

# Methods for Aquatic Plant Management



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# Plant Control Rules to Live By

1. In lighted areas with suitable sediments, plants will grow
2. Understanding plant biology and ecology is essential to control
3. There is no “One Size Fits All” solution to plant problems
4. It is unusual to successfully manage all plants in a lake with one technique
5. Watershed management is unlikely to reduce excessive rooted plant density
6. Prevention is far less expensive than rehabilitation but is not easy
7. A regional focus is needed to protect the investment made in control





# Options for Plant Inhibition

- Nutrient control (for algae and floating plants)
- Dyes (light limitation)
- Dredging (sediment removal)
- Benthic barriers (changing substrate, light limitation)
- Drawdown (freezing and dessication, substrate change)
- Plant competition (aquascaping for desired plants)

Note that flooding and surface covers are not addressed here



# Options for Plant Removal

- Flushing (moving algae and floating plants downstream)
- Hand harvesting (incl. Diver-Assisted Suction Harvesting)
- Mechanical harvesting (barge mounted cutter/collector)
- Hydroraking (York rake on barge)
- Herbicides (about a dozen active ingredients)
- Herbivorous invertebrates (insects and crayfish)
- Herbivorous fish (grass carp and other plant-eating fish)

Note that rotovation (underwater rototilling) and plant pathogens are not addressed here



# Options for Plant Inhibition

- Nutrient control (for algae and floating plants)
  - Works where plants get most nutrition from the water column, as with duckweed or watermeal
  - Not likely to affect truly rooted vascular plants
  - Increased clarity through reduced algae or suspended sediment may increase plant growths





# Options for Plant Inhibition

- **Dyes (light limitation)**
  - **Can limit rooted plant growth in water deeper than about 3-4 feet**
  - **Will heat water surface, may cause shallower stratification and faster oxygen loss**
  - **Tends to be applied to ornamental ponds**



# Options for Plant Inhibition

- Dredging (sediment removal)
  - Removes nutrient supplies, plant roots, seeds, and other propagules, alters substrate features
  - Very expensive with major permitting needs
  - Essential to understand sediment quantity and quality
  - Closest action to true restoration



# Options for Plant Inhibition

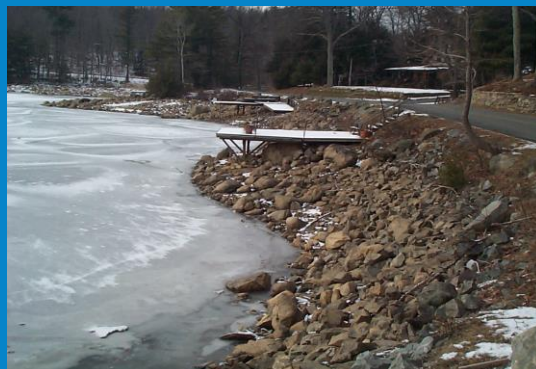
- **Benthic barriers (changing substrate, light limitation)**
  - **Synthetic materials placed on bottom to restrict plant growth**
  - **Porous and non-porous options, each with benefits and drawbacks**
  - **Usually applied on small scale due to cost and effort**
  - **Can be very effective with maintenance**





# Options for Plant Inhibition

- Drawdown (freezing and dessication, substrate change)
  - Lowered water level will expose target area/plants
  - Will create coarser substrate over time with adequate slope
  - Can kill plants that overwinter in vegetative state
  - Less effective on annual species, may even stimulate seed germination
  - Many impact considerations, some added benefits



# Options for Plant Inhibition

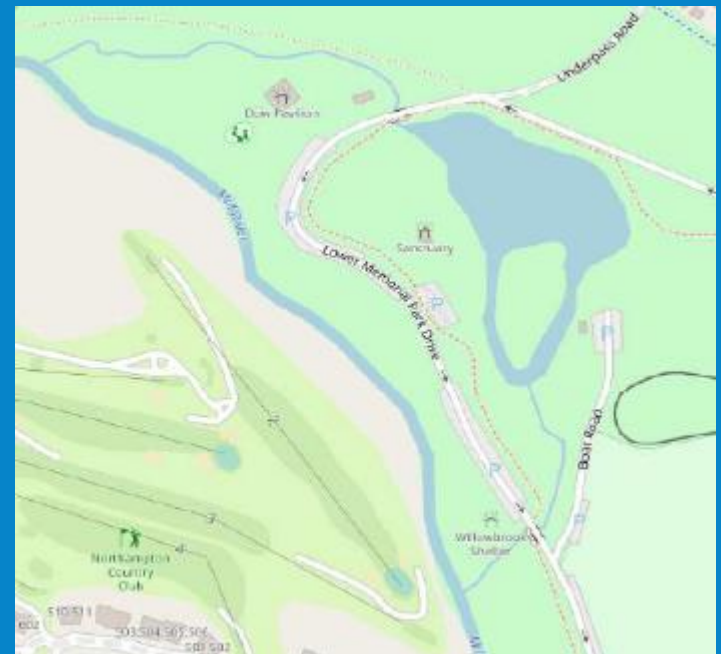
- Plant competition (aquascaping for desired plants)
  - Maintenance of healthy native community provides some protection against invasive species
  - Removing unwanted plants is only part of the process; fostering desired community advisable
  - This approach remains underdeveloped



# Options for Plant Removal



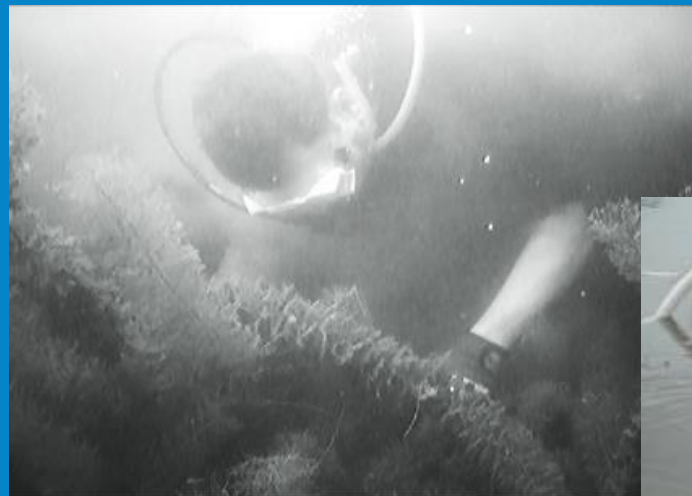
- Flushing (moving floating plants and algae downstream)
  - Can reduce free-floating plants like duckweed
  - Requires reliable source of water
  - Rate of flushing should be at least every 3 weeks
  - Not effective on species rooted in substrate





# Options for Plant Removal

- Hand harvesting (incl. Diver-Assisted Suction Harvesting)
  - Highly selective removal of target species
  - Works well with target species at low density, scattered among desired plants
  - DASH can improve efficiency at higher plant density
  - Labor intensive, requires organization for success



# Options for Plant Removal

- Mechanical harvesting (barge mounted cutter/collector)
  - Functionally mowing an underwater lawn
  - Can open areas for recreation while maintaining habitat
  - Works best in water 3-7 feet deep
  - Some nutrient removal
  - Rarely causes permanent change in plant community



# Options for Plant Removal

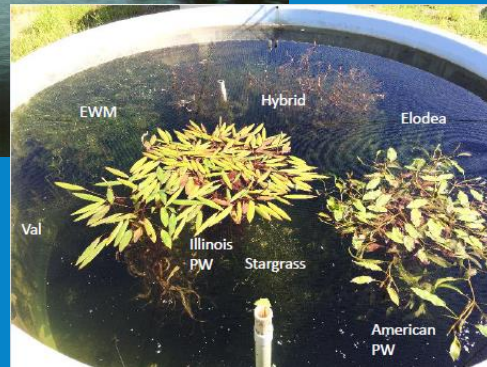
- **Hydroraking (York rake on barge)**
  - **Functionally small scale dredging**
  - **Can remove root masses, woody debris, rocks**
  - **Usually applied in water <4 feet deep**
  - **Most effective on emergent plants and water lilies**





# Options for Plant Removal

- Herbicides (about a dozen active ingredients)
  - Variety of active ingredients with different target plants and modes of action
  - Contact vs systemic herbicides
  - Spatial and temporal application considerations
  - Least expensive means for larger scale control



# Options for Plant Removal

- **Common active ingredients**
  - **Copper and peroxide (mostly for algae)**
  - **Glyphosate, imazapyr – broad spectrum systemic for emergent/floating leaved species**
  - **Diquat, endothall, flumioxazin – broad spectrum, mostly contact, rapid action for submergent species**
  - **Triclopyr, 2,4-D, imazamox – broad spectrum systemic, rapid action for submergent/floating leaved species**
  - **Fluridone – potentially selective systemic for submergent species, slow acting**
  - **Florpyrauxifen-benzyl – potentially selective systemic for submergent species, rapid action**

# Options for Plant Removal



## Effectiveness of active ingredients for algae and invasive plant species

Scientific Name	Common Name	Diquat	Endothall	Flumioxazin	2,4-D	Fluridone	Glyphosate	Imazapyr	Imazamox	Triclopyr	Florpyrauxifen-benzyl
<b>Algae</b>											
Chara/Nitella spp	Muskgrass/Stonewort	P		P					P		
Chlorophyta	Filamentous green algae mats	P		P							
Chlorophyta, Chrysophyta	Planktonic algae in general										
Cyanobacteria	Blue-green algae										
<b>Invasive Species</b>											
<b>Submergent</b>											
Cabomba caroliniana	Fanwort			C		C					
Egeria densa	Brazilian waterweed	C				P			P		
Hydrilla verticillata	Hydrilla	C	C	C		C			P		P
Myriophyllum aquaticum	Parrotfeather	C	P	P	C	P		P	P	C	C
Myriophyllum heterophyllum	Variable watermilfoil	C	P	C	C	P				C	C
Myriophyllum spicatum	Eurasian watermilfoil	C	C	P	C	C				C	C
Najas minor	Spiny or european naiad	C	C	P	P	C			P		
Potamogeton crispus	Curlyleaf pondweed	C	C	C		C			C		
<b>Floating leaved</b>											
Nelumbo nucifera	Indian lotus		P	P			C		P	C	C
Nymphaoides peltata	Yellow floating heart	C			P			P	P		C
Trapa natans	Water chestnut	P		P	C	P	P	C	C	P	C
<b>Emergent</b>											
Lythrum salicaria	Purple loosestrife						C	C		C	
Phragmites australis	Common reed						C	C	P	C	

C = high level of control with typical application rate. P = partial control or greater with multiple applications and/or higher dose. Blank entry indicates herbicide not generally effective for corresponding species at typical application rates and exposure times. Please recognize that dose, duration of exposure, formulation and timing of application are all key factors in results.

Note that some herbicides can be mixed or applied sequentially; for example, copper is often used to minimize attached algae on plants and maximize impact of other herbicides.

Note that most herbicides contain additional compounds, some intended to increase effectiveness; knowledge of additional ingredients can be helpful in selecting an herbicide.



# Options for Plant Removal



## Effectiveness of active ingredients for native plant species

Scientific Name	Common Name	Diquat	Endothall	Flumioxazin	2,4-D	Fluridone	Glyphosate	Imaza pyr	Imazamox	Triclopyr	Florpyrauxifen-benzyl
<b>Native Nuisance Species</b>											
<b>Submergent</b>											
Ceratophyllum demersum	Coontail	C	P	C	P	C			P		P
Eloдея canadensis	Waterweed	C				C					
Eloдея nuttallii	Slender waterweed	C				C					
Myriophyllum humile	Low watermilfoil	C		C	C	P				C	C
Najas flexilis	Bushy naiad	C	C	P	P	C			P		
Najas gaudalupensis	Southern naiad	C	C	C	P	C			P		
Potamogeton amplifolius	Bigleaf pondweed	P	C	P		P			P		
Potamogeton richardsonii	Richardson's pondweed	P	C	P		P			P		
Potamogeton robbinsii	Robbins' pondweed	P	C	P					P		
Potamogeton spp. (e.g., natans, pulcher, illinoensis)	Broadleaf pondweeds	P	C	P		P			P		
Potamogeton spp. (e.g., pusillus, berchtoldii, spirillus)	Thinleaf pondweeds	C	C	P		P			P		
Potamogeton spp. (e.g., gramineus, ephydrus, )	Other pondweeds	C	C	P		P			P		
Utricularia spp.	Bladderwort	C				C			P		
Vallisneria americana	Water celery	P	P			P					
<b>Floating leaved</b>											
Brasenia schreberi	Watershield			P	P	P	C	P	P	C	C
Lemna minor	Duckweed	P		C		C					
Nelumbo lutea	American lotus			P	P		C	P	P	C	C
Nuphar variegata	Yellow water lily			P	P	P	C	C	P	C	
Nymphaea odorata	White water lily			P	P	P	C	C	P	C	
Nymphoides cordata	Little floating heart	C		P	P	P		P	P	P	C
Persicaria amphibia	Water smartweed				P	P	C	P	P	P	
Wolffia columbiana	Watermeal	P		C		C					
<b>Emergent</b>											
Pontederia cordata	Pickerelweed	P					C	C	P	P	
Sagittaria spp.	Arrowhead	P					C	C	C	P	
Typha latifolia	Cattail	P				P	C	C	C	P	

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# Options for Plant Removal

- **Herbivorous invertebrates (insects and crayfish)**
  - **Native or exotic species that eat or otherwise damage target plant species**
  - **Biological methods hard to control, typically result in oscillating abundance of predator and prey**
  - **Ecological ripple effects – positive or negative**
  - **Less amenable to integrated pest management**



# Options for Plant Removal

- **Herbivorous fish (grass carp and other plant-eating fish)**
  - **Consume target (and often other) plant species**
  - **Diet preference may not match desired control**
  - **Many states prohibit use or have major restrictions**
  - **Tend to promote algae blooms**
  - **Complete plant control possible, partial or targeted control more elusive**





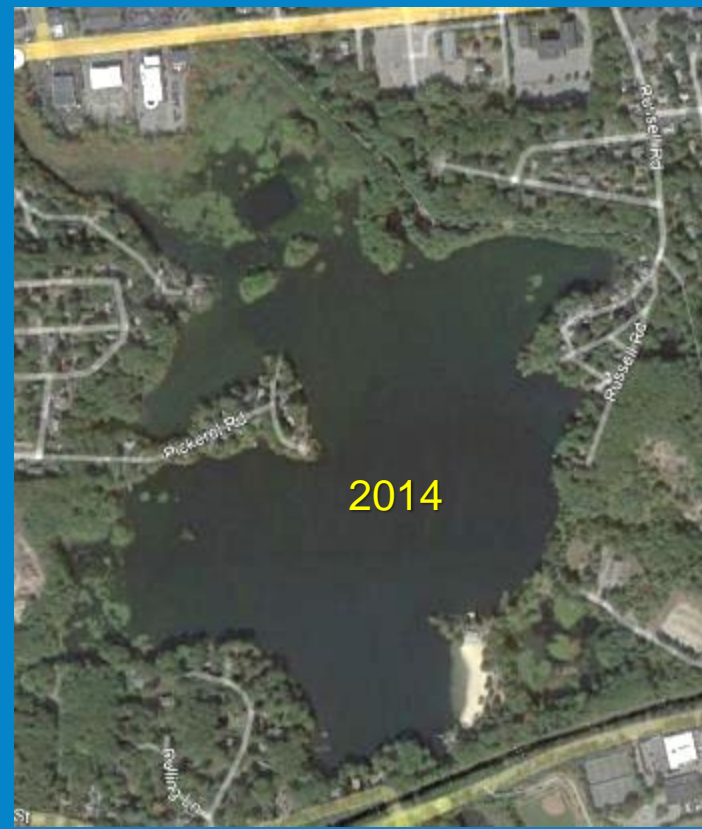
# Making Choices for Plant Control

- Is control needed?
- What will be most effective?
- What will provide greatest longevity of benefits?
- What will have the fewest undesirable impacts?
- What can be permitted?
- What can be afforded?



# Combining Techniques

- Different plants may require different techniques
- Removal then inhibition
- Localized and lakewide control
- Short-term and long-term control



# Developing Plant Control Plans

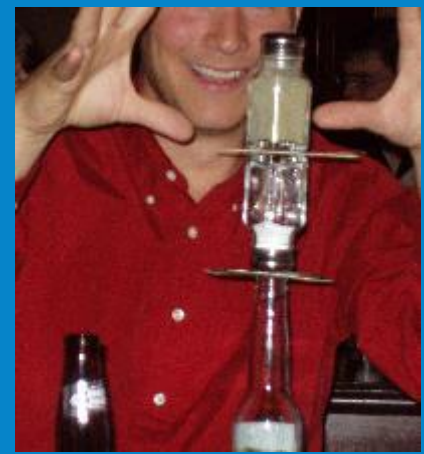
- Involve all stakeholders
- Clear statement of goals with measurable, realistic objectives
- Clear linkage of techniques with goals/objectives
- Monitoring program to track progress and facilitate adjustment
- Properly funded and managed for long-term results



Big picture view



Realistic expectations



Seek balance



# Questions and Comments

