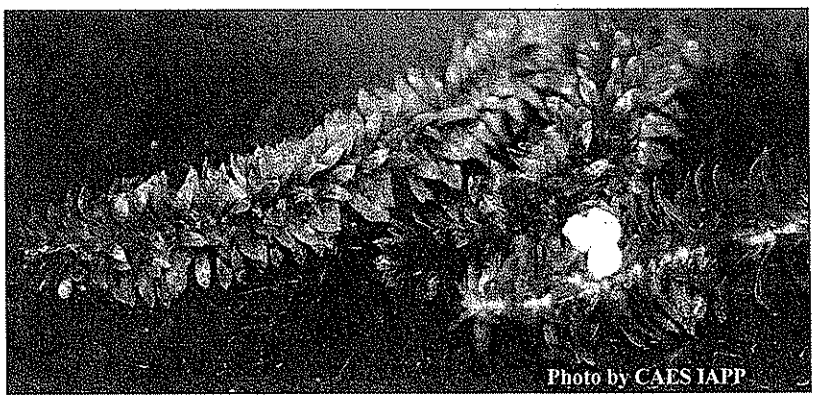


Photo by Leslie J. Mehrhoff



thought id were alike. Need to id by fruit

Egeria densa

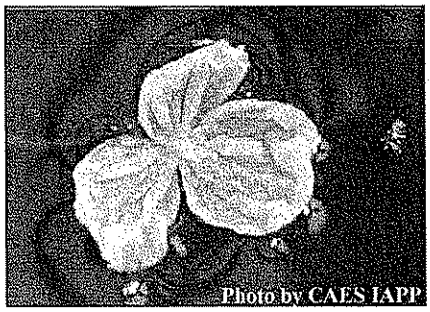


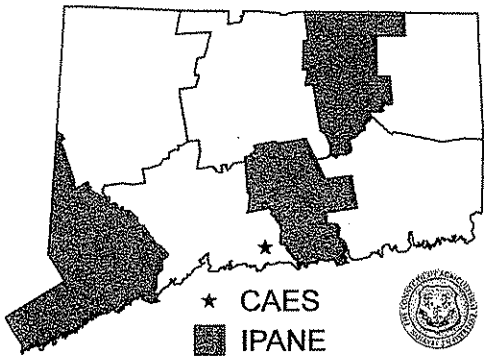
Common names:
Brazilian waterweed
Brazilian elodea
South American waterweed

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 *Elodea canadensis*
Hydrilla: *Hydrilla verticillata*





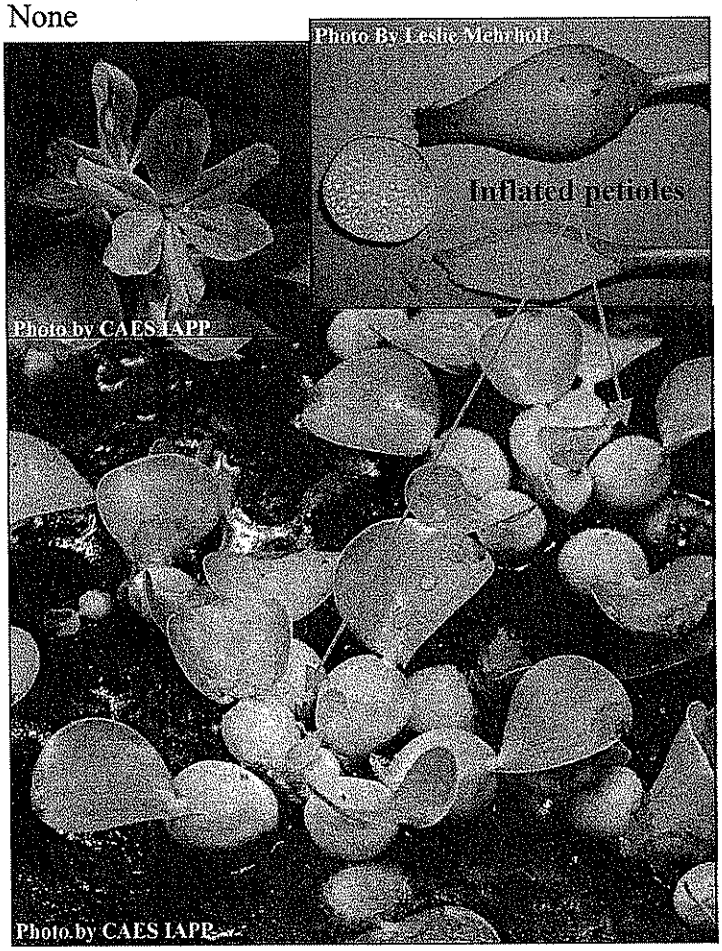
Eichhornia crassipes

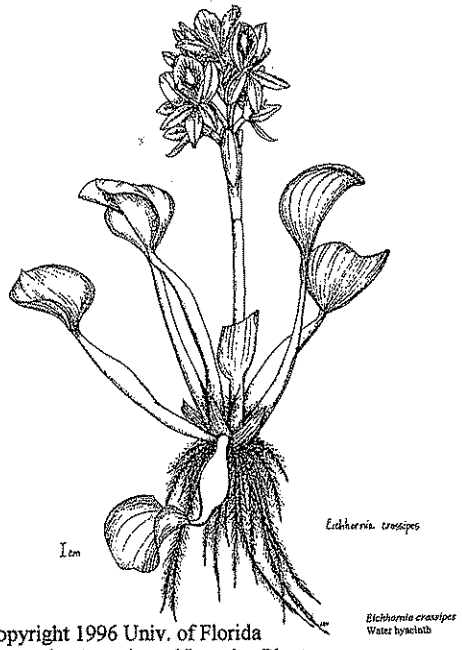
Common names:
Common water-hyacinth
Floating water-hyacinth

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





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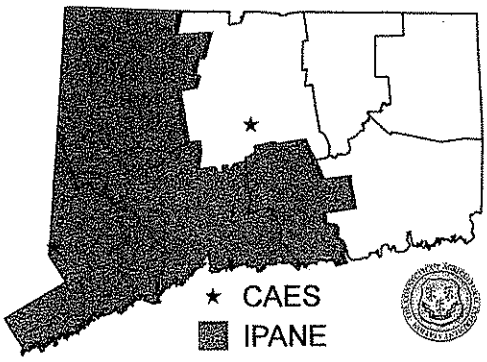
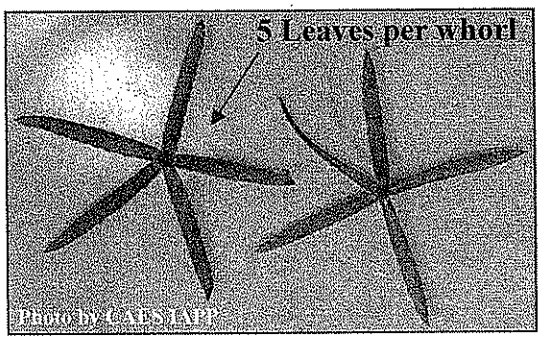


Hydrilla verticillata

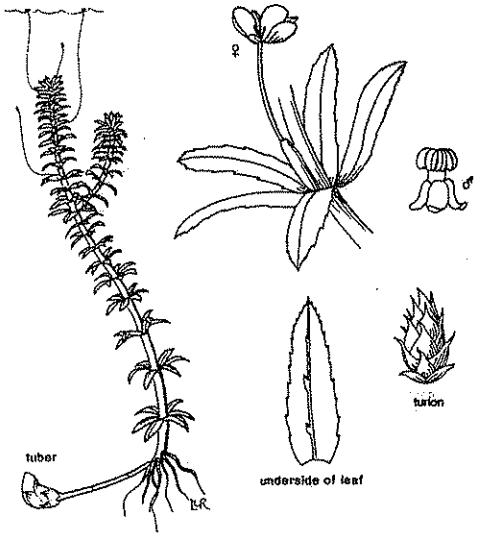
Common name:
Hydrilla

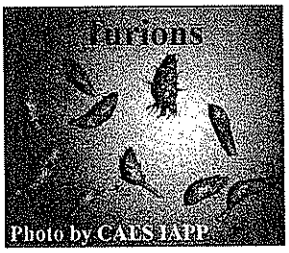
Origin:
Asia

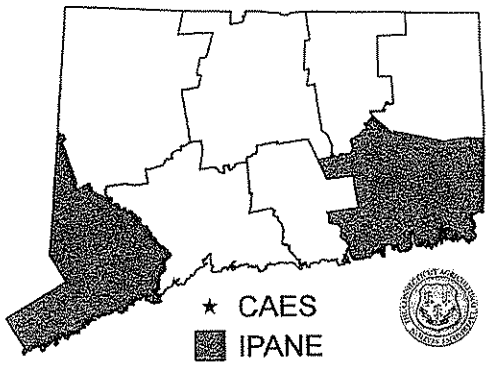
Key features:
Plants are submersed
Stems: Slender, branched and up to 25 feet (7.5 m) long
Leaves: Whorled leaves approx. 0.7 inches (1.5 cm) long, whorls often have 5 leaves (range 4-8); leaf margins are visibly toothed
Flowers: Female flowers have three translucent petals that have reddish streaks, 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*







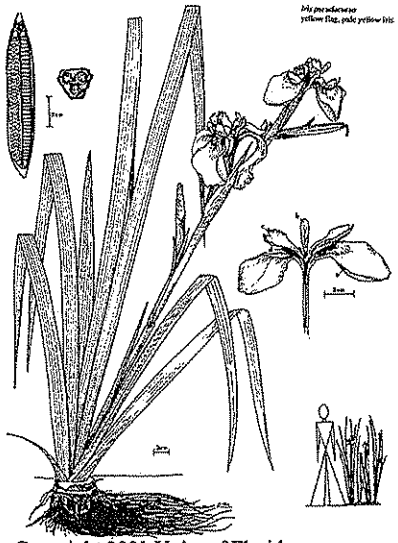
Hydrilla verticillata
Hydrilla

Iris pseudacorus

Common names:
Yellow iris
Yellow flag

Origin:
Europe, western Asia, and 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



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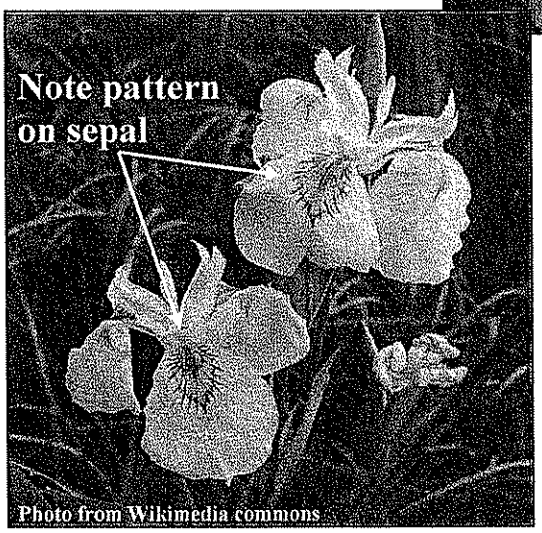
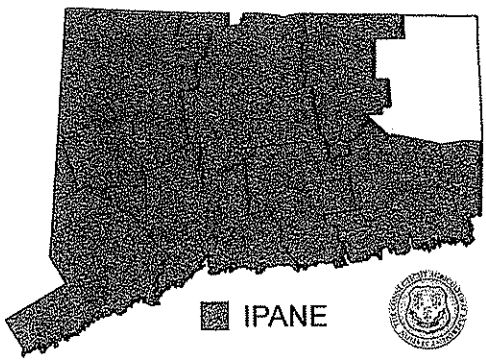
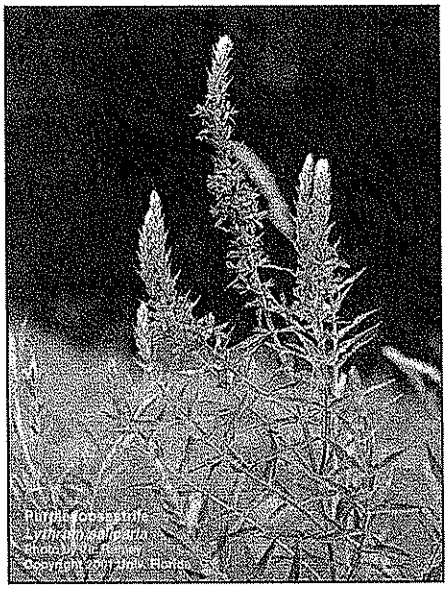
Easily confused species:
Northern blue flag iris: *Iris versicolor*





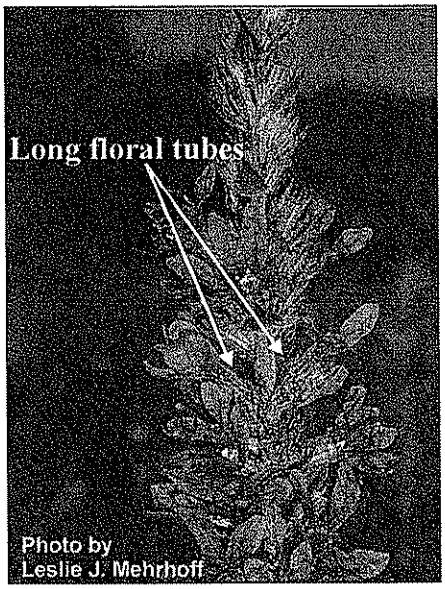
Lythrum salicaria



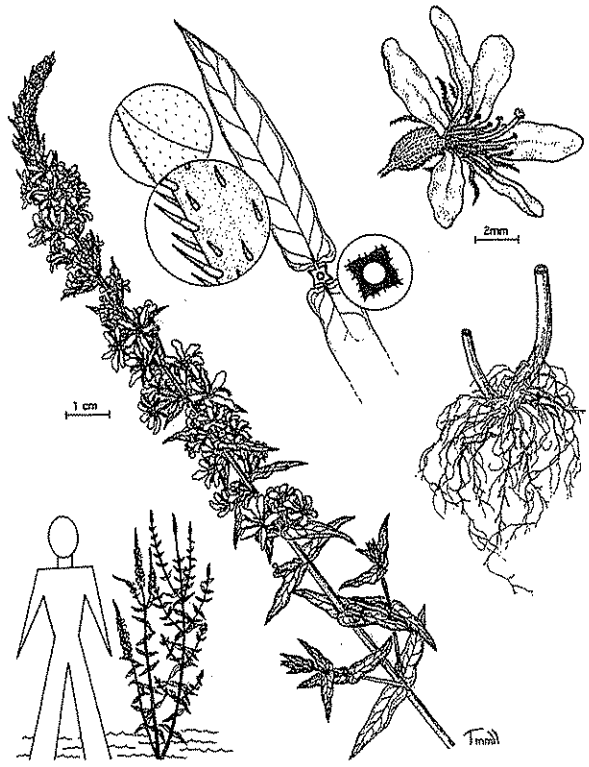
Common name:
Purple loosestrife

Origin:
Europe

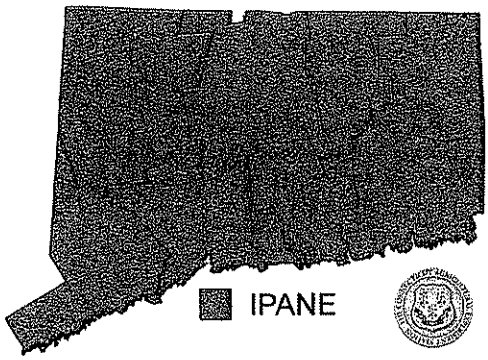
Key features:
Stems: Plants have herbaceous stems and can grow 1.5-5 feet (0.5-1.5 m) tall
Leaves: Opposite or in whorls of 3, 1-4 inches (3-10 cm) long, linear or lanceolate in shape, leaves can be smooth or hairy
Flowers: Large pink-purple flowers clustered on long terminal spikes 4-16 inches (10-40 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



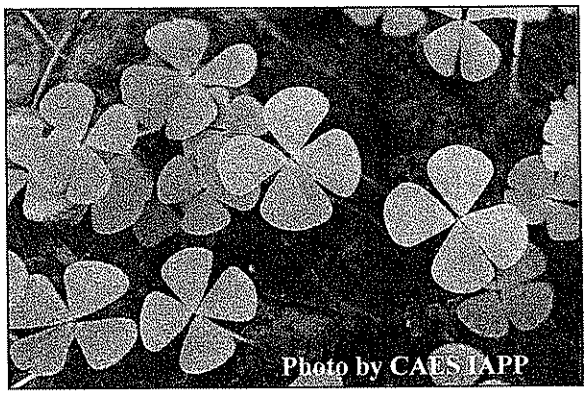
Easily confused species:
Winged loosestrife: *Lythrum alatum*



Lythrum salicaria
Purple loosestrife



Marsilea quadrifolia

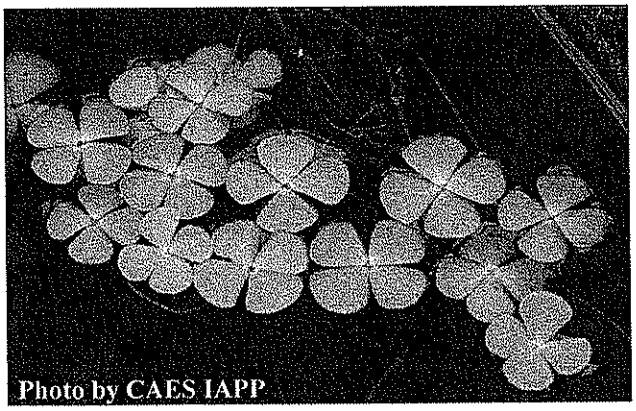


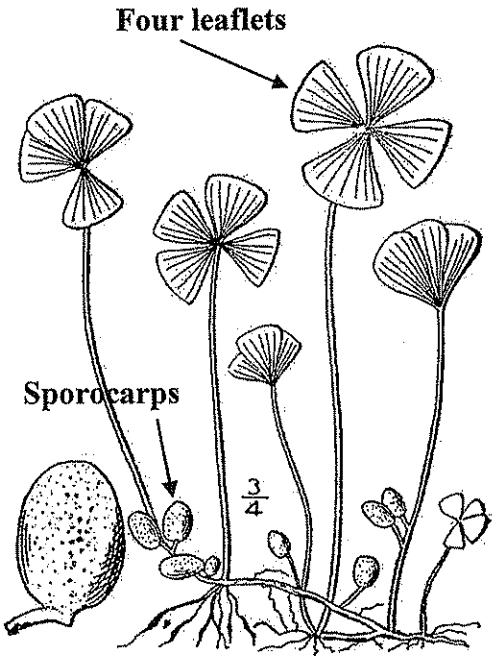
Common names:
European waterclover
Water shamrock

Origin:
Europe

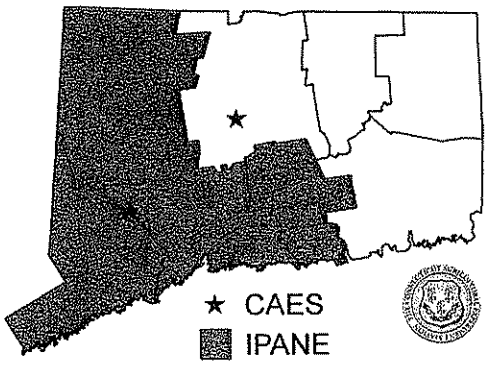
Key features:
Floating leaf plant
Stems: Smooth petioles 2-12 inches (5-30 cm)
Leaves: Comprised of 4 fan-shaped leaflets (similar to a four-leaf clover)
Fruits/Seeds: 2 or 3 dark brown sporocarps 0.2 inches × 0.2 inches (4-5.5 mm × 3-4 mm)
Reproduction: Cloning and sporocarps

Easily confused species:
None





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



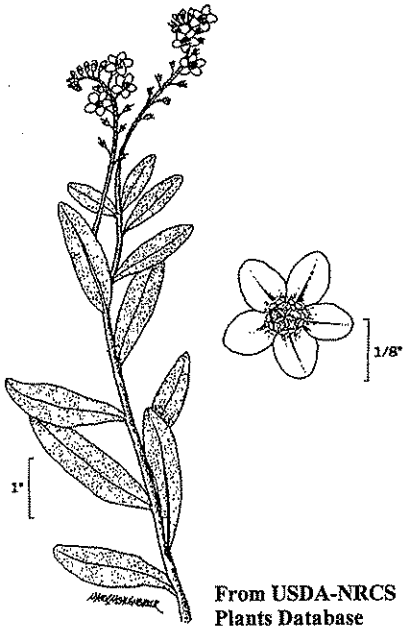
Myosotis scorpioides

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

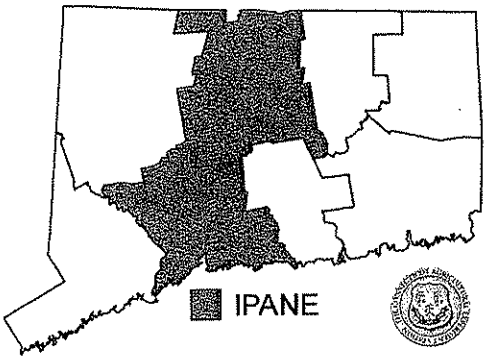
Origin:
Europe and western Asia

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



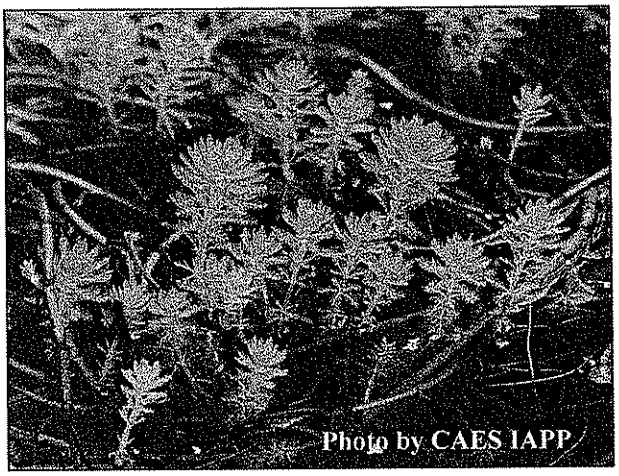
Myriophyllum aquaticum

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:
Eurasion watermilfoil: *Myriophyllum spicatum*
Variable-leaf watermilfoil: *Myriophyllum heterophyllum*



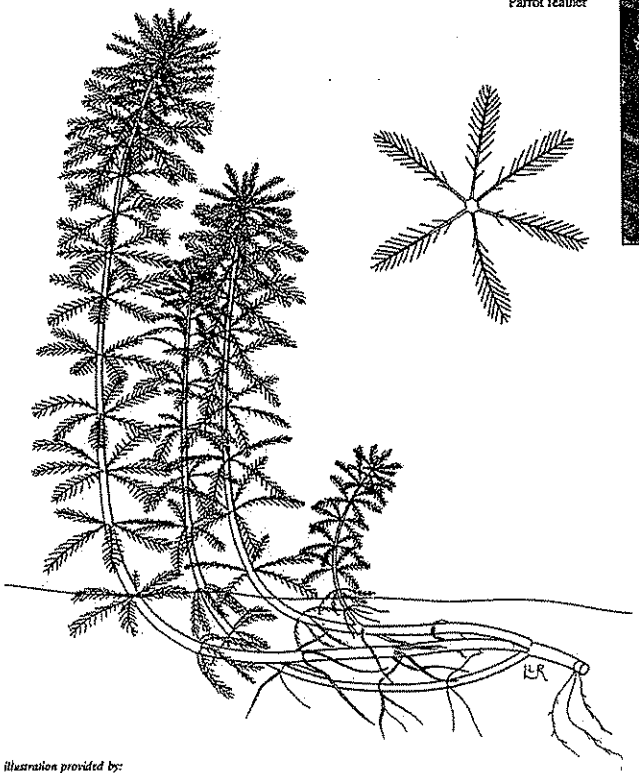
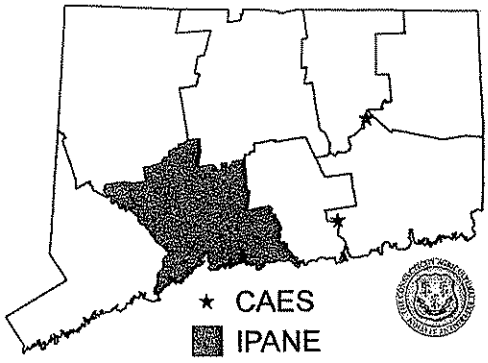
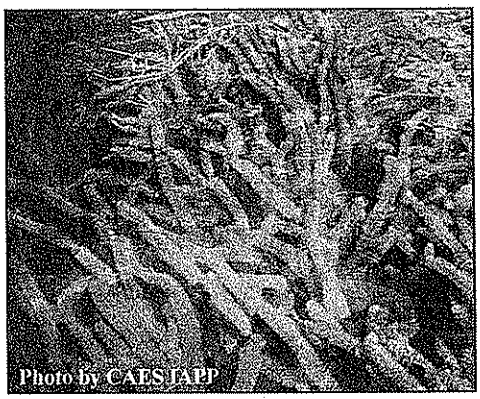


Illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990



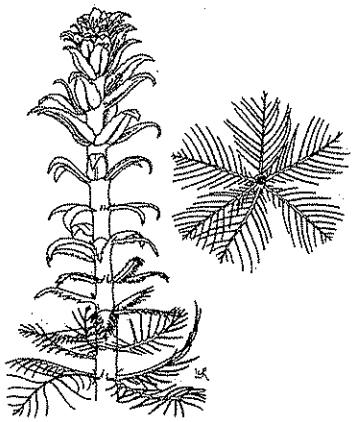
Myriophyllum heterophyllum



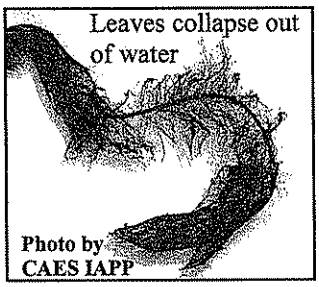
Common names:
Variable-leaf watermilfoil
Variable watermilfoil
Two-leaf watermilfoil

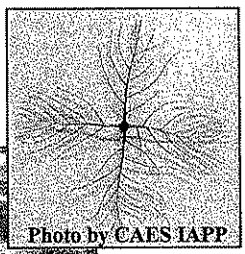
Origin:
Southern United States

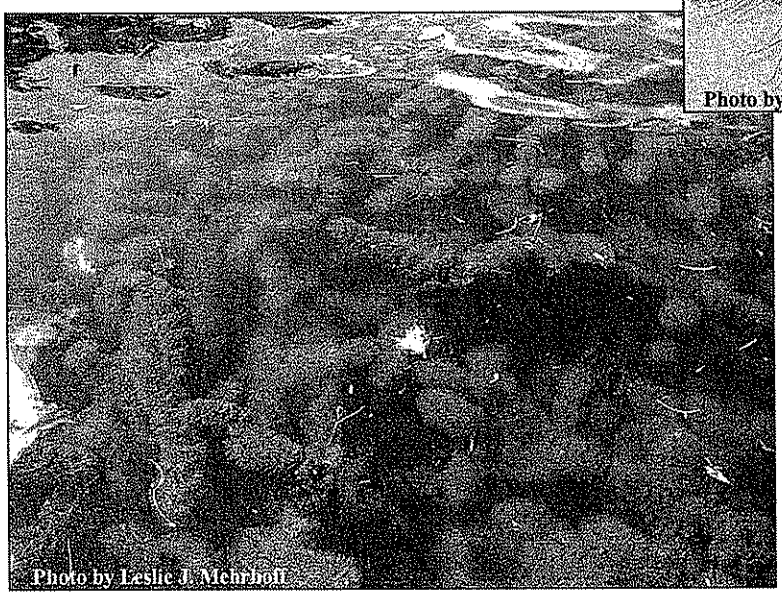
Key features:
Plants are submersed
Stems: Dark brown stems extend to the water's surface and spread to form large mats
Leaves: Triangular with ≤ 11 pairs of leaflets. Leaves are dissected and whorled (4-6 leaves/whorl) resulting in a feathery appearance with leaf whorls < 1 inch apart giving it a ropy 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

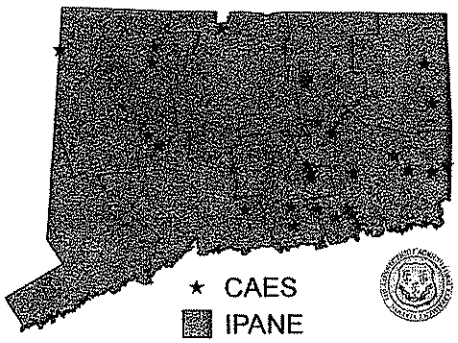


Easily confused species:
Eurasian watermilfoil: *Myriophyllum spicatum*
Low watermilfoil: *Myriophyllum humile*









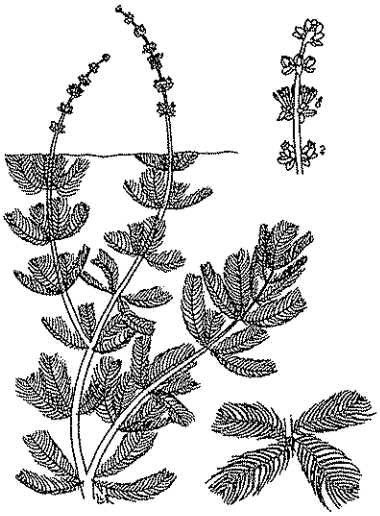
Myriophyllum spicatum

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 ≥ 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: *M. heterophyllum*
Low watermilfoil: *M. humile*
Northern watermilfoil: *M. sibiricum*
Whorled watermilfoil: *M. verticillatum*



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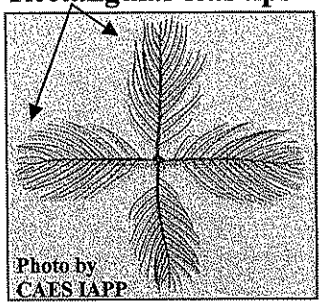
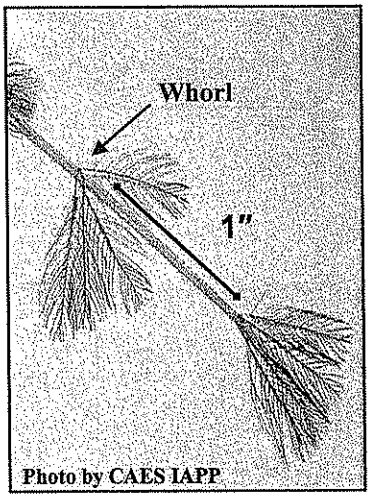
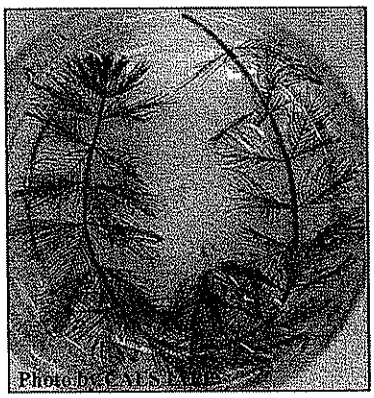
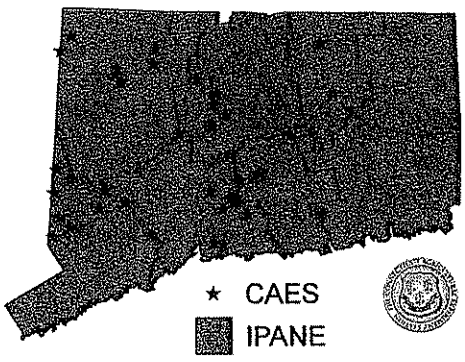
Rectangular leaf tips

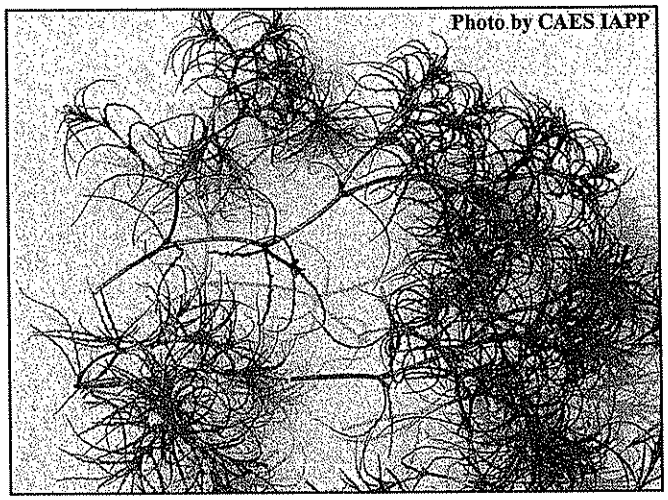








Najas minor

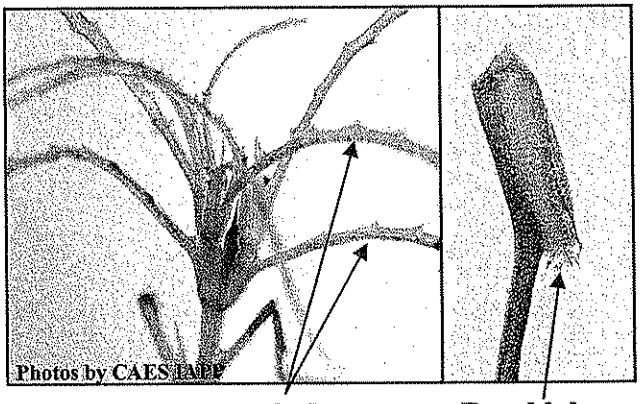


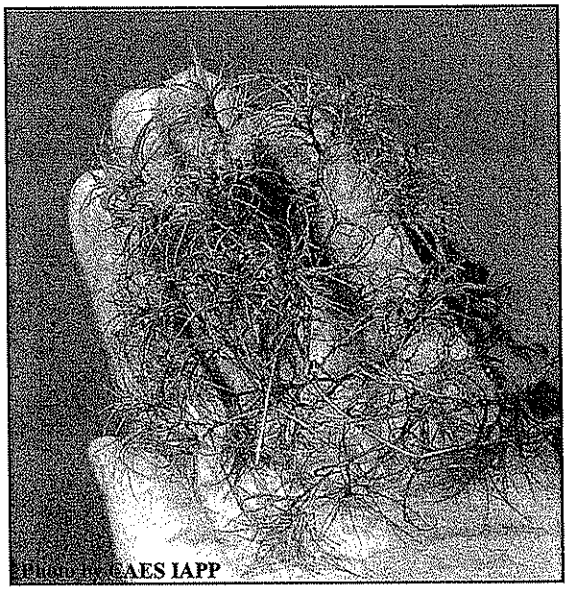
Common names:
Minor naiad
Brittle waternymph
Spiny leaf naiad
Eutrophic waternymph

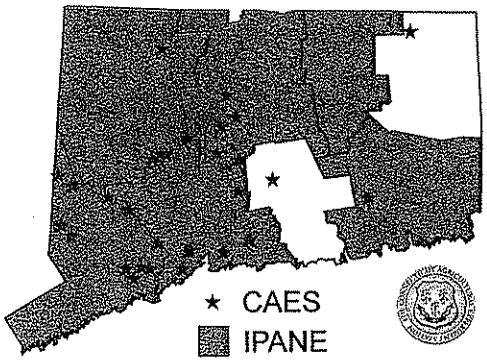
Origin:
Europe

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

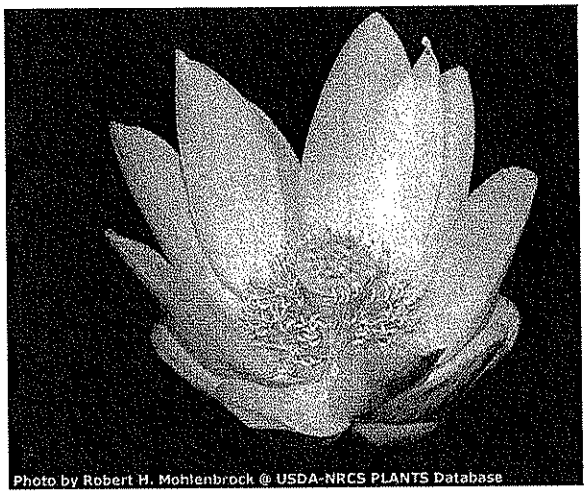
Easily confused species:
Other naiads (native): *Najas* spp.







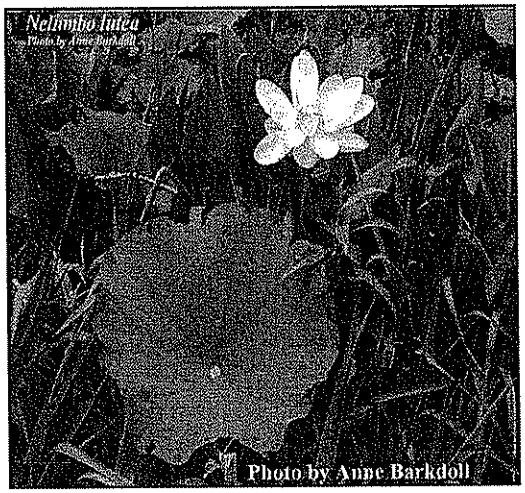
Nelumbo lutea



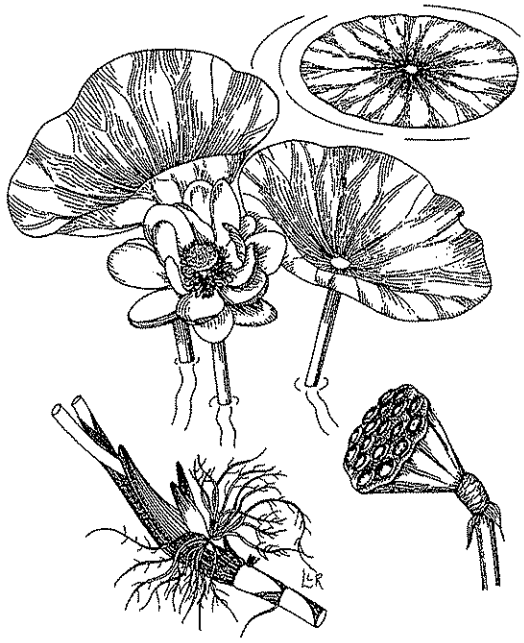
Common name:
American water lotus

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

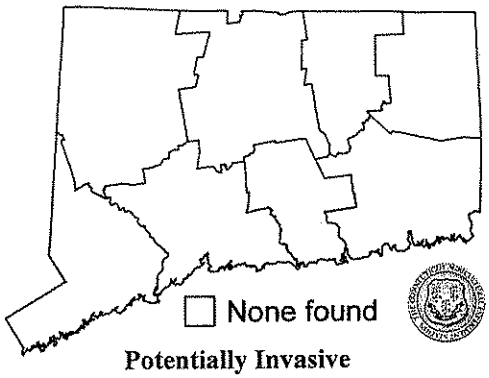
Key features:
Plants are on or above the water
Stems: Stiff stalk attaches to the center of the leaf
Leaves: Large bluish-green, circular leaves with no "slit" like water lilies
Flowers: White to yellowish flowers measure up to 8 inches (20 cm) wide
Fruits/Seeds: Seeds are nut-like and contained in a structure that resembles the top of a watering can
Reproduction: Seed



Easily confused species:
None

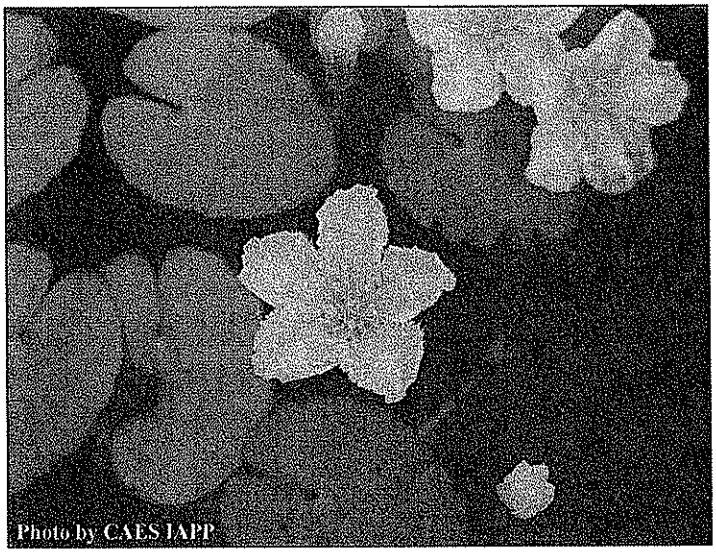


Nelumbo lutea
american lotus



Potentially Invasive

Nymphoides peltata

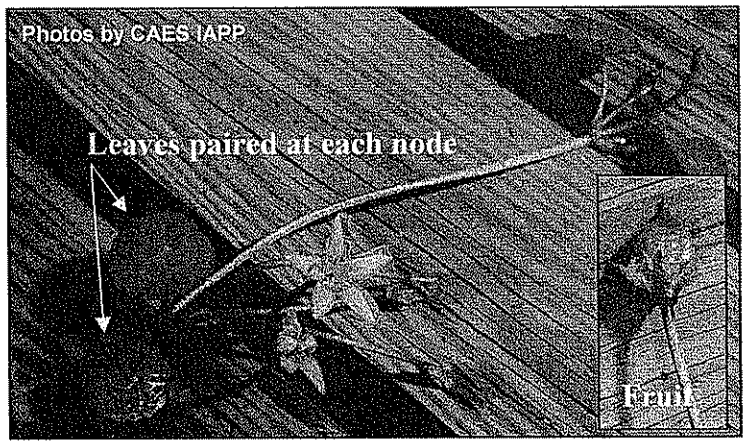


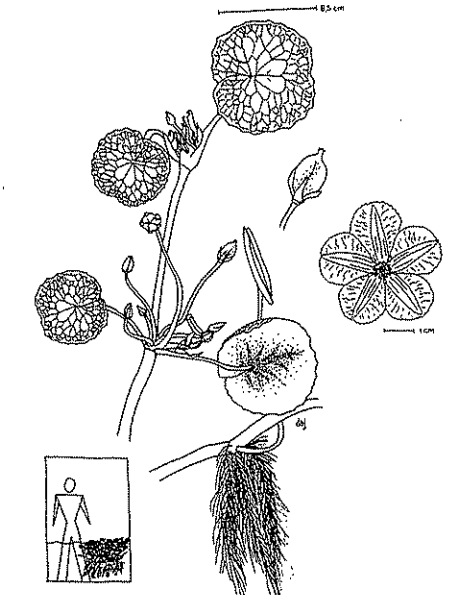
Common name:
Yellow floating heart

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*





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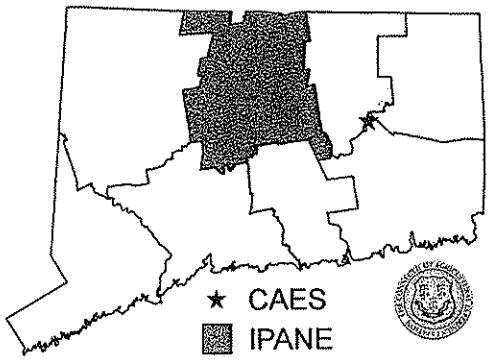
Center for Aquatic and Invasive Plants

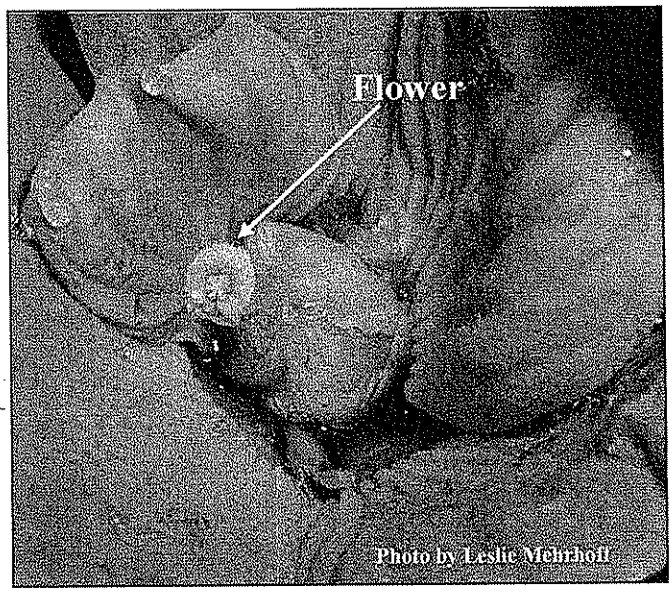


Pistia stratiotes

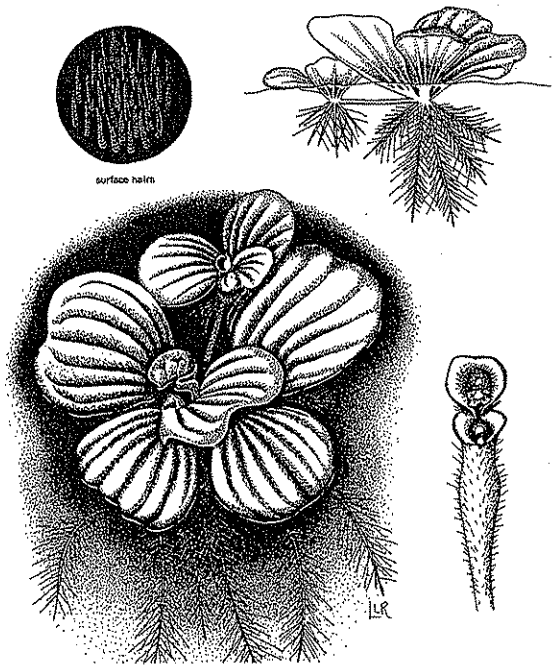
Common names:
Water lettuce
Tropical duckweed

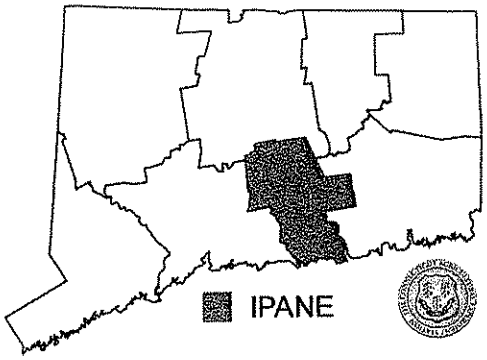
Origin:
Nativity unknown, but possibly South America, Africa, Southeastern US

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

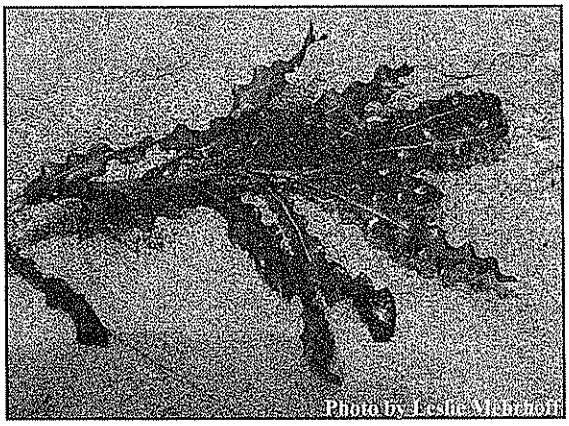


Easily confused with:
None





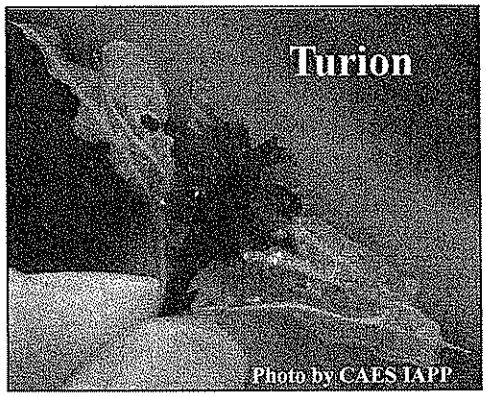
Potamogeton crispus



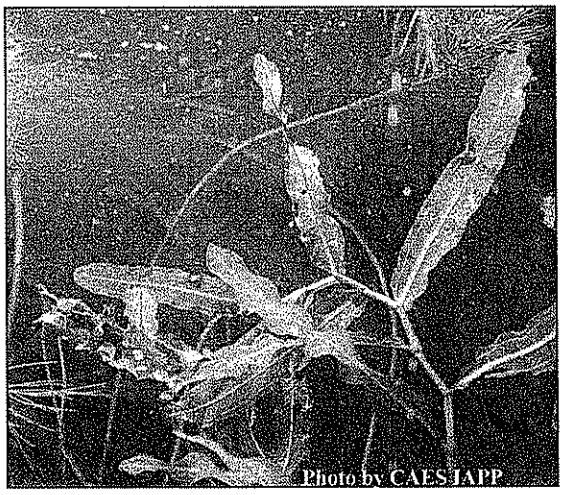
Common names:
Curly leaf pondweed
Crispy-leaved pondweed
Crisped pondweed

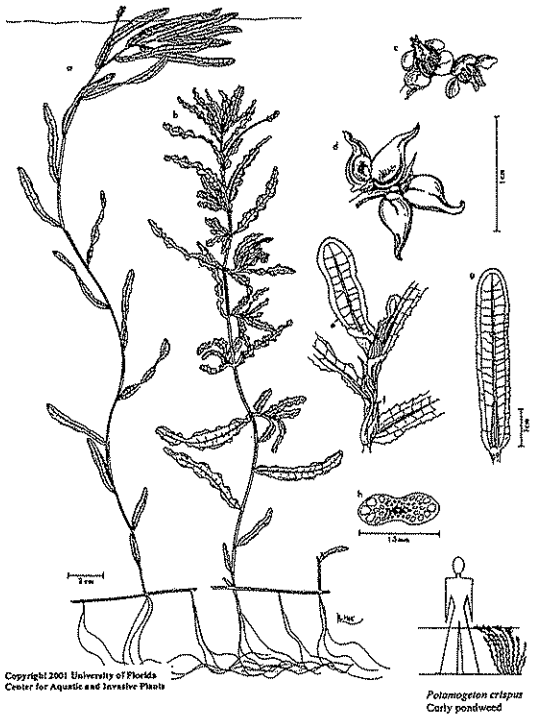
Origin:
Asia, Africa, and Europe

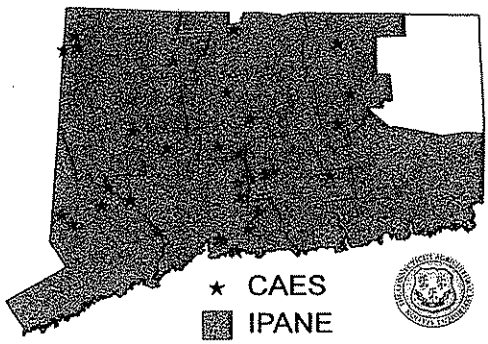
Key features:
Plants are submersed
Stems: Stems are flattened, can form dense stands in water up to 15 feet (5 m) deep
Leaves: Alternate leaves 0.3-1 inches (3-8 cm) wide with wavy edges (similar to lasagna) with a prominent midvein
Flowers: Brown and inconspicuous
Fruits/Seeds: Fruit is oval 0.1 inches (3 mm) long
Reproduction: Turions (right) and seeds



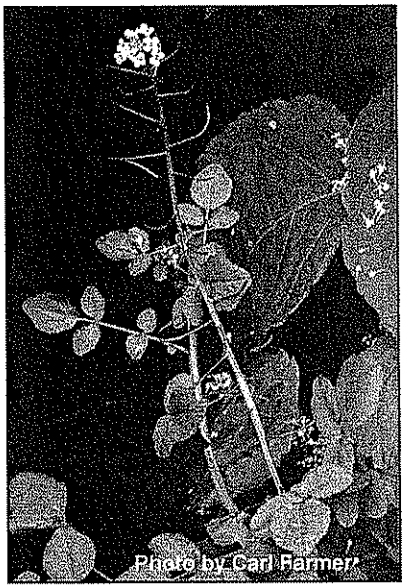
Easily confused species:
None







Rorippa microphylla



Common name:
Onerow yellowcress

Origin:
North Africa, Europe, and the Middle East

Key features:
Stems: Grow flatly across the ground and root at nodes and forms 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*

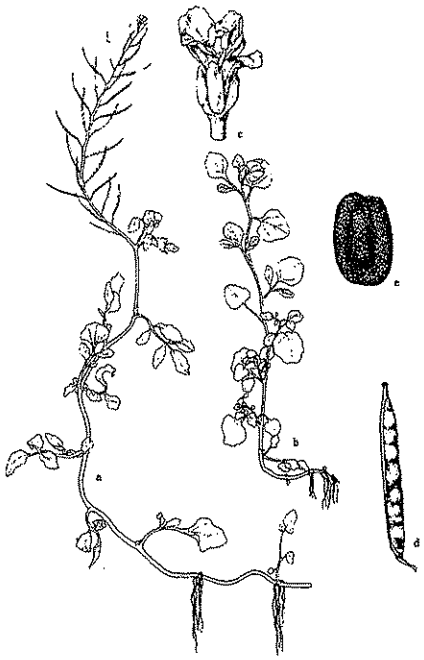


Fig. 129. *Nasturtium microphyllum*: a. habit, flowering and fruiting; b. habit, vegetative; c. flower; d. fruit; e. seed (G&W).

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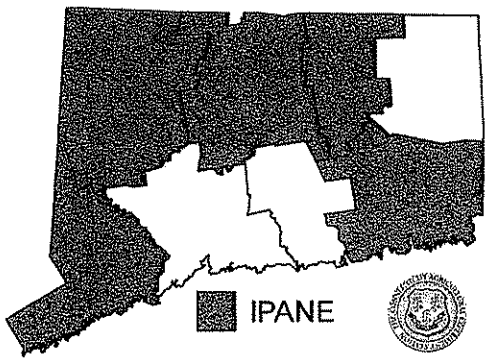
Crow and Hellquist 2000



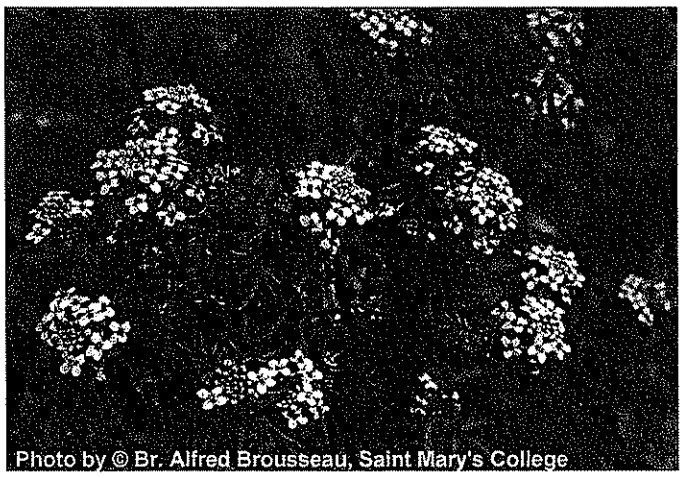
Rorippa nasturtium-aquaticum

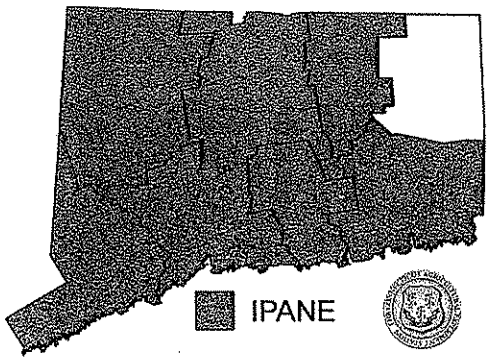
Common name:
Watercress

Origin:
North Africa, the Middle East, and Europe

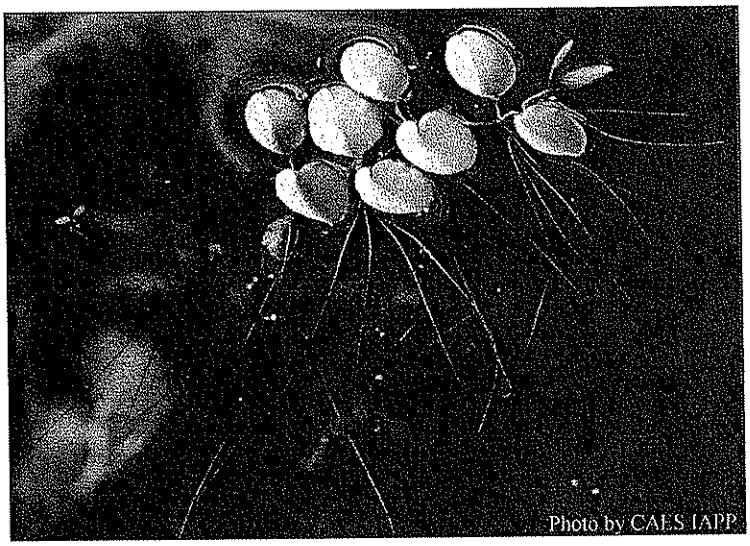
Key features:
Stems: Hollow stems can grow flat on mud or be fully or partially submersed
Leaves: Leaves are pinnately compound have 3-9 segments and vary in shape, the terminal leaf is the largest in each segment
Flowers: Small white and green flowers; four white petals with four long and 2 short stamens
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*





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

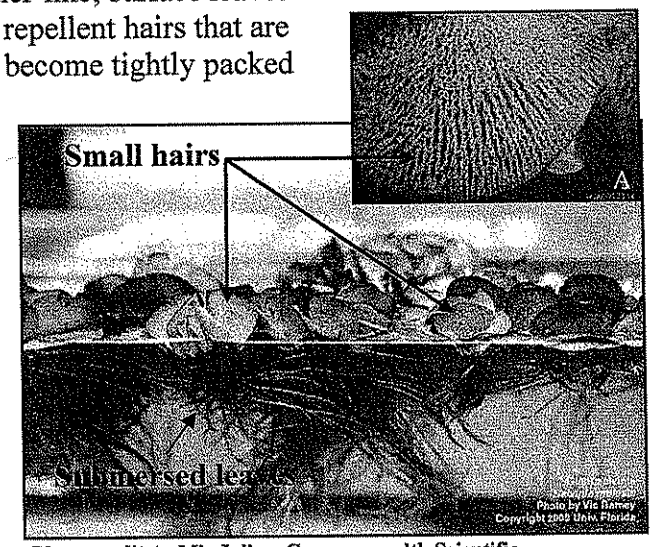
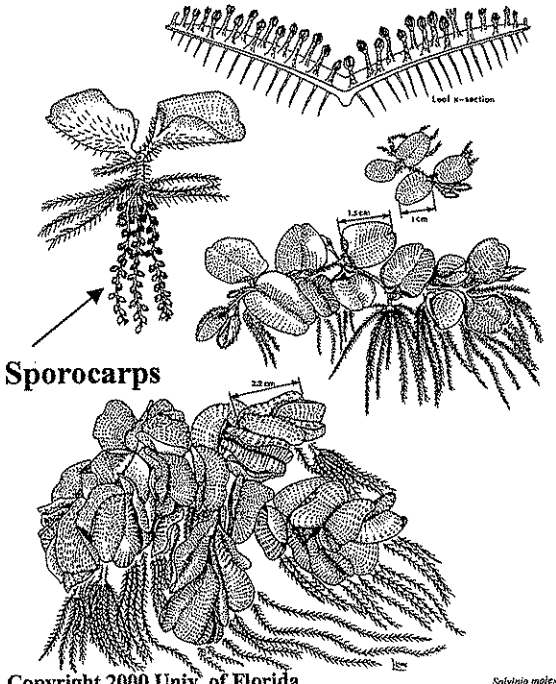


Photo credit A: Mic Julien, Commonwealth Scientific And Industrial Research Org., Bugwood.org

Easily confused species:
None



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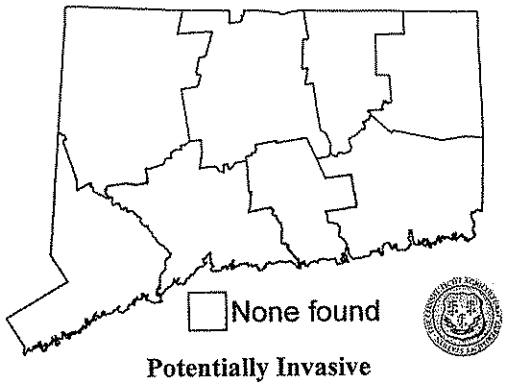
Salvinia molesta
Giant salvinia



Potentially Invasive

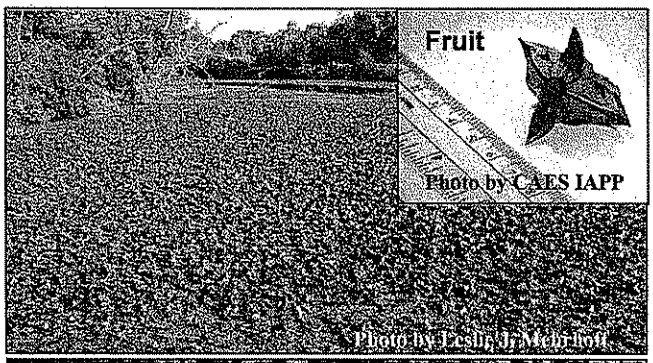
Trapa natans

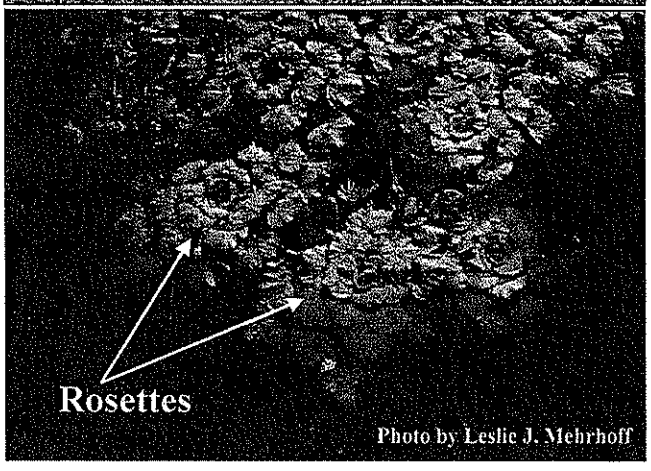
Common names:
Water chestnut
European water chestnut

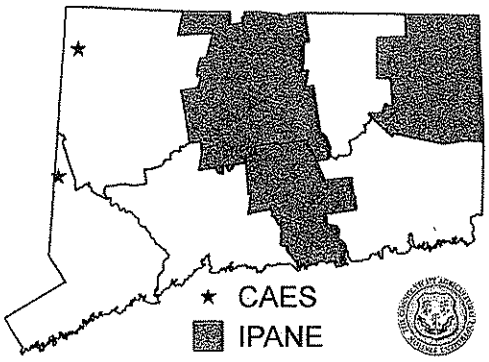
Origin:
Asia and Europe

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



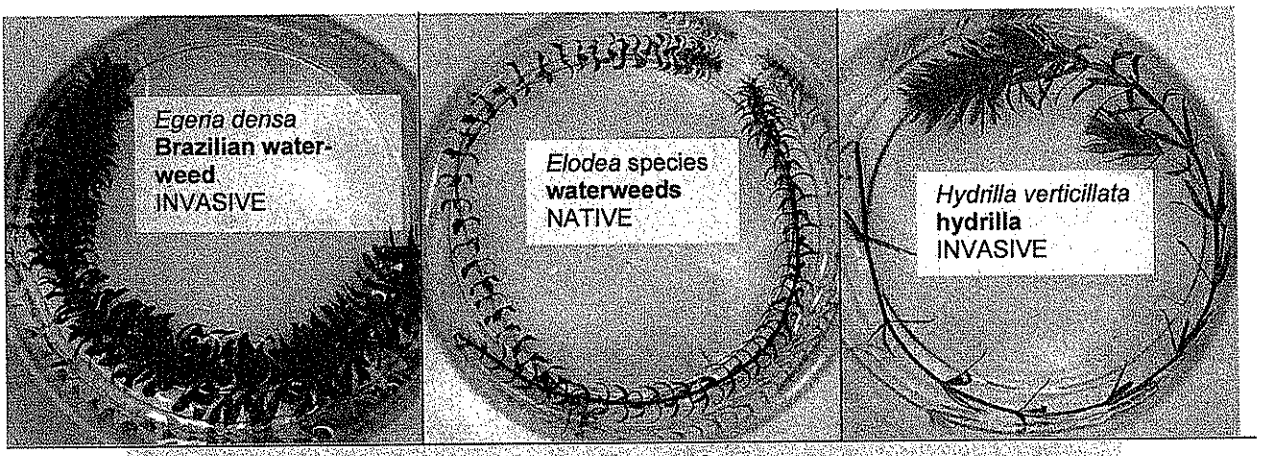


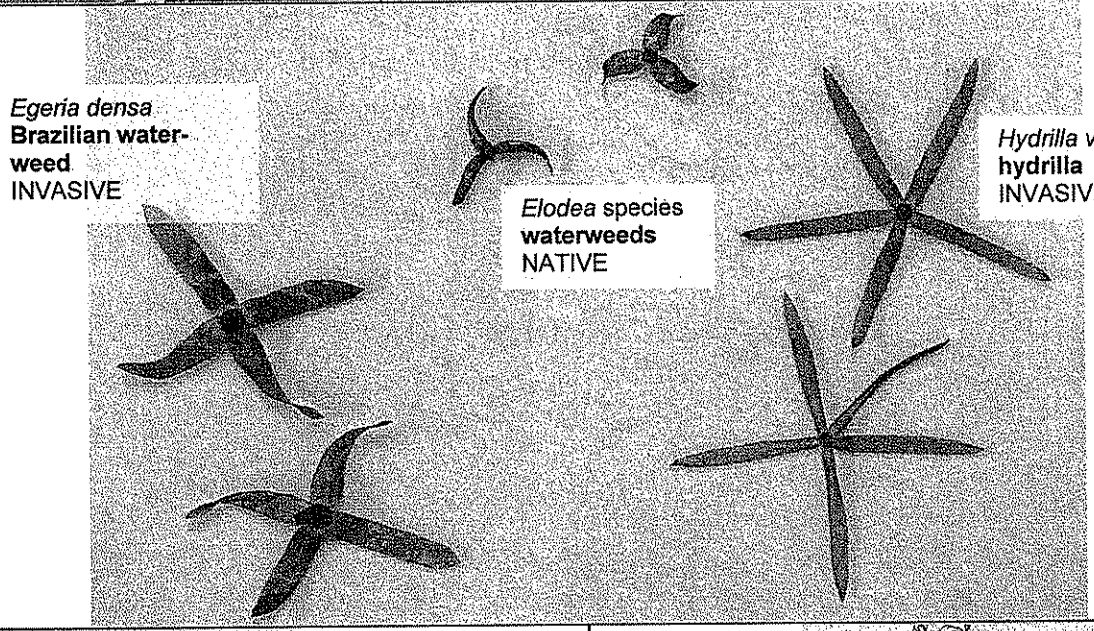


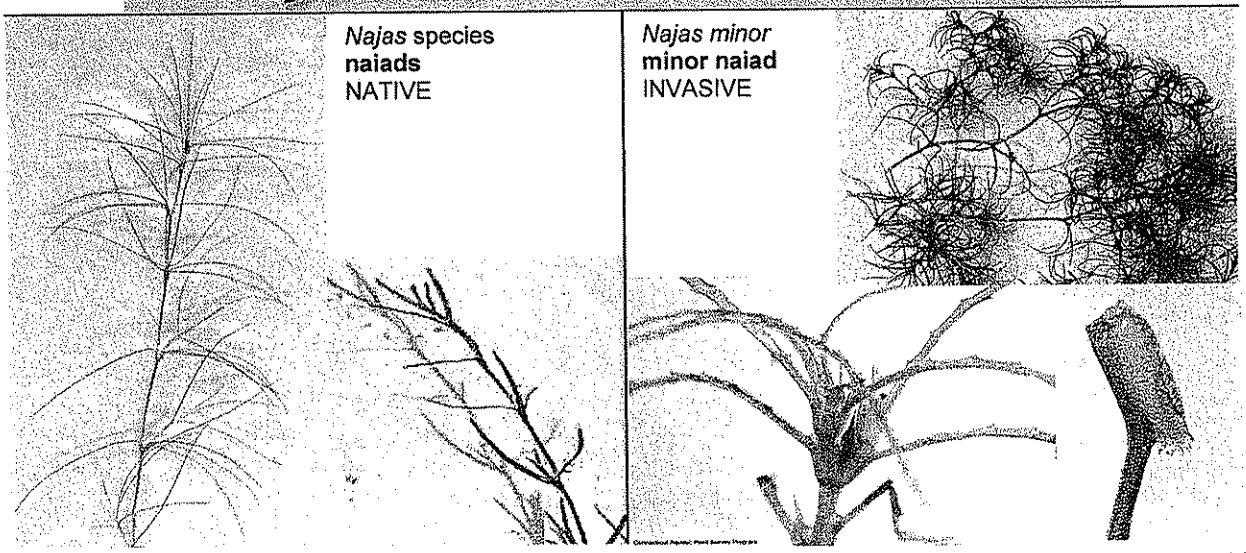
Commonly confused aquatic plants

Submersed plants with non-dissected leaves

(all photos CAES IAPP)

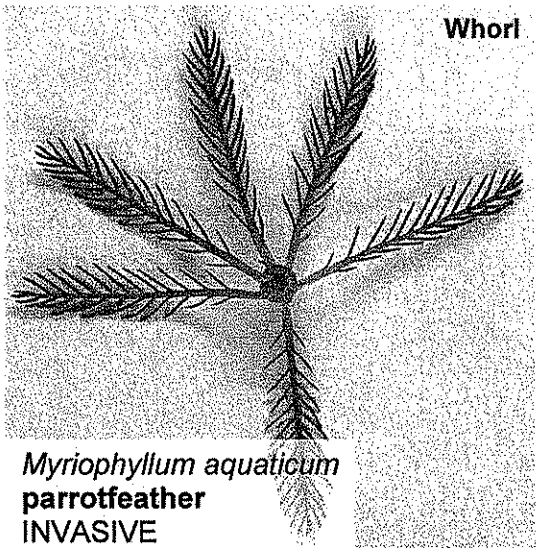


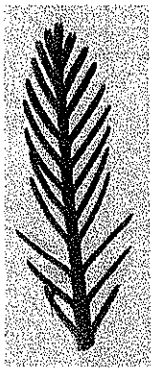


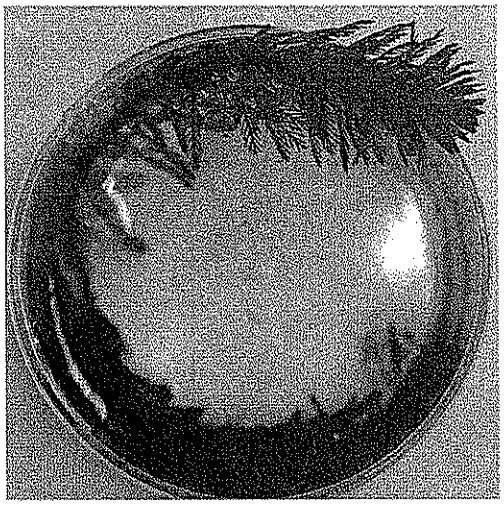


Submersed plants with feathery dissected leaves

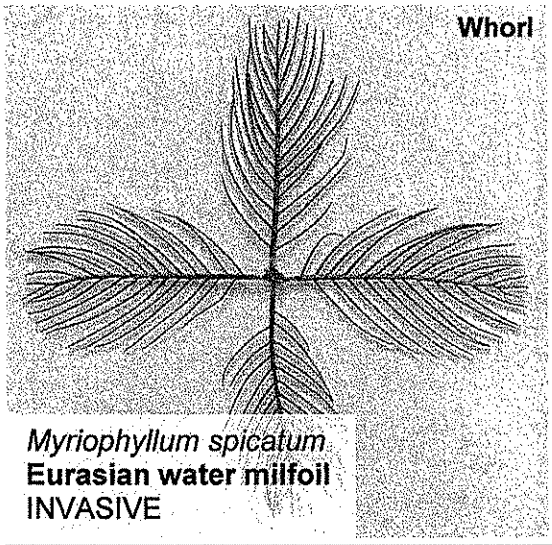
(all photos CAES IAPP)

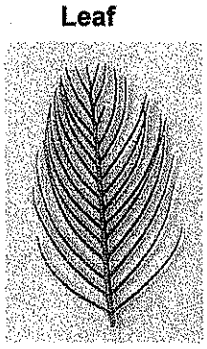


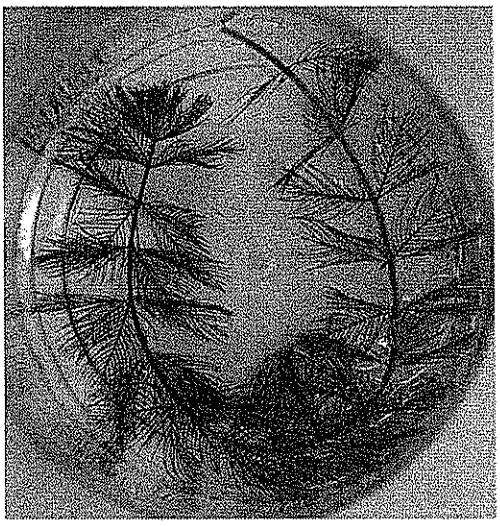




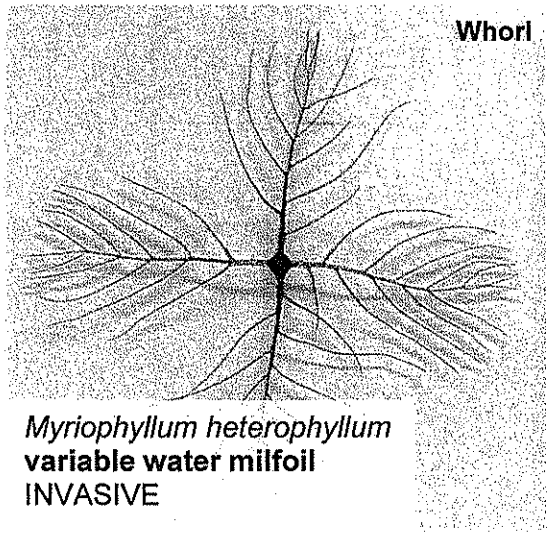
Myriophyllum aquaticum
parrotfeather
INVASIVE

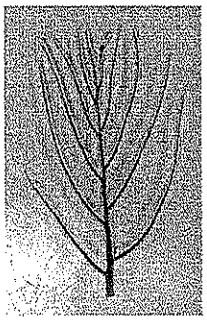


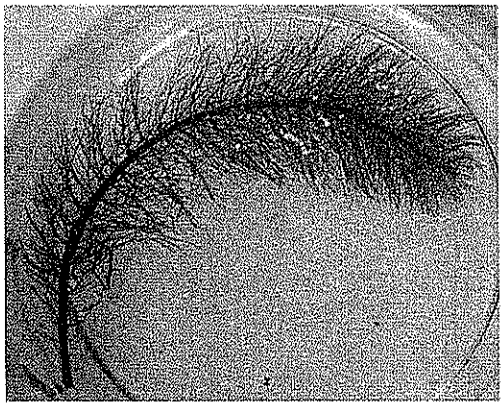




Myriophyllum spicatum
Eurasian water milfoil
INVASIVE



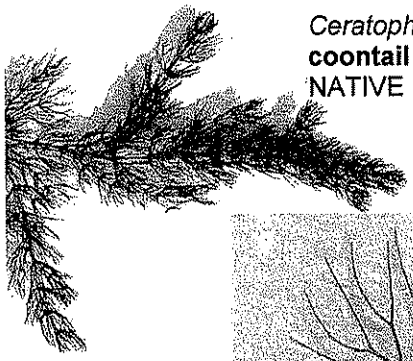




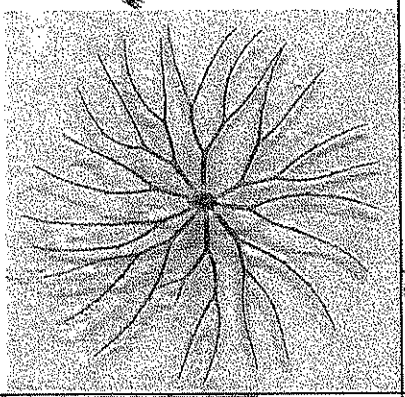
Myriophyllum heterophyllum
variable water milfoil
INVASIVE

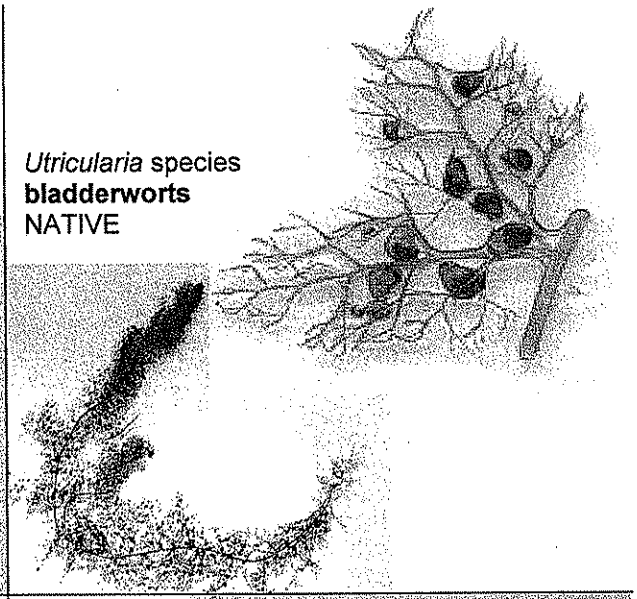
Submersed plants with forked and branched dissected leaves

(all photos CAES IAPP except where noted)

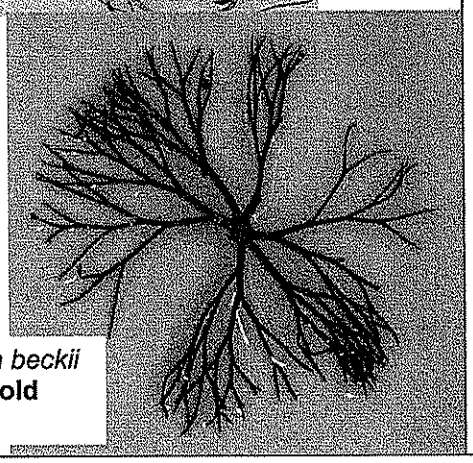


Ceratophyllum demersum
coontail
NATIVE





Utricularia species
bladderworts
NATIVE



Megalodonta beckii
water marigold
NATIVE

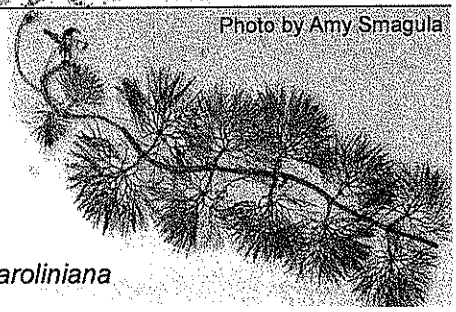
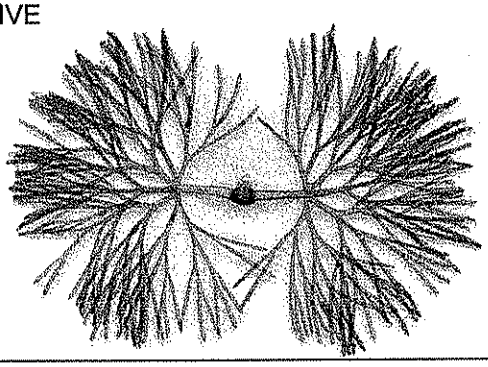
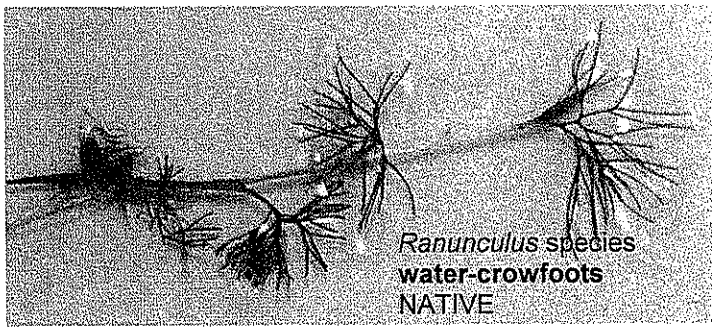


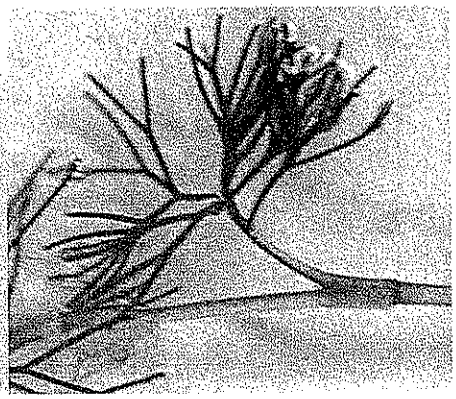
Photo by Amy Smagula

Cabomba caroliniana
fanwort
INVASIVE





Ranunculus species
water-crowfoots
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; leaves appear curled under..... ..... *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 ropy 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 apart (2.5 cm); rectangular shaped leaves, with greater than or equal to 12 pairs of leaflets; thin spike with leaves smaller than flowers..... ..... *Myriophyllum spicatum* (**Eurasian Watermilfoil**)
  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-crowfoots**) (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**) (threatened native)

Literature Cited

Britton, N.L., and A. Brown. 1913. An illustrated flora of the northern United States, Canada and the British Possessions. Vol. 1: 37.

CAES IAPP. 2010. The Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP). Retrieved February 13, 2010. http://www.ct.gov/caes/iapp.

Center for Aquatic and Invasive Plants, University of Florida. 2005. Aquatic, Wetland and Invasive Plants in Pen-and-Ink. IFAS Publications, Gainesville, Florida.

Center for Aquatic and Invasive Plants, University of Florida. 2009. Plant information and images. Retrieved February 18, 2009. http://aquat1.ifas.ufl.edu/.

Connecticut Aquatic Nuisance Species Working Group. 2006. Connecticut aquatic nuisance species management plan. Retrieved December 17, 2007. http://www.ctiwr.uconn.edu/ProjANS/SubmittedMaterial2005/Material200601/ANS%20Plan%20Final%20Draft121905.pdf.

Couch, R., and E. Nelson. 1985. *Myriophyllum spicatum* in North America. Pp. 8-18 in: Anderson, L.W.J., ed., Proceedings of the First International Symposium on Water Milfoil (*Myriophyllum spicatum*) and related Haloragaceae Species. Aquatic Plant Management Society, Vicksburg, Mississippi.

Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of northeastern North America. Vol 1. Pteridophytes, gymnosperms, and angiosperms: dicotyledons. The University of Wisconsin Press, Madison, Wisconsin.

Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of northeastern North America. Vol 2. Angiosperms: Monocotyledons. The University of Wisconsin Press, Madison, Wisconsin.

Fassett, N. 1957. A manual of aquatic plants. Rev. Eugene Ogden. The University of Wisconsin Press. Madison, Wisconsin.

Fishman, K.J., R.L. Leonard and F.A. Shah. 1998. Economic evaluation of Connecticut lakes with alternative water quality levels. Connecticut Department of Environmental Protection. 79 Elm St. Hartford CT.

Invasive and aquatic species. 2009. Weeds. Invasive.org. Retrieved February 23, 2009. http://www.invasive.org/.

Invasive plant atlas of New England (IAPNE). 2009. IPANE species. Retrieved February 20, 2009. http://nbii-nin.ciesin.columbia.edu/ipane/index.htm.

Invasive plant atlas of New England. 2009. Data and Maps. Retrieved February 20, 2009. http://nbii-nin.ciesin.columbia.edu/ipane/index.htm.

Les, D.H., and L.J. Mehrhoff. 1999. Introduction of nonindigenous aquatic vascular plants in southern New England: A historical perspective. Biological Invasions 1:281-300.

North Carolina State University Aquatic Plant Management Website. 2009. Aquatic plant fact sheet. Retrieved February 18, 2009. http://www.weedscience.ncsu.edu/aquaticweeds/.

USDA Natural Resources Conservation Service (NRCS). 2009. Plants database. Retrieved February 18, 2009. http://plants.usda.gov/.

Washington State Noxious Weed Control Board. 2009. Weed list. Retrieved February 18, 2009. http://www.nwcb.wa.gov/index.htm.