Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

Katie Dykes
Commissioner

Fisheries Division

FISHERIES INFORMATION CIRCULAR

STOCKING RECOMMENDATIONS

For

TRIPLOID GRASS CARP

photo courtesy of US Fish & Wildlife

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This circular is intended to provide stocking recommendations and information on aquatic vegetation control through the use of triploid grass carp.

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CONNECTICUT FISHERIES INFORMATION CIRCULAR

Stocking Recommendations for Triploid Grass Carp

INTRODUCTION

Grass carp *(Ctenopharyngodon idella)*, or white amur, were originally imported into the United States during the early 1960s for biological control of aquatic plants. Many have welcomed these fish as an alternative to chemical plant control. There are, however, major concerns with this exotic species regarding their ability to reproduce; effects on other fishes, ability to control certain varieties of aquatic plants, appropriate stocking densities, and overall impact on the ecology of aquatic systems.

In Connecticut grass carp are regulated through special importation and liberation permits. Such permits may prescribe the number and size class that may be liberated. Further, all grass carp must be certified as triploid (sterile). Such certification and a copy of the permit must accompany the shipment and be available for inspection by an agent of the Commissioner.

Triploid grass carp may only be liberated into lakes and ponds that meet the following criteria: those approved for liberation, in writing, by all individuals who have ownership rights on such waters; those which, in the opinion of the Commissioner are ecologically isolated; those which in the opinion of the Commissioner, are adequately screened so as to prevent fish emigration. For the purposes of this activity, an ecologically isolated lake or pond is one from which the emigration of such grass carp will not significantly impact public waters or waters of another, or from which there is no surface water outflow. Refer to Regulations of Connecticut State Agency (RCSA) Section 26-55-1.

The owner of any waters into which triploid grass carp are liberated is required to allow agents of the Commissioner to monitor the environmental conditions, including population dynamics, to determine the long term efficacy of grass carp in Connecticut waters. These stocking recommendations were developed from a review of the available literature. The Fisheries Division may make changes to these recommendations as necessary.

CONSIDERATIONS

Pond owners and managers must define their pond management goals and objectives. The available alternatives to completing those objectives should be fully explored before any single management tool is selected. The decision to utilize triploid grass carp and planned stocking densities depend upon several criteria: type of plant to be controlled, desired level of plant removal, climatic and physical features of the site, and screening requirements and criteria. A combination of techniques often provides the best results by preventing plant growth (benthic barriers, shading chemicals), site-specific plant removal (harvesting), or killing specific varieties (aquatic herbicides, drawdown). Grass carp are the **least selective** of the available methods for plant control.

Pond Balance: Only rarely is complete plant eradication desirable. Plants constitute a vital element of the aquatic environment upon which all other organisms depend. Total eradication would result in a severe decrease in shelter and food needed by other resident fish, amphibians, waterfowl, aquatic invertebrates, aquatic reptiles and aquatic mammals; a potential for the destruction of the habitat of food organisms upon which many of these species depend, and could lead to a significant increase in the amount of unicellular algal growth and the density of aquatic vascular plants not easily controlled with grass carp. In fact, grass carp may act as an environmental disturbance and destabilizing influence, facilitating the spread of species such as water lilies or other floating leaf aquatic plants by removing all other plant competitors. As such, the aquatic plant community should be managed to afford maximum ecological diversity.

Amount of Aquatic Plant Reduction Desired: The recommendations contained herein were developed to provide aquatic plant control and should result in an aesthetically and environmentally acceptable aquatic habitat. An estimated 20-40% plant cover is considered by the Fisheries Division to be a “best” management level in most multi-use ponds.

Identification of Plants to be Controlled: Grass carp prefer certain plants to others. Single/celled algae are not eaten, while preferred plants such as the advanced algae stoneworts (*Chara*, and *Nitella*) are eaten rapidly. Basically unpalatable types such as the watershield (*Brasenia schreberi*) and water lilies

(*Nymphaea spp*.) are consumed, but reluctantly. Information to aid in identifying plants that may cause problems in Connecticut, is provided in the accompanying figures.

Size at Stocking: Grass carp are vulnerable to the normal sources of mortality thus it is highly recommended that grass carp be at least 10-12" long, especially if they are liberated into ponds containing predatory fish. Smaller grass carp should not be stocked in waters, due to potential losses caused by species such as largemouth bass, chain pickerel and fish eating birds.

Site Specific Variables: Results achieved by grass carp are dependent upon the physical environment. Preferred feeding depths are under 10 feet, and feeding rates increase rapidly as water temperature rise with the greatest activity occurring at temperatures above 68˚F (20C). The stocking recommendations provided are adjusted for the general climatic conditions in three regions of Connecticut (Table 1) and users should note their particular zone.

Grass Carp Emigration: In their native range, grass carp are not a species of lakes and ponds, but rather are found in large low gradient rivers and backwaters. They readily seek flowing water, often before controlling the targeted aquatic plants. The urge to leave the pond increases as the availability of preferred food plants at the stocking site is reduced. It is the responsibility of the pond owner or manager to ensure that these fish do not emigrate and become a nuisance in waters owned by another or in public waters of the State.

Grass Carp Emigration Control: Grass carp are noted escape artists and an adequate screening/control system must be provided at the inlet and outlet of lakes and ponds to limit the loss of these expensive fish and to prevent potentially significant impacts to public waters or to waters of another. Please consult with the Fisheries Division document entitled, "Screening Recommendations for ponds stocked with Triploid Grass Carp" for additional information.

Stocking Strategy: An aquatic plant control program utilizing grass carp may be considered a long-term effort, but periodic renewal is required as indicated in Tables 2-4. If control is desired, restock the pond as necessary. The recommended rates assume a spring or early summer stocking (April- July) when it is most cost effective. If a fall stocking is planned, multiply the rates shown in

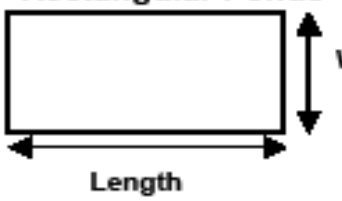
Tables 2-4 by 1.5. Since it is uncommon for the results to be noticed during the first year after introduction, pond owners are urged to exercise patience when awaiting reductions in vegetation.

STOCKING PLAN

Pond owners or managers who wish total removal of vegetation may simply determine the total acreage of plants in the pond; and utilize Tables 2-4 to decide on the number of grass carp to be stocked per acre of total area. However, the development of a complete, managed and environmentally sound stocking program requires additional information about the body of water to be stocked. If the following method is used, basic nuisance control should result while ecological values are preserved.

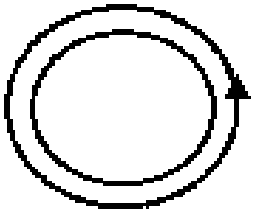
Determine the "Surface Acreage" of the pond. One acre is 43,560 square feet or approximated by a square of 209 by 209 feet.

Rectangular Ponds



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

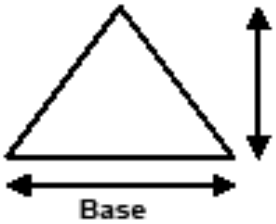
Circular Ponds



Total feet of shoreline

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

Triangular Ponds



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

1. Determine the percentage of the pond less than 10 ft. deep.
2. Determine the percentage of the pond that is heavily vegetated when aquatic plant cover is at its peak, usually July or August.
3. Compute an "Area Correction Factor" (ACF):

$$ACF = \frac{\text{Percentage of pond heavily vegetated}}{\text{Percentage of pond less than 10 feet deep}}$$

Note: This correction factor adjusts the stocking rates in Tables 2-4 to give plant coverage of approximately 30%-40%. If the ACF is less than or equal to 0.40 then grass carp are not recommended. If the ACF is greater than 1.0, it should be reduced to 1.0.

5. Identify the dominant plant(s) in the pond or those plants targeted.
6. Identify the number of fish to be stocked per vegetated acre (Tables 2-4).
7. Identify the climatic zone (by town) in which the pond is located (Table 1).
8. Calculate the total number of fish to be stocked as follows:

Stocking Rate (Tables 2-4)	X	Surface Acreage	X	Percentage of Pond Vegetated	X	Area Correction Factor	=	Number of Grass Carp

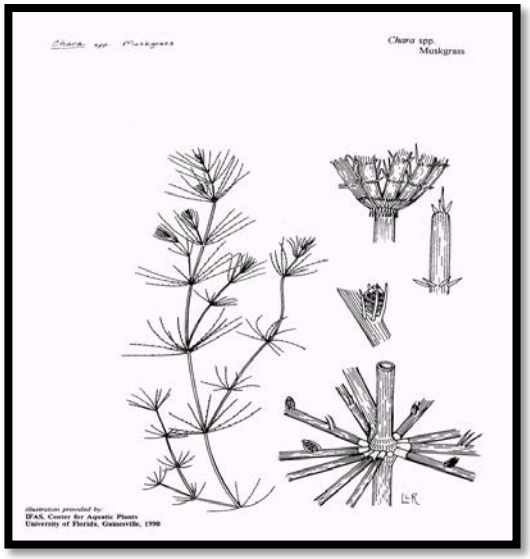
AQUATIC PLANT DESCRIPTIONS

It is necessary to identify the target species or type of aquatic plants to determine an effective stocking rate. Observing an intact specimen placed in a shallow pan of water often facilitates plant identifications. Descriptions of the more common types of nuisance plants found in Connecticut are included below.

Unicellular Algae includes many different species of microscopic single/celled plants that are suspended in the water. Millions of these plants are normally found in ponds, and when they become abundant, they give the water a soupy green or brown, color. This condition is known as an algal bloom.
UNICELLULAR ALGAE CANNOT BE CONTROLLED WITH GRASS CARP!

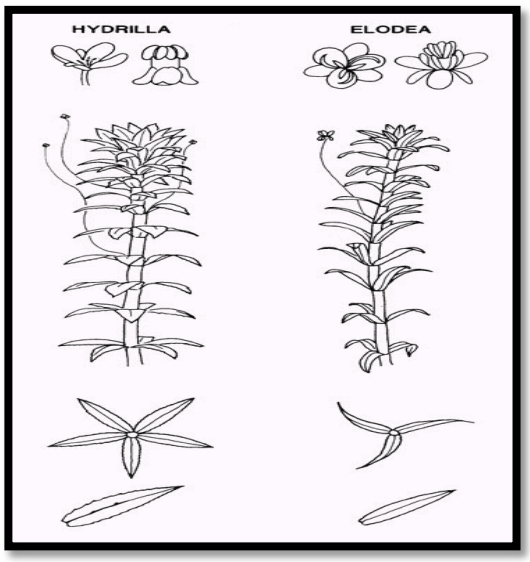
Filamentous Algae include many different species that consist of long hairline strands. They may be either slimy or cottony in appearance. Algae begin their growth on the bottom but may float to the surface due to entrapped oxygen bubbles produced during photosynthesis. Grass carp may provide fair control of some species, but generally only after preferred vegetation has been eliminated. As a result, extreme caution must be exercised when attempting control of these plants with grass carp (Table 3).

Advanced Algae are forms of algae that resemble more complex aquatic vascular plants. Grass carp provide excellent control of advanced algae (Table 2).

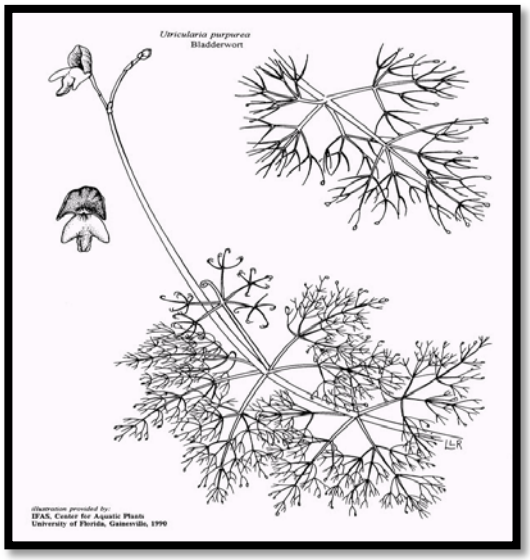


Stonewort: (*Chara* & *Nitella* spp.) Grow on the pond bottom and have short, bristly branches located at each stem joint. In **Nitella,** branches often end in clumps of branchlets. **Chara** has a strong skunky odor. The accompanying picture is of Chara. Nitella is very similar.
Expected control: Excellent.

<u>Vascular Plants:</u> a large group of plants noted for their variety. Expected levels of control for these plants range from excellent to poor (Table 2-4).

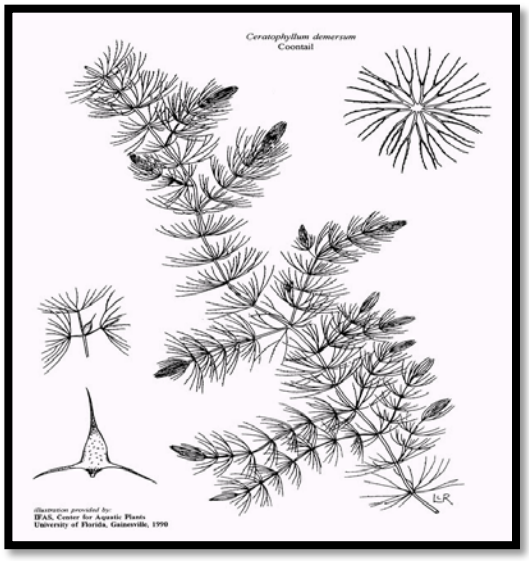


American Elodea: (*Elodea canadensis)*
Grows completely underwater and forms large masses on the bottom. The plant has branching stems and leaves that are bunched near the tip of the stem. The leaves often have a purple tint and and are grouped in threes at each stem joint. The size of leaves and bunching may vary.
Expected control: Excellent.

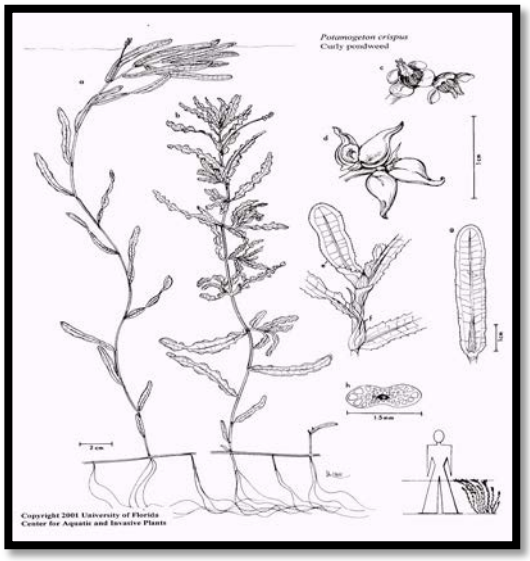


Bladderworts: *(Utricularia spp.)*
Characterized by bladders located on some of the leaf segments. The leaves are thin and highly divided and yellow or purple flowers appear during mid-summer. There are several bladderwort species and not all have floating leaves**.**
Expected control: Good.

Bushy Pondweed: *(Najas spp.)*
Species may vary from inch high plants on sandy bottoms, to three foot high plants on silt bottoms and are characterized by highly branched slender stems and by narrow leaves that are enlarged at the base. The species all look very much alike.
Expected control: Excellent

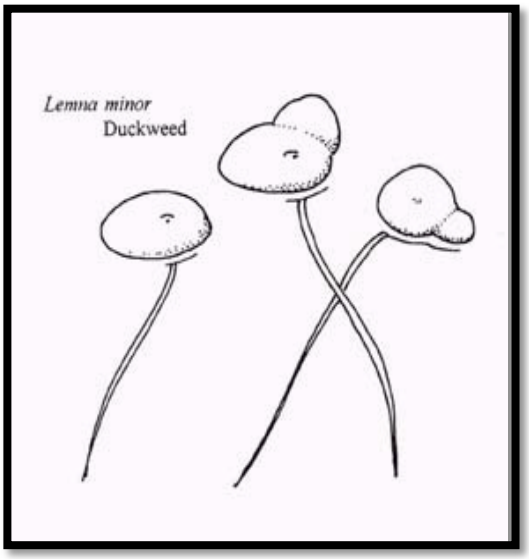


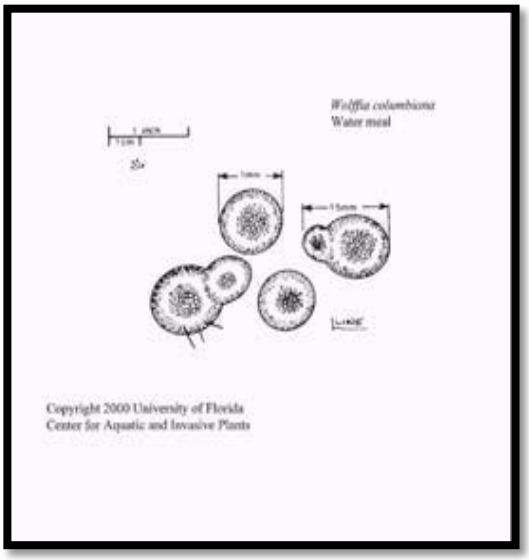
Coontail: (*Ceratophyllum demersum*)
Grows completely underwater. Stiff forked leaves, often four to a whorl, are attached to a central, hollow stem and crowded toward the stem tip. Threadlike leaf divisions have teeth along one side**.**
Expected control: Fair to Poor.



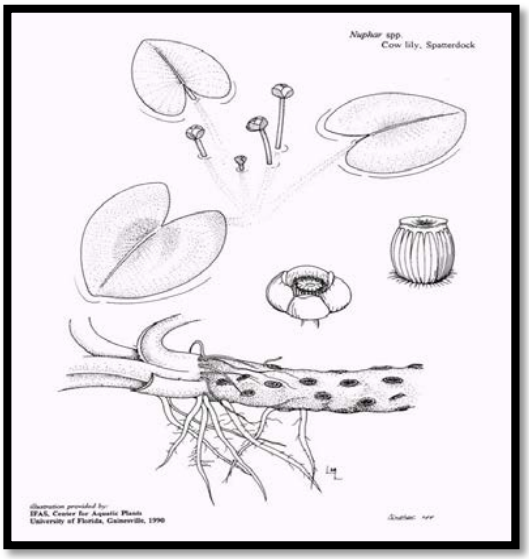
Curlyleaf Pondweed: *(Potamogeton crispus*)
Has curly or wavy, membranous leaves, with a row of spines along the edges. The flowers are borne on spikes. This species may start to grow in the fall and winter, then die down in midsummer**.**
Expected control: Good.

Floating Leaf Pondweed:
(Potamogeton spp.)
Characterized by floating leaves that are firm and usually elliptical. The submerged leaf, which varies in shape with different species, is thin and membranous. Flower spikes often rise over the water in early summer.
Expected control: Good

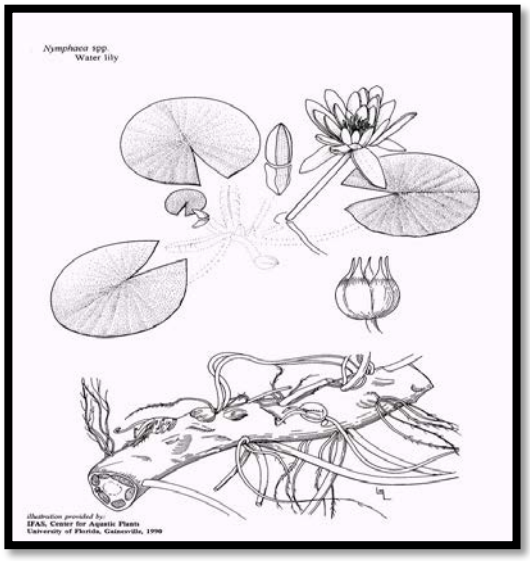




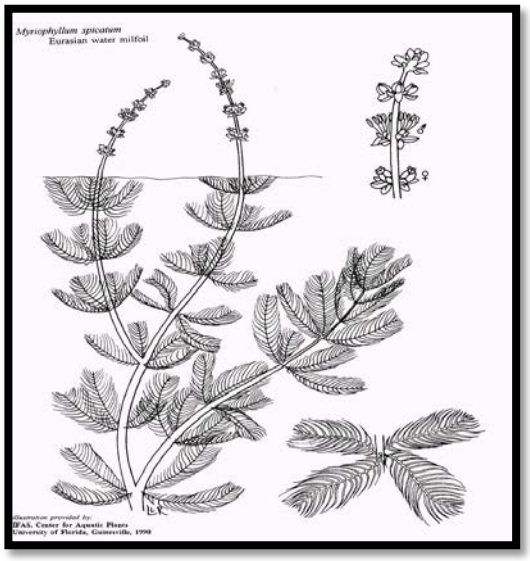
Duckweed/Watermeal: (*Lemna & Wolffia spp*.)
The smallest of flowering plants.
Duckweed has rootlets hanging down into the water that appear as tiny clovers floating on the surface.
Watermeal has neither rootlets nor leaves and appear as tiny green grains on the water surface.
Both plants tend to occur together.
Due to the explosive reproductive potential of these plants, grass carp may not be able to fully control these plants.
Expected control: Variable (Fair to Good)



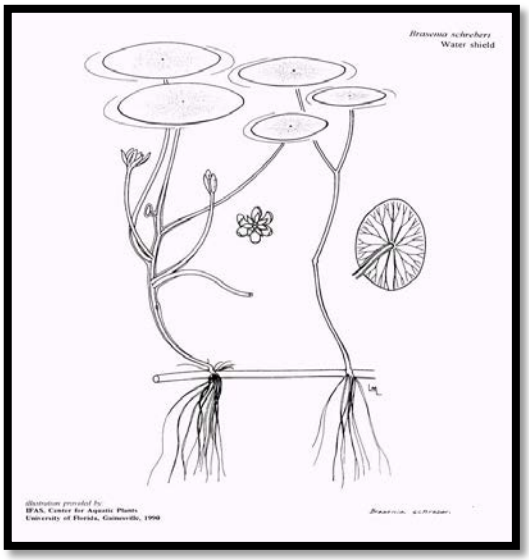
Spatterdock or Yellow Pond Lilly: (*Nuphar advena*)
Has heart shaped-floating leaves and the stem is attached to the notch between the lobes of the leaves. The ball shaped flowers are yellow with petals that curve inward.
Expected control: Poor.



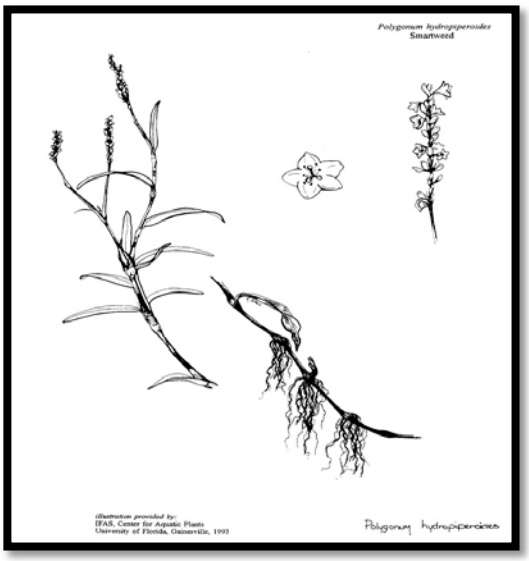
Water Lilies: (*Nymphaea spp.*)
Have round floating leaves. The stem is attached to the leaf center and flowers are white and rarely pink.
Expected control: Poor.



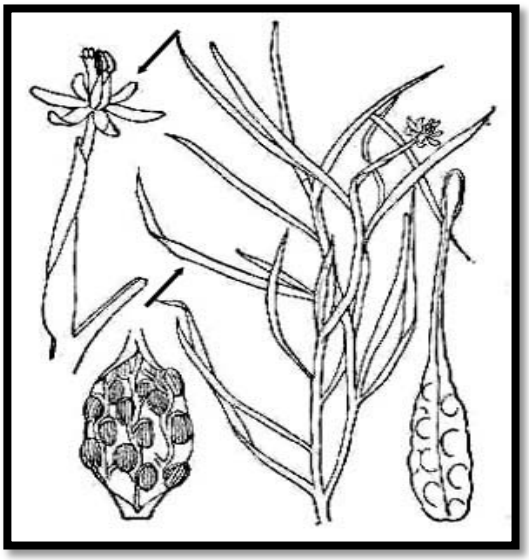
Water Milfoil: ***(Myriophyllum spp.)***
Have hollow, reddish stems. The featherlike submerged leaves collapse when taken out of the water. There are normally four leaves attached at each stem joint. Most have floral bracts consisting of tiny brown flowers located between reduced leaves, on stems that stand erect over the surface.
Expected control: Fair.



Watershield: *(Brasenia schreberi)*
Have floating, elliptical leaves that are usually covered, on the underside, with a thick jelly-like material. The stem is attached to the leaf center. Dull purple flowers appear during early summer.
Expected control: Poor.



Water Smartweeds: *(Polygonum spp.)*
Have jointed stems and submerged oblong leaves. These plants bloom in midsummer and have pink flowers that rise above the surface.
Expected control: Fair to poor.



Waterstargrass: *(Heteranthera dubia)*
A rooted plant with grassy leaves, and stems, that are flexible and trail in the water. The leaves form a sheath around the stem and have no midvein. This species may be found in still or flowing water and has yellow starlike flowers that appear between July and October.
Expected control: Excellent.

Waterstarworts: *(Callitriche spp*.)
Are small, delicate plants that have limp stems. Sets of two leaves are opposite at the stem joints. Submerged leaves are ribbon-like while floating leaves are wide, are found toward the tip of the stem forming rosettes on the surface. Fruits, the size of pinheads, are found in leaf and stem junctions. These plants occur in slow moving streams and ponds.
Expected control: Excellent.

Table 1. CONNECTICUT CLIMATIC ZONES

FAIRFIELD COUNTY

City/Town	Zone	City/Town	Zone
Bethel	2	Norwalk	3
Bridgeport	2	Redding	2
Brookfield	2	Ridgefield	2
Danbury	2	Shelton	3
Darien	3	Sherman	2
Easton	3	Stamford	3
Fairfield	3	Stratford	3
Greenwich	3	Trumbull	3
Monroe	3	Weston	3
New Canaan	3	Westport	3
New Fairfield	2	Wilton	3
Newtown	2		

HARTFORD COUNTY

City/Town	Zone	City/Town	Zone
Avon	2	Manchester	2
Berlin	2	Marlborough	2
Bloomfield	2	New Britain	2
Bristol	2	Newington	2
Burlington	2	Plainville	2
Canton	1	Rocky Hill	2
East Granby	2	Simsbury	1
East Hartford	2	South Windsor	2
East Windsor	2	Southington	2
Enfield	2	Suffield	2
Farmington	2	West Hartford	2
Glastonbury	2	Wethersfield	2
Granby	1	Windsor	2
Hartford	2	Windsor Locks	2
Hartland	1		

Table 1. CONNECTICUT CLIMATIC ZONES (continued)

LITCHFIELD COUNTY

City/Town	Zone	City/Town	Zone
Barkhamsted	1	Norfolk	1
Bethlehem	1	North Canaan	1
Bridgewater	2	Plymouth	2
Canaan	1	Roxbury	2
Colebrook	1	Salisbury	1
Cornwall	1	Sharon	1
Goshen	1	Thomaston	2
Harwinton	1	Torrington	1
Kent	1	Warren	1
Litchfield	1	Washington	1
Morris	1	Watertown	2
New Hartford	1	Winchester	1
New Milford	2	Woodbury	2

MIDDLESEX COUNTY

City/Town	Zone	City/Town	Zone
Chester	3	Haddam	2
Clinton	3	Killingworth	3
Cromwell	3	Middlefield	3
Deep River	3	Middletown	3
Durham	3	Old Saybrook	3
East Haddam	2	Portland	3
East Hampton	2	Westbrook	3
Essex	3		

Table 1. CONNECTICUT CLIMATIC ZONE (continued)

NEW HAVEN COUNTY

City/Town	Zone	City/Town	Zone
Ansonia	2	New Heaven	3
Beacon Falls	2	North Branford	3
Bethany	2	North Heaven	3
Branford	3	Orange	3
Cheshire	2	Oxford	2
Derby	3	Prospect	2
East Haven	3	Seymour	2
Guilford	3	Southbury	2
Hamden	2	Wallingford	3
Madison	3	Waterbury	2
Meriden	3	West Heaven	3
Middlebury	2	Wolcott	2
Milford	3	Woodbridge	2
Naugatuck	2		

NEW LONDON COUNTY

City/Town	Zone	City/Town	Zone
Bozrah	2	New London	3
Colchester	2	North Stonington	3
East Lyme	3	Norwich	2
Franklin	2	Old Lyme	3
Griswold	2	Preston	2
Groton	3	Salem	2
Ledyard	3	Sprague	2
Lisbon	2	Stonington	3
Lyme	3	Voluntown	2
Lebanon	2	Waterford	3
Montville	3		

Table 1. CONNECTICUT CLIMATIC ZONE (continued)

TOLLAND COUNTY

City/Town	Zone	City/Town	Zone
Andover	2	Somers	1
Bolton	2	Stafford	1
Columbia	2	Tolland	1
Coventry	1	Union	1
Ellington	1	Vernon	2
Hebron	2	Wilmington	1
Mansfield	1		

WINDHAM COUNTY

City/Town	Zone	City/Town	Zone
Ashford	1	Pomfret	2
Brooklyn	2	Putnam	1
Canterbury	2	Scotland	2
Chaplin	1	Sterling	2
Eastford	1	Thompson	1
Hampton	1	Windham	2
Killingly	1	Woodstock	1
Plainfield	2		

Table 2. Stocking recommendations (Number per vegetated acre) for control of **American elodea, bushy pondweed, stoneworts, waterstargrass and waterstarwort**.

Table 2	Stocking Rates		Years Between Stockings
Climatic Zone	Initial Stocking	Second Stocking	
	10”-12”	10”-12”	
1	16	12	6
2	12	12	5
3	12	12	5

Table 3. Stocking recommendations (Number per vegetated acre) for control of **duckweed, watermeal, filamentous algae, bladderwort, curlyleaf pondweed, water milfoil and floating leaf pondweed**.

Table 3	Stocking Rates		Years Between Stockings
Climatic Zone	Initial Stocking	Second Stocking	
	10”-12”	10”-12”	
1	19	19	5
2	16	16	5
3	24	24	5

Table 4. Stocking recommendations (Numbers per vegetated acre) for control of **coontail, spatterdock, water lilies, watershield and water smartweeds**.

WARNING: THE USE OF GRASS CARP TO CONTROL THESE SPECIES MAY ACTUALLY PROMOTE THEIR GROWTH BY THE TOTAL REMOVAL OF COMPETING PLANTS.

Table 4	Stocking Rates		Years Between Stockings
Climatic Zone	Initial Stocking	Second Stocking	
	10”-12”	10”-12”	
1	77	28	7
2	61	20	6
3	65	20	6

NOTES

TRIPLOID GRASS CARP AQUATIC PLANT PREFERENCE GUIDE

EXCELLENT CONTROL:

American Elodea (*Elodea canadensis*)


Bushy Pondweed (*Najas spp.*)


Stonewort (*Chara & Nitella spp.*)


Waterstargrass (*Heteranthera dubia*)


Waterstarworts (*Callitriche spp.*)


FAIR CONTROL:

Duckweed/Watermeal (*Lemna/Wolffia spp.*)

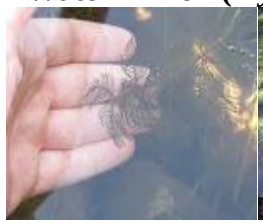

Bladderworts (*Utricularia spp.*)


Coontail (*Ceratophyllum demersum*)


Curly Leaf Pondweed (*Potamogeton crispus*)


Floating Leaf Pondweed (*Potamogeton spp.*)


Water Milfoil (*Myriophyllum spp.*)



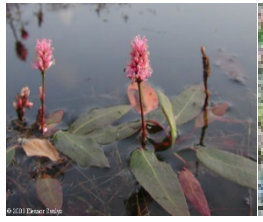

POOR CONTROL:

Spatterdock/Yellow Pond Lilly (*Nuphar advena*)


Watershield (*Brasenia schreberi*)


Waterlilies (*Nymphaea spp.*)


Water Smartweeds (*Polygonum spp.*)




Revised 04/30/2012

SCREENING RECOMMENDATIONS FOR PONDS STOCKED WITH TRIPLOID GRASS CARP

Bar spacing or mesh size should be selected to maximize the passage of floating materials (leaves, letter, etc) while effectively prohibiting escape of grass carp. The sizes typically sold in Connecticut are 10" or 12" triploid grass carp. The maximum mesh size allowed is 1 ½".

Screens should be constructed from rigid materials such as aluminum, steel or stiff plastic (polyvinylchloride or PVC). Prefabricated fence materials such as chicken wire and hardware cloth should NOT be used since they are more prone to clogging and are more likely to deteriorate (rust) rapidly. Likewise, screens constructed from wood should be avoided because they can be damaged by beavers (*Castor canadensis*).

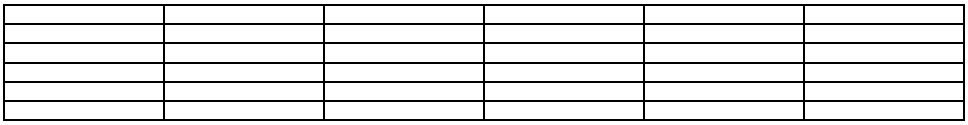
Screening should be installed to cover the entire outlet opening when the pond is served by a small culvert (pipe) or similar structure, provided that doing so will not result in back-flooding issues. When the outlet is served by a dam, spillway, or swale, the screening must be placed in such a manner as to ensure containment of the fish under high water or flood conditions. This may involve extending the screening well beyond the area of normal flow. Since grass carp are excellent jumpers, screening height should extend 2 ½ to 3 feet above the normal high mark. Screening must be securely anchored to the pond bottom or outlet to prevent fish from swimming underneath or around it. Screens must extend several inches into the substrate, since sediments can shift or erode, thereby creating an escape route for grass carp.

Screens installed on dams and spillways may require permitting by the Dam Safety Section of the DEEP Land and Water Resources Division. Applicants considering the installation of a screening device on any dam or spillway should contact the Dam Inspection & Safety Section at (860) 424-3706 for guidance. Since the Dam Inspection & Safety Section has jurisdiction for issuing permits required for dam construction/reconstruction, the Inland Fisheries Division will not approve screening devices that are disallowed by the Dam Safety Section.

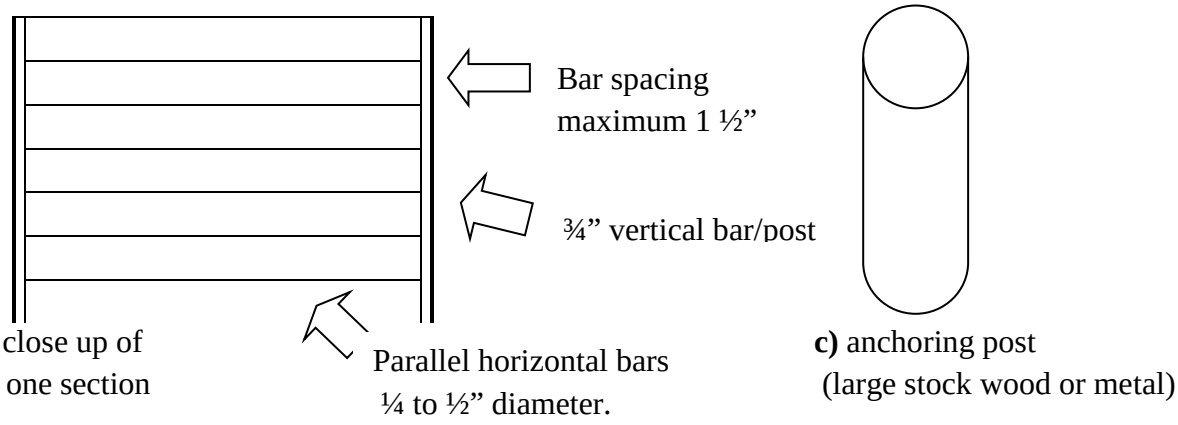
Please note that screen installation may also require approval by your local Inland Wetlands and Watercourses Agency. You should contact your town hall for further information before proceeding.

Regardless of the screen design that is installed, pond owners must be prepared to regularly inspect the screening device and manually remove any debris that has accumulated. Inspections and cleaning may become more frequent when excessive debris is in the water, such as during and after the autumn leaf drop.

Figure 1. General layout for parallel bar style emigration control screen.



a) Entire screen – Should extend from bottom of inlet/outlet to 2 ½ to 3 feet above high water mark.



b) close up of one section

c) anchoring post (large stock wood or metal)

Note – Parallel bars can be secured to ¾” vertical bars 48” apart or attached directly to large stock anchoring posts.

Acceptable Inlet/Outlet Screening Examples

HATCHERIES KNOWN TO SUPPLY TRIPLOID GRASS CARP IN CONNECTICUT

Connecticut Suppliers:

Phillips Fish Farm LLC
Russell Phillips
107 Zaicek Road
Ashford, CT 06278
Phone: (860) 429.3616
Email:
Captincrusty812@hotmail.com

Rowledge Pond Aquaculture
Todd Darren Bobowick
Rowledge Pond Road
Sandy Hook, CT 06482
Phone: (203) 426.6701
Fax: (203) 426.2977
Website: www.rowledgepond.com

Out of State Suppliers:

Northeastern Aquatics
John W. Clark, Jr.
1 Kerr Road, Suite 2
P.O. Box 575
Rhinebeck, NY 12572
Phone: (845) 876.3983

Hopper-Stephens Hatcheries, Inc.
989 Johnson Road
Lonoke, AR 72086
Phone: (501) 676.2435
Fax: (501) 676.7776
Email: hopperstephens@aol.com

Musky Trout Hatchery, Inc.
279 Bloomsbury Road
Asbury, NJ 08802
Phone: 908.479.4893
Fax: 908.479.4855
Email:
muskytrhatchery@embargmail.com
Web Site:
http://www.muskytrouthatchery.net/

Keo Fish Farms, Inc.
P.O. Box 166
6444 Highway 165 N.
Keo, AR 72083
Phone: (501) 842.2872
Fax: (501) 842.2156
Email: kkeo@centurytel.net

Please Note: Purchase of triploid grass carp requires submittal of an "APPLICATION FOR PERMIT TO IMPORT/LIBERATE TRIPLOID GRASS CARP." Inclusion of hatcheries on this list does not constitute a recommendation by the Inland Fisheries Division. All triploid grass carp imported must be certified by a person or persons acceptable to the Commissioner.