

# Aquatic Weed & Algae Control



# Aquatic Systems: Multiple uses

- Fishing
- Swimming
- Boating
- Aesthetics
- Drinking Water
- Wildlife
- Flood Control
- Irrigation
- Hydroelectric



# Aquatic Plant Management Plan

- Prevention
- Assessment
- Site-specific management
- Evaluation
- Monitoring
- Education



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# Aquatic Plant Management

## ❖ Prevention

- ❖ Educational signs at boat launches, marinas
- ❖ Volunteer Plant Survey to watch for invasive plants in pond

## ❖ Identify plant species

## ❖ Site Considerations

## ❖ Select Management Approach

mechanical  
biological  
herbicides

## ❖ Monitor / Follow Up Application







# Aquatic and Riparian Weeds of the West

Sponsored by the California Weed Science Society

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University of California  
Agriculture and Natural Resources



Publication 3421



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the California Weed Science Society

# Weeds of California and Other Western States

Vol. 1

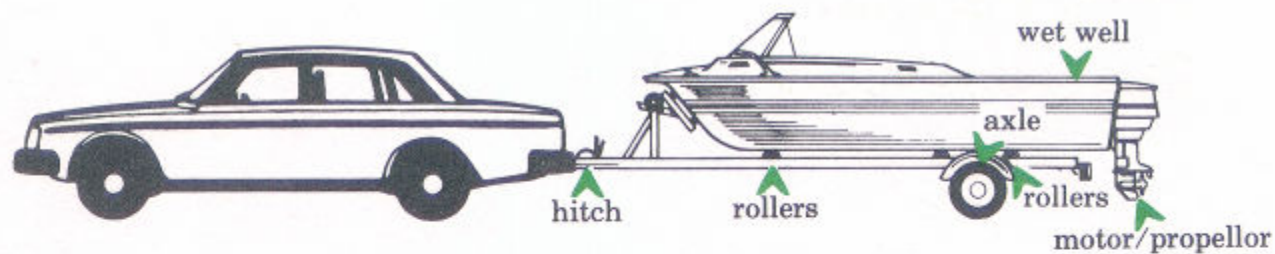
*Aizoaceae-Fabaceae*

University of California  
Agriculture and Natural Resources



Publication 3488

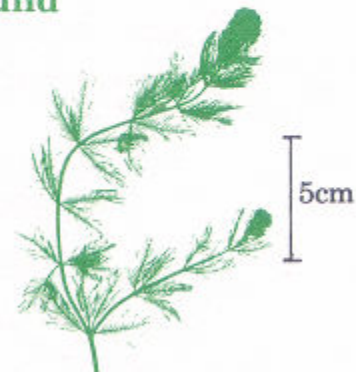




### ◀ Locations where aquatic weeds are often found

Boaters can help prevent the spread of Eurasian water milfoil by removing all aquatic weeds from **trailer**, **boat**, **motor/propellor** and **anchors** before launching and after leaving water.

Special care should be taken to remove aquatic weeds from the wet wells of trailered boats and the interior of cartop boats and canoes.



EURASIAN WATER  
MILFOIL FRAGMENT

## Aquatic Weed Alert



### Sutter/Yuba Weed Management Area

Sutter County Department of Agriculture  
Yuba County Department of Agriculture

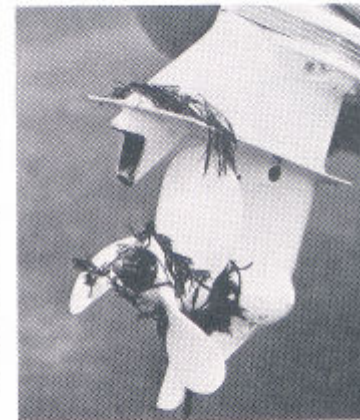


*Hydrilla verticillata*

## STOP Spread of Eurasian Water Milfoil

Eurasian water milfoil is an aquatic weed which interferes with boating, swimming, waterskiing, and fishing in southern British Columbia and on Vancouver Island.

Fragments of Eurasian water milfoil may survive if transported on boating equipment and can initiate new colonies if introduced to noninfested lakes. It has not yet been found north of Shuswap Lake and in most of the Kootenay Regions.



Do not transport aquatic weeds!



Province of  
British Columbia

Ministry of  
Environment

# Prevention

Eliminate shallow areas during construction  
> 3 feet deep, except in designated  
swimming areas.

Prevent nutrients from entering the pond  
point sources

use 10 - 20 foot wide grass buffer strips

fertilize areas adjacent to pond sparingly

prevent livestock from entering the pond directly

reduce the number of waterfowl





# Management Goals


Management approach will depend on your goals for the site:



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# Site Considerations

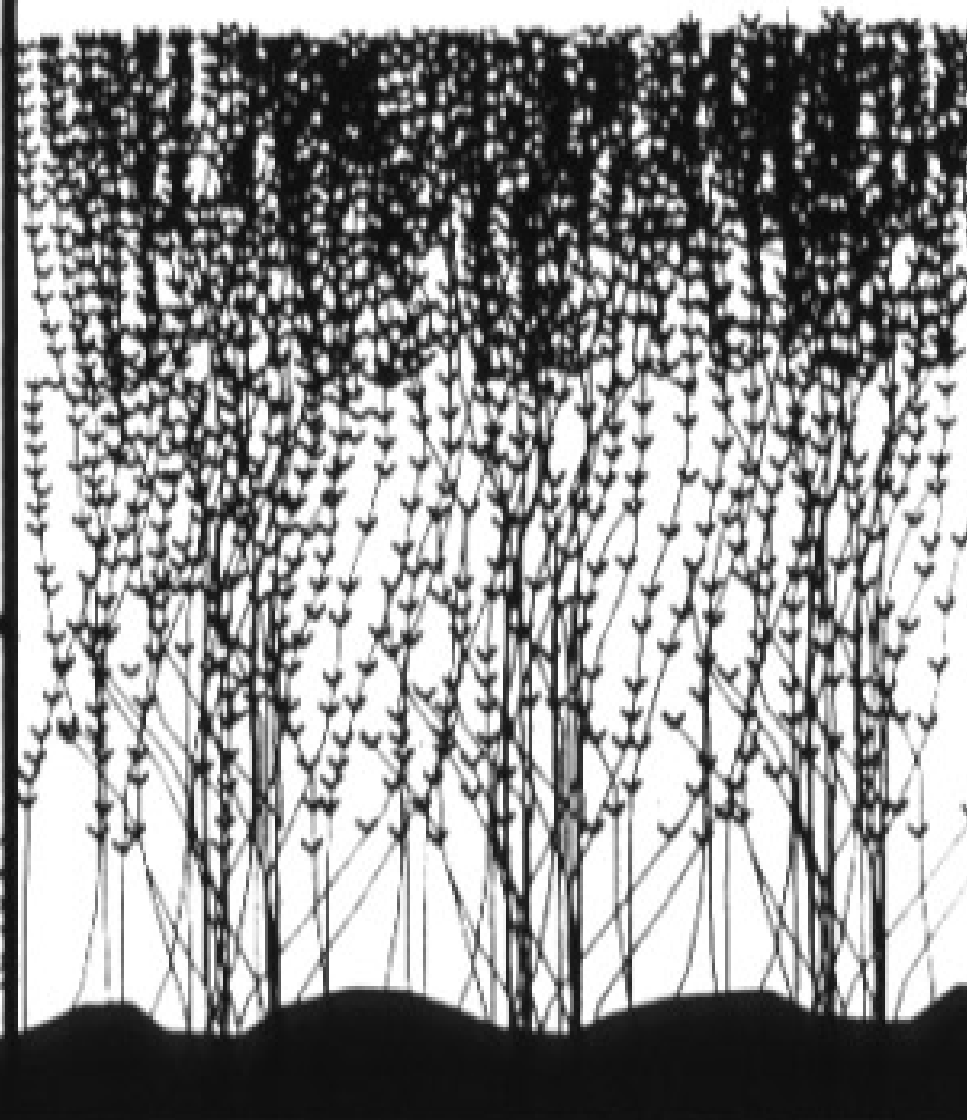
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- ❖ Pond Dimensions
  - ❖ Average Depth
  - ❖ Inflows / Outflows
  - ❖ Location in the Floodplain
  - ❖ Types of Fish
  - ❖ Water Uses
- 

**A. Diverse native community**



**B. Monospecific non-indigenous population**



# *Costs of aquatic weed management*

- Ranges from \$500 to \$3,000 per acre
- Ranges from \$500 to \$5,000 per mile of canal

## What are the costs associated with?

- Consumable Materials (e.g. herbicides, fuel)
- Equipment (sprayers, harvesters, trucks, boats, safety gear)
- Personnel (salaries, training, insurance, benefits)
- Regulatory: NPDES-monitoring and compliance (sampling equipment, training, analysis, documentation, record storage)



# Aquatic Plant Management Approaches

- Mechanical Control
- Cultural Control
- Biological Control
- Chemical Control



# Mechanical Control



- Hand pulling and raking
- Cutting and harvesting
- Shredding
- Dredging
- Chaining
- Diver-operated suction harvesting
- Rotovating

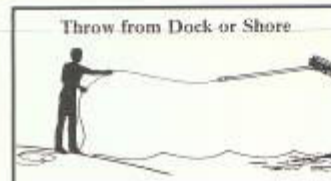
Hand operated  
tools

# AQUA WEED RAKE™

Removes  
Cut Weeds  
and Algae from  
Lakes and Ponds

- Fun and Easy because  
it's **LIGHT WEIGHT!**

Just  
Throw it out and  
Rake in the weeds



**ATTACHABLE FOAM FLOAT**  
for removing Weeds & Algae  
that float.



Unwanted water weeds make  
excellent garden Fertilizer



Safe,  
Simple,  
Economical,  
and Effective

Environmentally safe. **SWIM IMMEDIATELY** after using—no more concern about toxic effects to fish, wildlife, pets or humans. **SO SIMPLE** any one person can use this lightweight (3½ pound) - 36 inch-5½ foot Magnesium Aluminum Rake. Adjustable extension (6' to 10') allows for removing weeds and debris from lake bottoms. **ECONOMICAL** because it provides many years of weed removal for less than the cost of chemical treatments. Ideal for fast and easy "Shoreline clean-up" or "Sand Raking" beaches or gardens. The Attachable Float makes the rake **MORE EFFECTIVE** for removing weeds that float.

- **What could be a better companion tool for "Aqua Weed Cutter" owners?**



LAKE WEED- A- WAY INC. PO BOX 132 Caledonia Michigan 49316-0132 616 891-1294





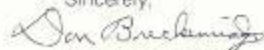
## HANDY MARKETING CO.

Dear Friend:

If you have a water weed problem, you already know what a job it is keeping the weed growth under control. Water weeds can greatly affect the use of your water property by inhibiting swimming, fishing and boating. Uncontrolled water weeds can also be an unsightly mess.

The AQUA WEED CUTTER will not only solve your water weed problems, but also help you do your part in preserving our nation's most valuable resource. If for any reason you are not satisfied in 30 days with the operation of the AQUA WEED CUTTER, return it to wherever you purchased it for a full refund. This is a no risk offer on your part.

The AQUA WEED CUTTER is manufactured with the highest degree of workmanship and the highest quality of materials. The AQUA WEED CUTTER is 100% manufactured in the United States. Zinc plating and the stainless steel resharpenable blades offer a high degree of corrosion resistance. We are so sure of the quality of materials and workmanship that goes into each AQUA WEED CUTTER that we have recently extended the limited warranty period from 90 days to 1 year.

Sincerely,  
  
 Don Breckenridge,  
 President

## SATISFIED CUSTOMERS

"Does a fantastic job - I figured I cleared more weeds in two hours than I've previously been able to in a whole summer."  
 -South Haven, MI

"My friend brought his AWC over to my house and I tried it. I thought it was great and I ordered one. The AWC is effective and easy to use."  
 -Webster, WI

"I like it very much. It does a very good job. I had to put a longer rope on it because I can throw it farther than the rope would permit. It's nice to be able to cut weeds without getting wet, especially when the water is cold."  
 -Aitkin, MN

"Gentlemen, I wish to inform you that your AQUA WEED CUTTER does a very good job and I am pleased. Several of the neighbors have also ordered them."  
 -Gowen, MI

"We have tried the AQUA WEED CUTTER and find it does an excellent job of cleaning the weeds in our beach, along the long pier and boat docks. We are very satisfied with the product and would recommend it to anyone who has a need."  
 -Claypool, IN

**BEACHES • PONDS &  
 SMALL LAKES CAN BE  
 WEED FREE!  
 SAFE, EASY-TO-USE •  
 HELPS TO CONTROL  
 WATER WEEDS**

- Cuts a 48" path up to 20' deep (without operator getting wet!)
- Just throw it out and pull it in from **Any Dock or Shore!**

**Stainless Steel Resharpenable Blades!  
 30-DAY MONEY BACK GUARANTEE!!**



# Cutting/Harvesting





# Cutting/Harvesting





Underwater cutting head



Small fish and invertebrates become trapped in the plant material. The plant material has to be carried to appropriate disposal site.







# Shredding

- Shredders chop material in place, too small for clogging waterways
- Immediate relief

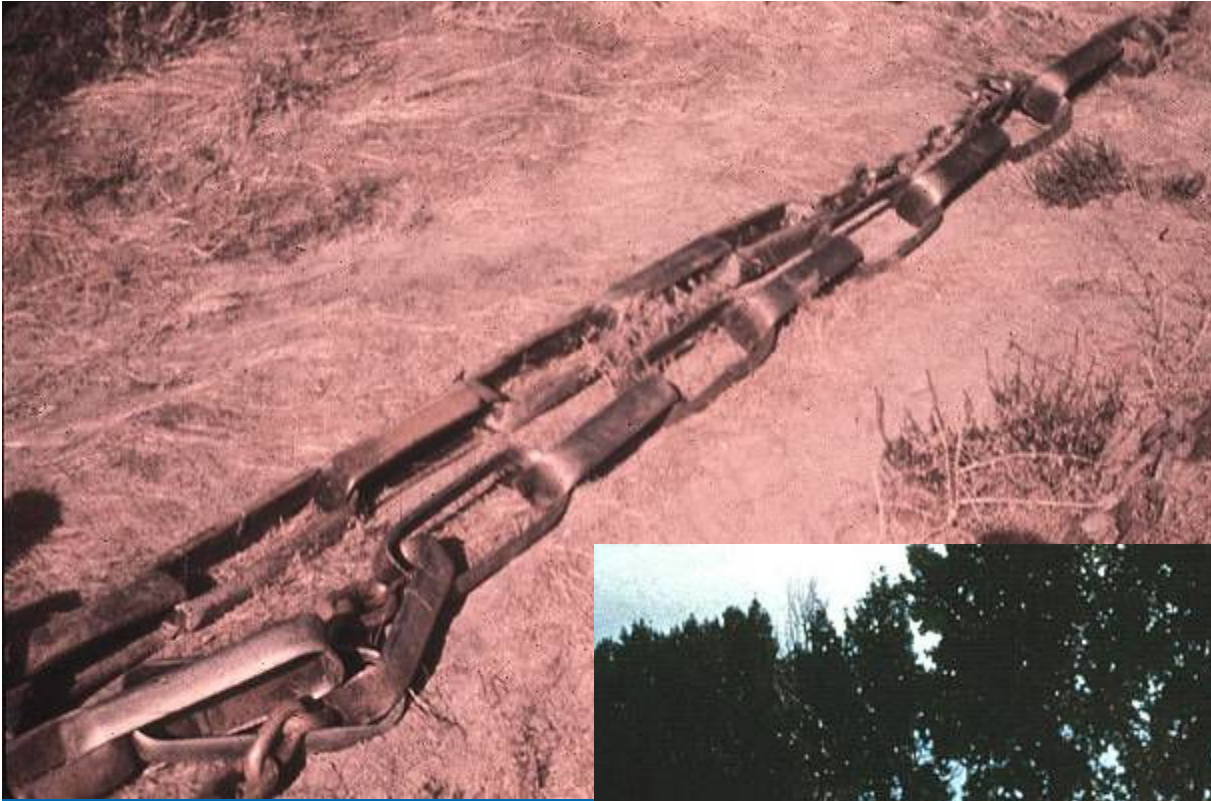






Dredging: remove nutrient-rich sediments expose nutrient poor layers; deepens and results in less light penetrating to the bottom.





# Chaining



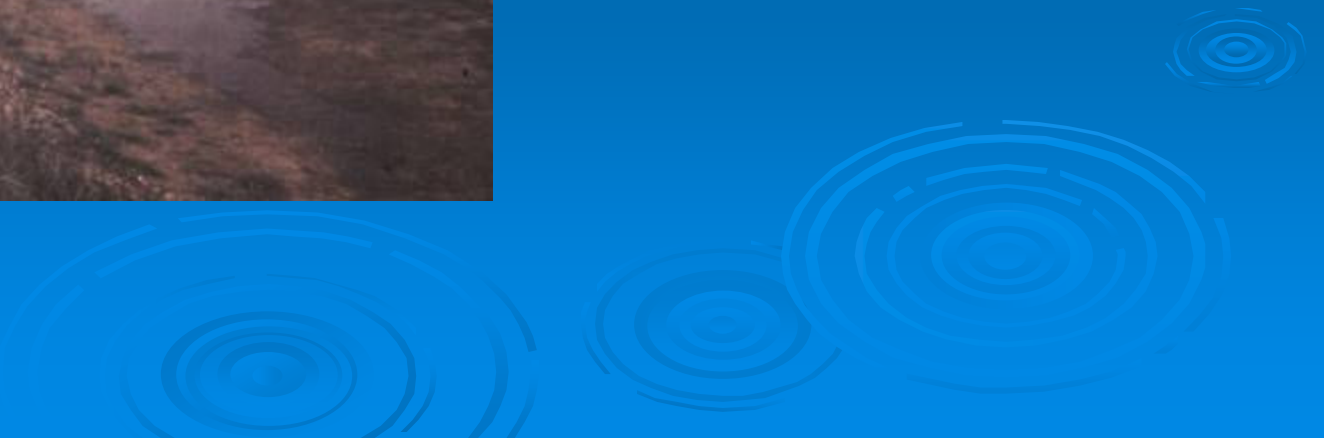
# Cultural Control

- Drawdown
- Benthic Barrier
- Shading
- Nutrient Inactivation
- Barley Straw



# Drawdown

- Effective on some species, and inexpensive
- Damage to other non-target organisms
- Can impact human use of water
- Need water controls



## Water Level Drawdown

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↓ Coontail, Egeria, Eurasian watermilfoil,  
Southern Naiad, Water Lily, Robbin's Pondweed

↑ Alligator weed, Hydrilla, Bushy Pondweed

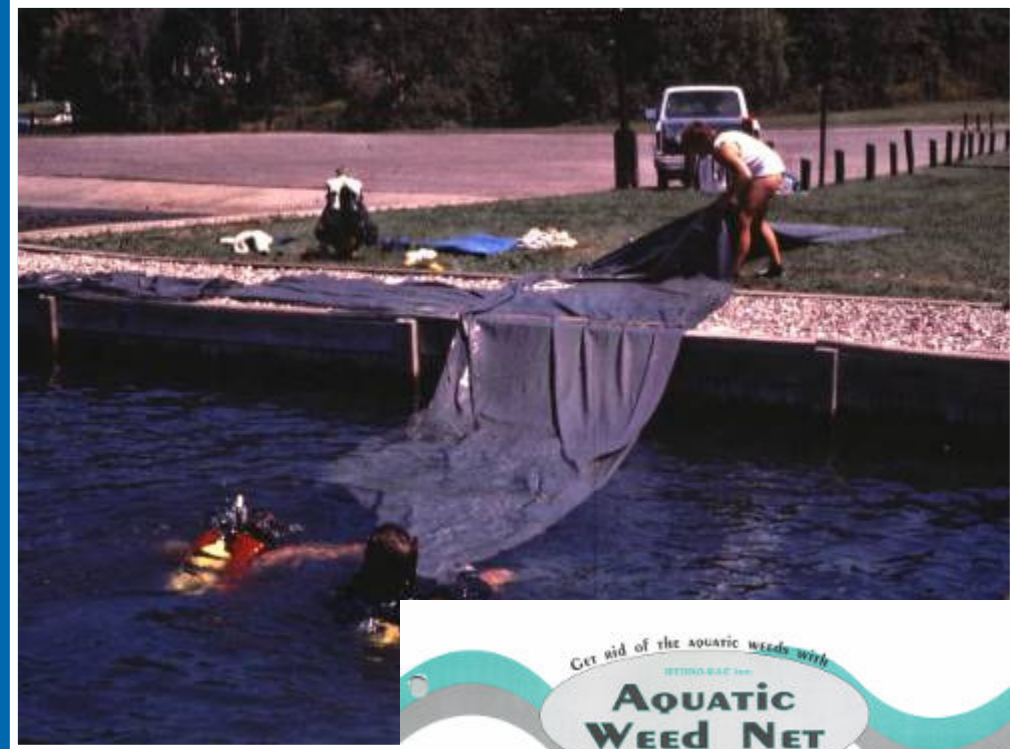
↕ Waterhyacinth, Elodea, Cattail



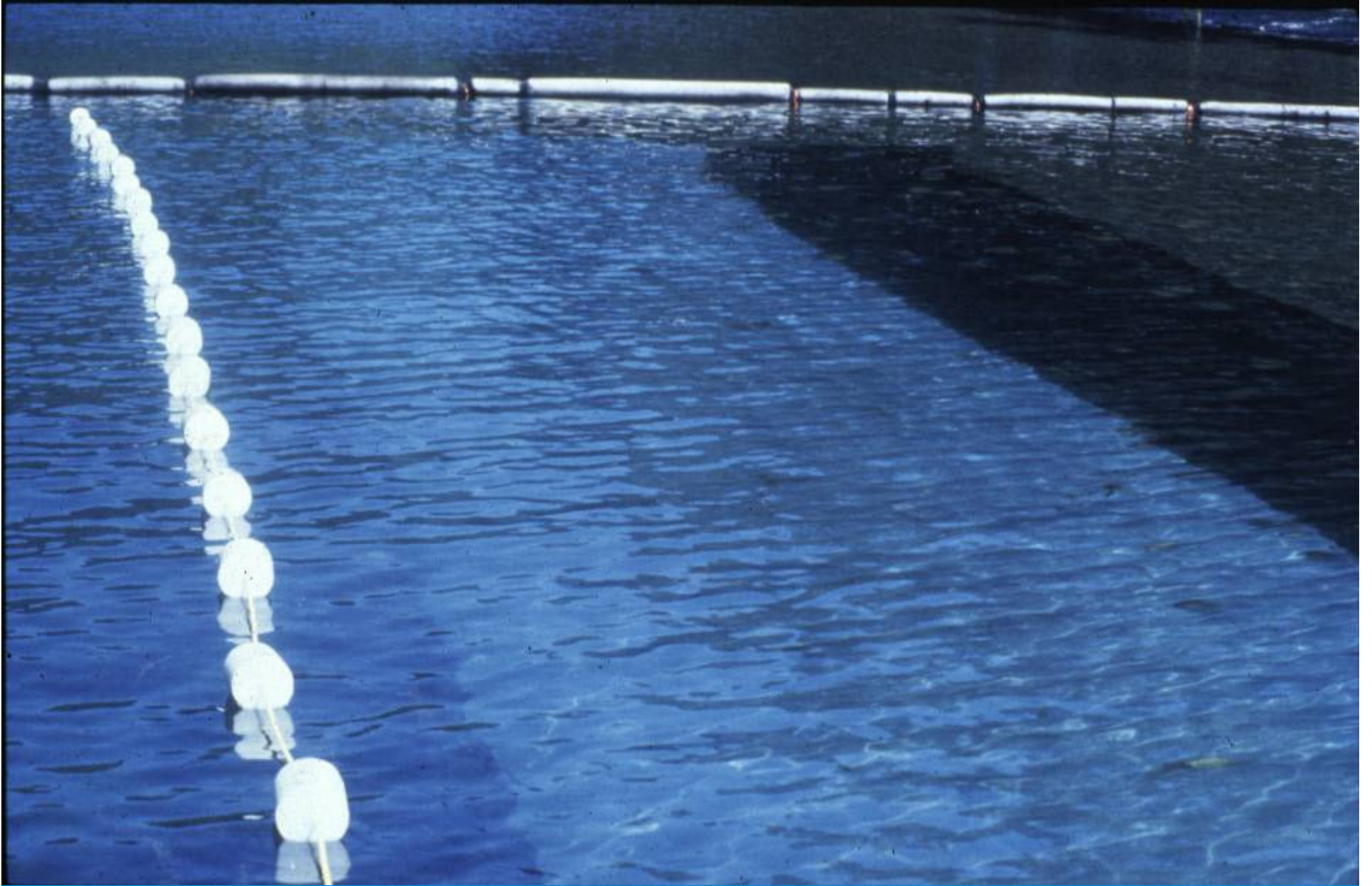
# Benthic Barrier

- Frees areas for immediate use.
- Last up to 10 years
- Easy to install in small areas.
- Prevent new plant growth.if used early in the spring.

- Not suitable for large-scale (expensive)
- Must be removed and cleaned in the fall.
- Too shallow an installation may entangle props.
- Habitat can be eliminated.
- Installation may be strenuous especially in deep water.











Barley straw

## Light Alteration as a Management Approach

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Increase water depth by dredging.

Increase shade from stream banks by planting tall grass, shrubs or trees.

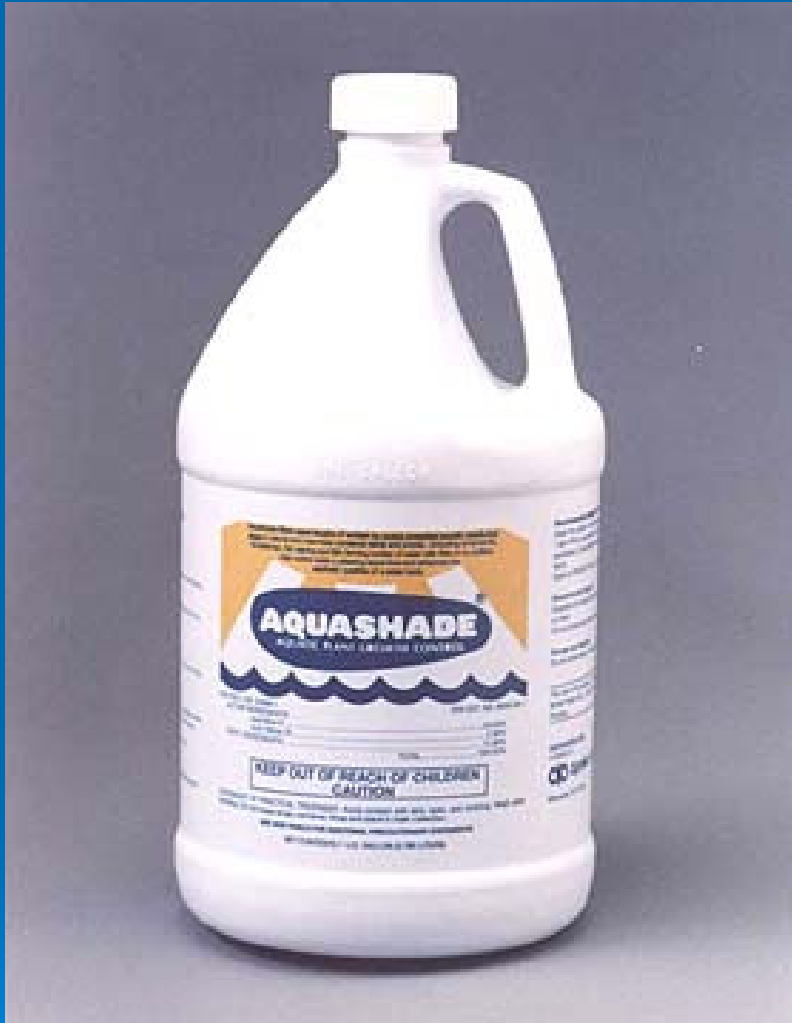
Add nutrients to stimulate algal blooms.

Increase turbidity due to suspended clay.

➤ Use light absorbing dyes.

(slow water turnover, dilution, apply early in growing season, most effective in clear water, require minimum depths of > 0.5 to 2 m)





# Shading

- Water-soluble dye
- Inexpensive
- Discoloration appears artificial

# AQUASHADE

AQUATIC PLANT GROWTH CONTROL

FOR ALL SEASONS

U.S. Pat. No. 4,042,267

EPA Reg. No. 33095-1

EPA Est. No. 35069-OH-1

AQUASHADE FILTERS WAVE LENGTHS OF SUNLIGHT TO CONTROL UNWANTED AQUATIC WEEDS AND ALGAE IN NATURAL AND MANMADE CONTAINED LAKES AND PONDS...INCLUDING ORNAMENTAL, RECREATIONAL FISH REARING & FISH FARMING BODIES OF WATER WITH LITTLE OR NO OUTFLOW ALSO COLORS WATER A PLEASING AQUA... ENHANCES THE AESTHETIC QUALITIES OF A...

**ACTIVE INGREDIENTS:**

Acid Blue 9  
Acid Yellow 23

**INERT INGREDIENTS:**

TOTAL

**KEEP OUT OF REACH OF CHILDREN  
CAUTION**

**STATEMENT OF PRACTICAL TREATMENT:**  
Avoid contact with skin, eyes, and clothing. Wash hands thoroughly after use. Do not reuse empty container. Wrap and place in a safe place.

**DIRECTIONS FOR USE**

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

**GENERAL CLASSIFICATION**

**WHERE TO APPLY**

Natural and manmade contained Ponds, Lakes & Fountains including Ornamental, Recreational, Fish Rearing and Fish Farming Ponds with little or no outflow, Golf Course Ponds and Watering Turt.

Do not apply directly to streams, other natural bodies of water or any body of water not under total control of the user. Do not apply to water that will be used for human consumption.

**HOW TO APPLY**

Pour from the container near shoreline into water. It will mix throughout. For an early control, pour onto the ice in a meter diameter circle. It will melt a hole & disperse underneath.

**WHEN TO APPLY**

For best results, apply before growing season starts, or when growth is on the bottom. Less effective when growth is near surface (2 ft.) in that case, physical removal or chemical killing of growth already above surface may be done before AQUASHADE is applied. When using an aquatic herbicide, follow all label restrictions, precautions and directions for use.

**PRECAUTIONS**

May be used Do not reuse as this will c...

**RECOMMENDATIONS**

1 ppm - With desirable green Chloa, Slen algae, Spiro 2 ppm to PP

**ENVIRONMENTAL**

Shoreline not control burn Do not pour washwaters.

**STORAGE**

Do not reuse collectible.

The use of it is prohibited by 1,059,888, Fm

NET CONTENTS: 1 GALLON (3.785)



MILWAUKEE, WISCONSIN 53218

8W 1192

1-800-558-5108



## TRUE BLUE™ LAKE & POND DYE

### TECHNICAL BULLETIN

**DESCRIPTION:**

TRUE BLUE is a dark aqua blue, odorless, non-toxic liquid formulated to impart an attractive blue coloring to natural and man-made ponds, lakes, fountains and water features.

Designed to turn water blue without producing an artificial appearance, TRUE BLUE aids in beautifying parks, corporate campuses, golf courses, campgrounds and retention ponds.

**ADVANTAGES:**

- Non-toxic, tested by independent agencies
- Harmless to fish, wildlife and other aquatic species
- True, natural looking color
- Easy to use
- Long-lasting
- Odorless
- Economical
- Highly concentrated!

**DIRECTIONS FOR APPLICATION:**

Apply TRUE BLUE at a rate of one gallon (3.77L) per four acre feet of water. Note: one acre foot is the quantity of water (43,560 cubic feet), that would cover one acre to a depth of one foot. One gallon of TRUE BLUE will treat up to 1,250,000 gallons of water, depending on water quality.

Recommended application method: TRUE BLUE may be applied with a hand-held pressure sprayer (use caution if windy conditions exist), but can also be poured from a slow-moving boat or directly from the container along the shoreline. Following application, TRUE BLUE will be slowly dispersed and mixed throughout the entire body of water by wind and water currents.

For best results, apply in early spring and throughout the season, depending on the desired level of color intensity.

**PACKAGING:**

TRUE BLUE is available in one gallon containers, packaged six gallons per case.

**PROPERTIES:**

Form	.....	Liquid
Odor	.....	None
Color	.....	Dark blue
Storage Stability	.....	Excellent
Cold Stability	.....	Keep above 32°F
Corrosion Factor	.....	None
Flashpoint	.....	None
Solubility in Water	.....	Infinite
Boiling Point	.....	212°F
pH	.....	5.4
Specific Gravity	.....	1.045
% Volatile by Weight	.....	70.75%
Evaporation Rate	.....	Same as water
Weight per Gallon	.....	8.7 lbs.

**IMPORTANT NOTE:**

Do NOT apply this product to water intended for human consumption. Do NOT use this product for streams, rivers or other bodies of water not under control of the user. Do NOT use in water that has been or will be chlorinated.

**HEALTH HAZARD AND FIRST AID INFORMATION**

Keep out of reach of children. Do not take internally. Avoid contact with skin, eyes or clothing. If accidentally ingested, drink large volumes of water. Do not induce vomiting. If skin contact occurs, wash skin with soap and water. If eye contact occurs, flush eyes with water for fifteen minutes. If irritation persists, obtain medical attention. Material Safety Data Sheet available on request.

**STORAGE AND DISPOSAL**

Store above 32°F. Do NOT reuse empty container. Dispose of container in a safe manner in accordance with federal, state and local regulations. Do not use product in a manner inconsistent with labeling.

**INQUIRY INFORMATION**

The information contained in this bulletin is based on information which is believed to be reliable. However, Precision Laboratories does not warrant a third party's express or implied accuracy thereof. In preparing and publishing this bulletin, no attempt has been made to investigate or discuss any patent or trademark situation which may be involved.

YOUR LOCAL DEALER IS:

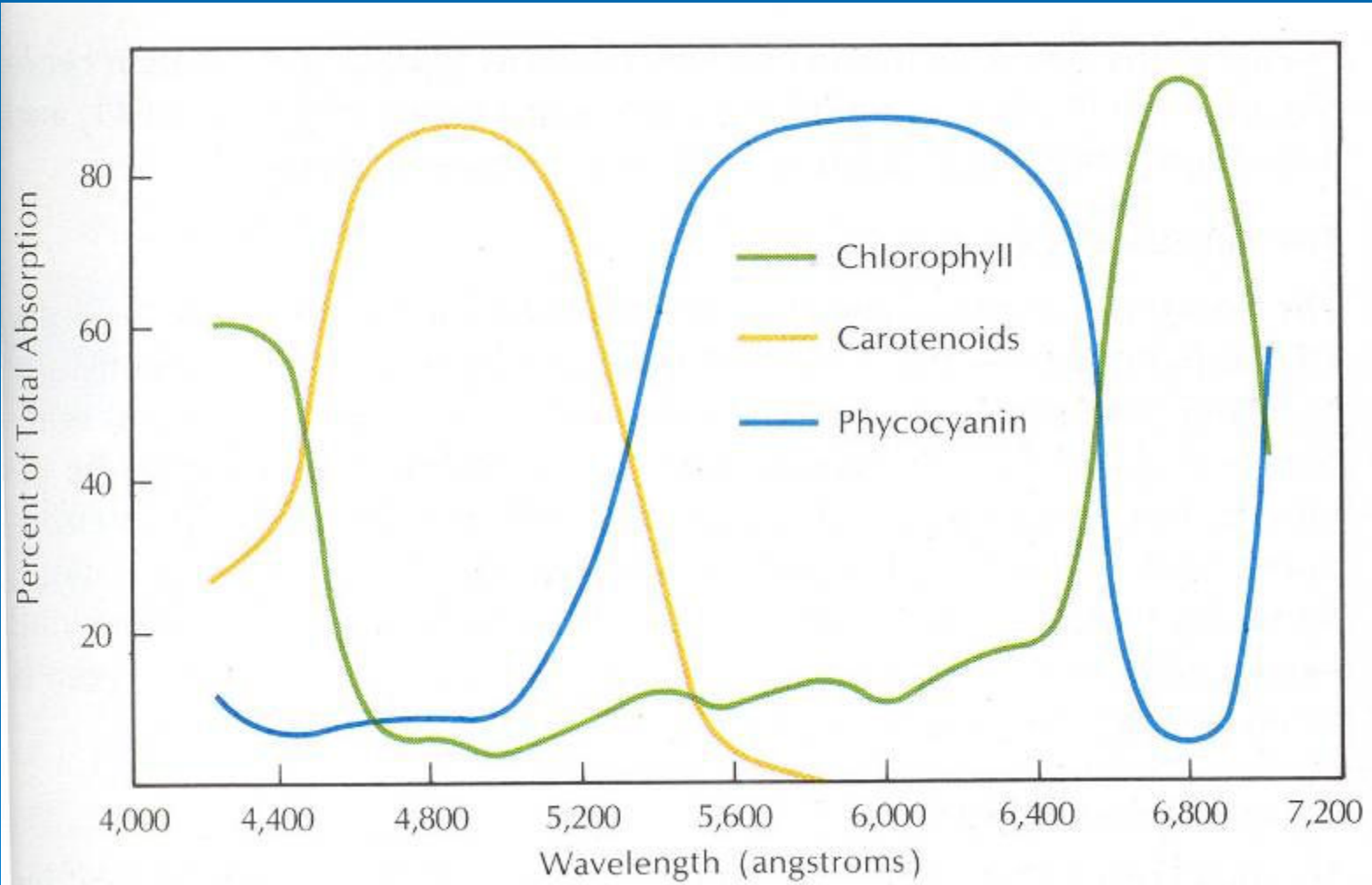


**PRECISION LABORATORIES, INC.**  
P.O. Box 127  
Northbrook, IL 60062  
800-323-4280 • 312-488-0800  
FAX: 312-488-1170

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Precision, U.S.A.







# Nutrient Inactivation

- Complex P with
    - Alum
    - Iron
    - Other
  - Controls algae relatively inexpensively and can clarify water
  - May not effect plants, particularly rooted ones
  - Can have an effect on fish and other organisms
- 

# Biological Control



- Insects
  - Classical
  - Native
- Herbivorous Fish
  - Grass Carp
- Pathogens
  - Classical
  - Native

# West Indian Manatee





# Grass Carp

## ■ Advantages

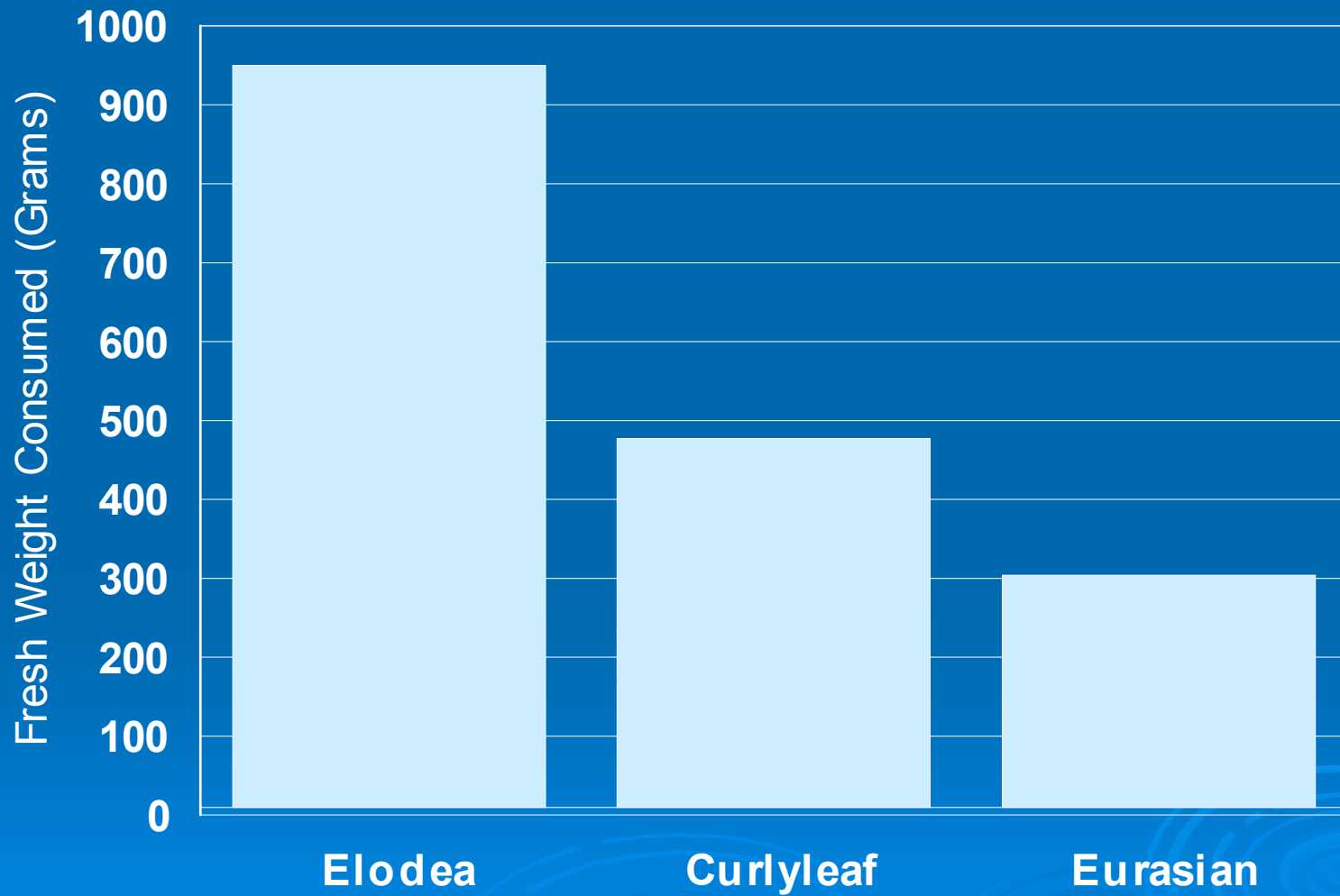
- Effective
- Inexpensive
- Long-term

## ■ Disadvantages

- “All-or-none” response
- Not selective
- Cannot control feeding sites
- Cannot stop fish
- Difficult to contain
- Reproduction?



## Triploid Grass Carp Prefer Other Species



*Pine et al. 1990*

# Classical Insect Control

- Advantages

- Public perception
- Low cost after R&D
- Long-term

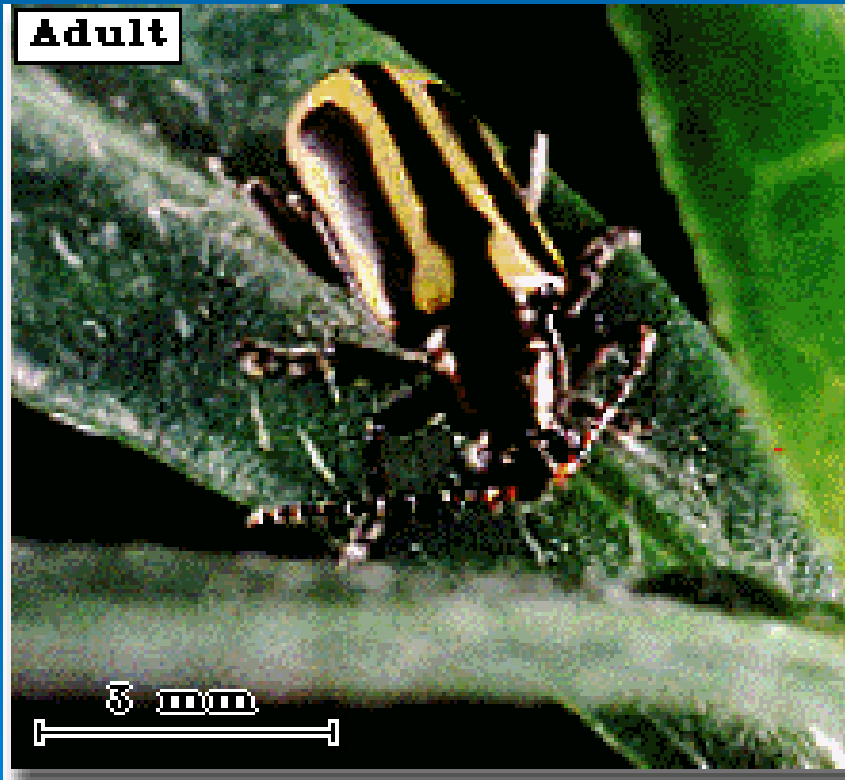


- Disadvantages

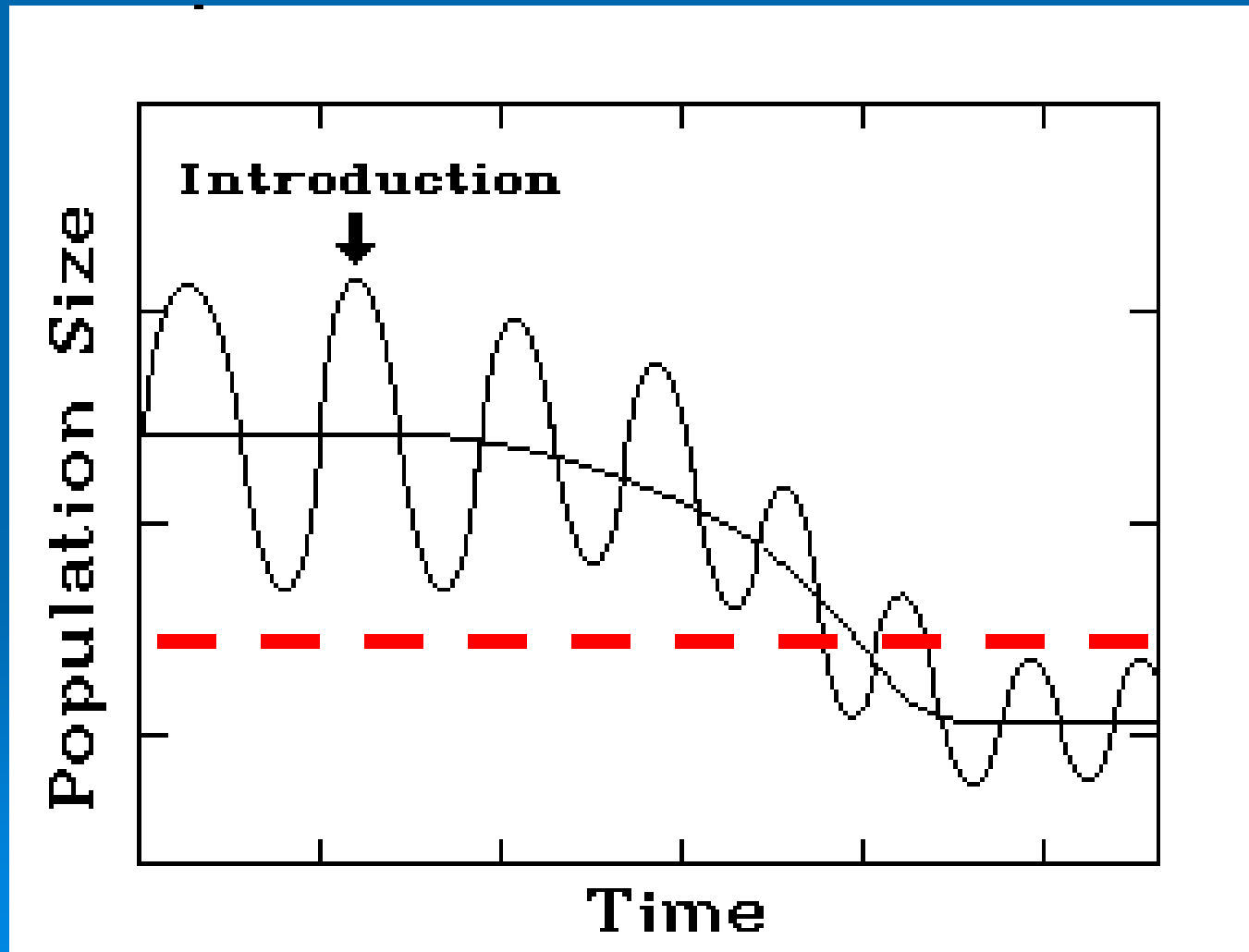
- No agents for several target nonindigenous plants
- Long time for R&D
- Unpredictability of results



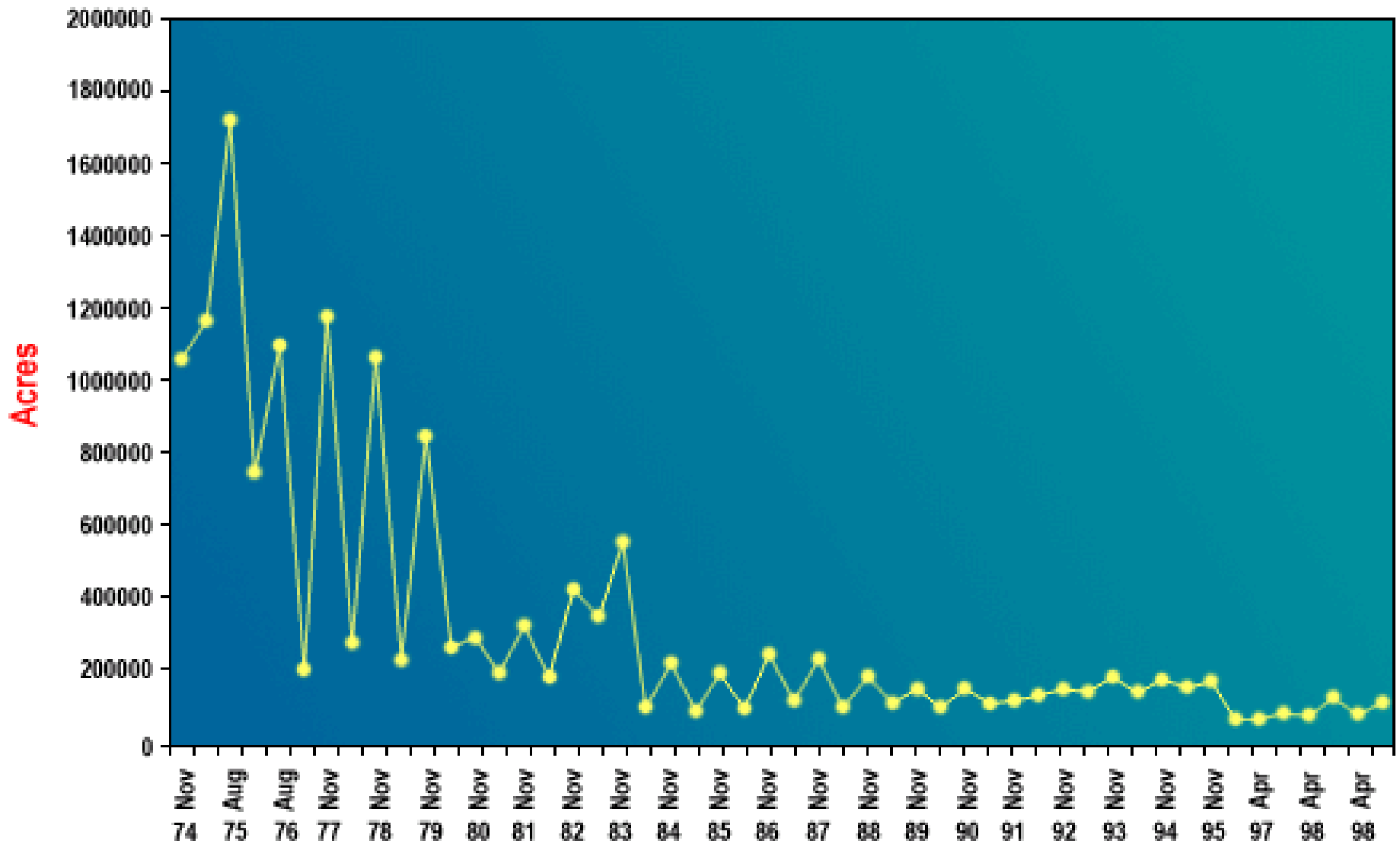
# *Agasicles hygrophila* – Alligatorweed Flea Beetle



# Goal of a Classical Insect Biological Control Program



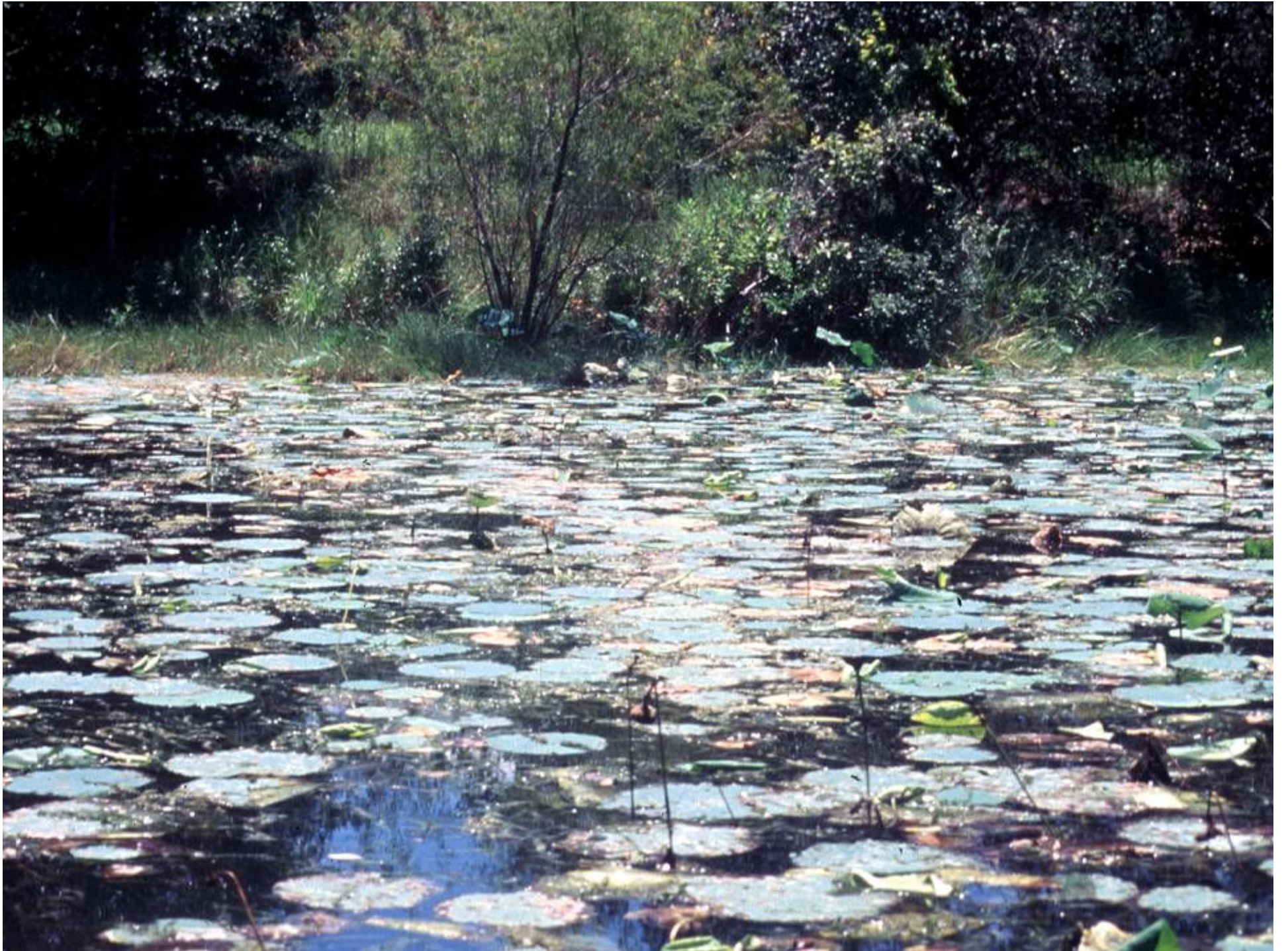
## Louisiana Waterhyacinth Data











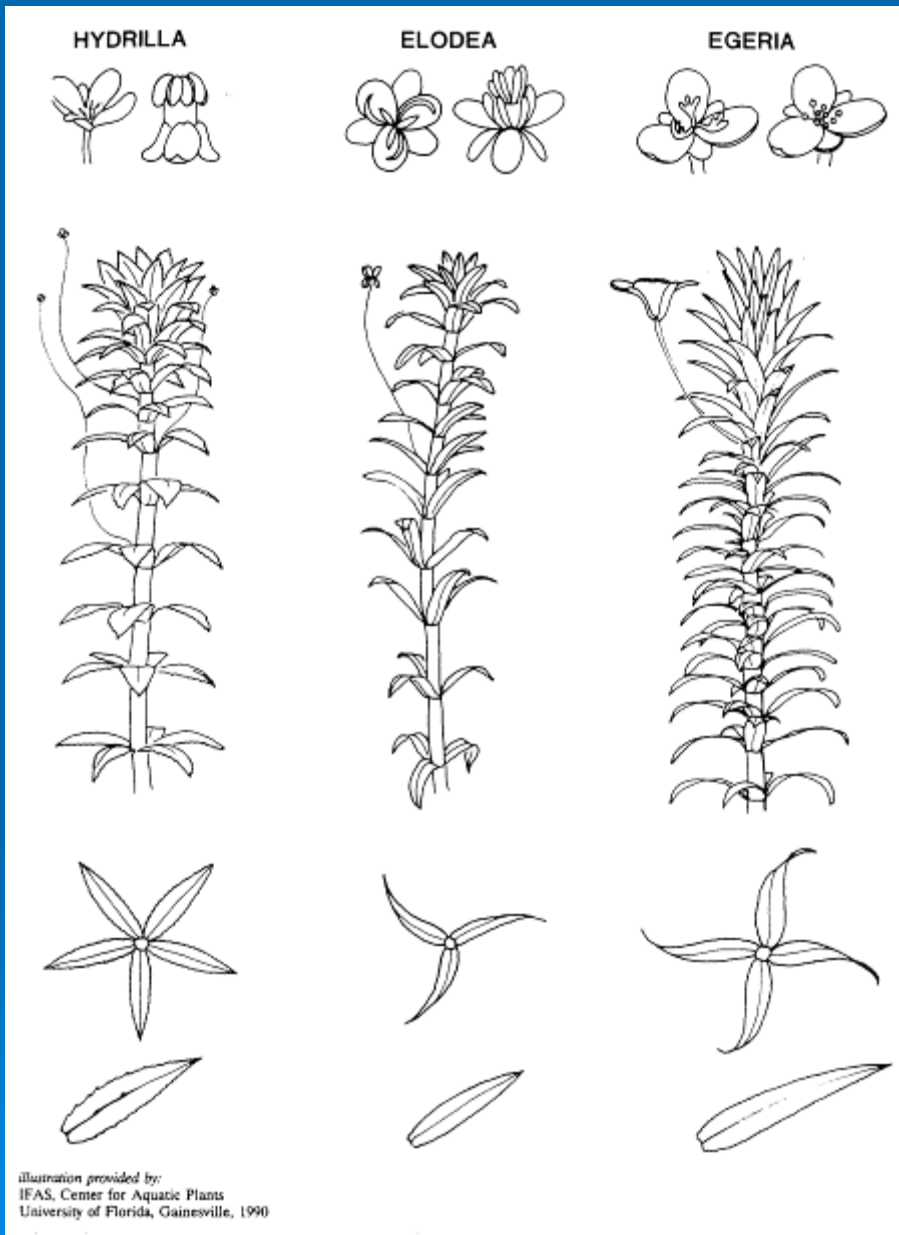


# Chemical control to submerged or floating leaf aquatics



- Contact
  - Complexed copper
  - Diquat
  - Endothall
- Systemic
  - 2,4-D
  - Fluridone
  - Glyphosate
  - Triclopyr





# Target Species

- Proper identification of the target species of plant (or algae) is critical for optimal control
- For instance, herbicide selection:
  - Aquathol-K works well on hydrilla
  - Aquathol-K does not work well on egeria

# Submersed Application Techniques

- Helicopter, Boat, Airboat
- Surface spray, Subsurface injection, granular spreader



## Aquatic Herbicides

Read and follow the label!



Check with Ag  
Commissioner for  
local use restrictions.





Airplane

Airboat





## Adding Copper Sulfate to an Irrigation Canal



# SUBMERSED TREATMENT

## WATER EXCHANGE

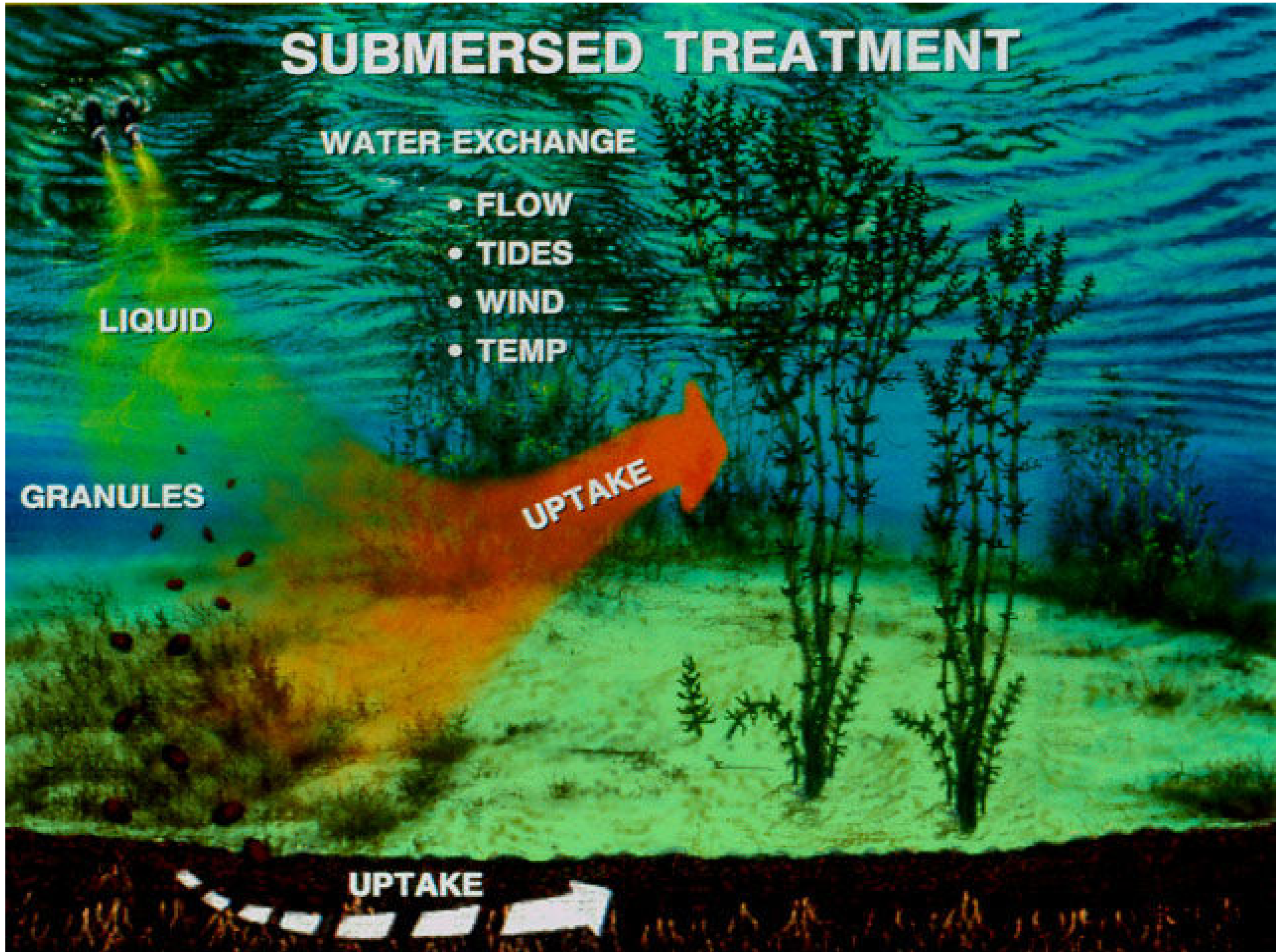
- FLOW
- TIDES
- WIND
- TEMP

LIQUID

GRANULES

UPTAKE

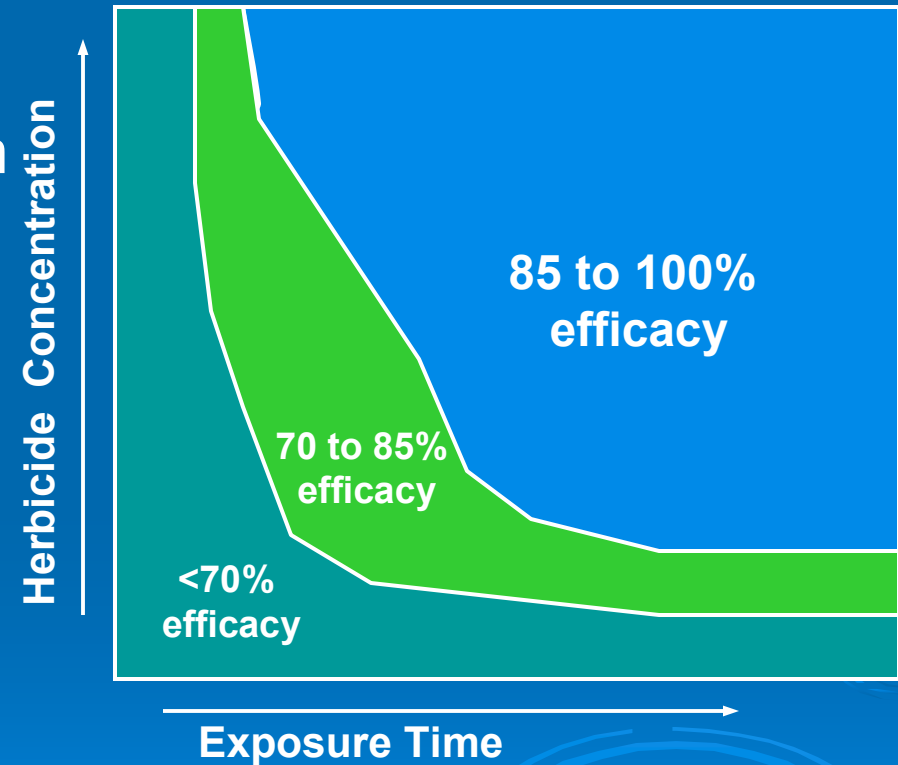
UPTAKE





# Submersed Plants: Dose & Exposure

- Herbicide efficacy and selectivity dependent on dose and length of exposure to target plant
- Relationships identified for hydrilla and milfoil
  - 2,4-D
  - Endothall
  - Fluridone
  - Triclopyr



# Herbicides Used for Submersed Weed Control in Lakes and Reservoirs

Herbicide	Uptake	Half-life (days)	Use
Diquat	FAST	1-7	Spot applications
Copper	FAST	1-5	Spot applications
Endothall	Fast	4-7	Spot applications
Triclopyr	Fast	1-4	Spot applications
Fluridone	Slow	20-90	Only large areas, except for pelleted formulation



**Sonar used in golf course pond**



# Management Goals and Plans

- The question:
  - “What’s the best method to control plant X?”
- The best method depends on your management goals and your acceptable economic, environmental, and regulatory limitations

## Example of Goals and Management Selection

Target Plant	Limitation	Technique
Eurasian watermilfoil in a small farm pond with ability to drain and add water	Funds	Drawdown or backhoe
	Maintain plant diversity	Triclopyr
	No fishing restriction	Fluridone (SONAR)
	Fish production pond	Shading





## *Summary of biological management methods for aquatic plants.*

<b>Management Method</b>	<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Systems where used effectively</b>	<b>Plant species response</b>
<b>Grass Carp / White Amur</b>	<b>Herbivorous Fish</b>	<b>Long-term (decades), relatively inexpensive</b>	<b>Cannot control feeding sites, difficult to contain in water body, tendency for "all or none" community response, persistent</b>	<b>Isolated water bodies, effective against hydrilla and other preferred species. Operational.</b>	<b>Fish have strong preference for hydrilla and some native plants, avoid Eurasian watermilfoil, generally do not prefer floating plants</b>
<b><i>Neochetina</i> spp.</b>	<b>Waterhyacinth weevils</b>	<b>Species selective</b>	<b>Not effective in reducing areal coverage in many situations</b>	<b>Released in Florida, Gulf Coast states. (Developmental)</b>	<b>Leaf scars, some reduction in growth</b>
<b><i>Hydrellia</i> spp. <i>Bagous</i> spp.</b>	<b>Hydrilla fly, hydrilla stem weevil</b>	<b>Species Selective</b>	<b>Has not yet been established</b>	<b>Released in Florida, Alabama, Texas. (Research)</b>	<b>Limited</b>
<b><i>Euhrychiopsis lecontei</i> and other native insects</b>	<b>Weevil - native or naturalized</b>	<b>Already established in U.S.</b>	<b>Less selective, currently under R&amp;D</b>	<b>Currently under study in Vermont, Minnesota (Research)</b>	<b>Plants loose buoyancy, weevil interferes with transfer of carbohydrates</b>
<b><i>Mycleptodiscus terrestris</i> (Mt)</b>	<b>Fungal pathogen; acts as a contact bioherbicide</b>	<b>Low dispersion, fairly broad spectrum</b>	<b>Expense, cross-contamination, inconsistent viability and virulence of formulation</b>	<b>Under R&amp;D for both Eurasian watermilfoil and hydrilla</b>	<b>"Contact Bioherbicide", plants rapidly fall apart, but regrow from roots</b>
<b>Native Plant Community Restoration</b>	<b>Planting of desirable native plant species or community</b>	<b>Provides habitat, may slow reinvasion or initial invasion</b>	<b>Expensive, techniques still under development</b>	<b>Under R&amp;D around the country</b>	<b>Native plants provide ecosystem benefits, slow invasion</b>

## *Use suggestions for US Environmental Protection Agency-approved aquatic herbicides.*

<b>Compound</b>	<b>Exposure Time (Water)</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Systems where used effectively</b>	<b>Plant species response</b>
<b>Complexed Copper</b>	<b>Intermediate (18-72 hours)</b>	<b>Inexpensive, rapid action, approved for drinking water</b>	<b>Does not biodegrade, but biologically inactive in sediments</b>	<b>Lakes as algicide, herbicide in higher exchange areas</b>	<b>Broad-spectrum, acts in 7-10 days or up to 4-6 weeks</b>
<b>2,4-D</b>	<b>Intermediate (18-72 hours)</b>	<b>Inexpensive, systemic</b>	<b>Public perception</b>	<b>Waterhyacinth and Eurasian watermilfoil control, Lakes and slow-flow areas, purple loosestrife</b>	<b>Selective to broad-leaves, acts in 5-7 days up to 2 weeks</b>
<b>Diquat</b>	<b>Short (12-36 hours)</b>	<b>Rapid action, limited drift</b>	<b>Does not affect underground portions</b>	<b>Shoreline, localized treatments, higher exchange rate areas</b>	<b>Broad-spectrum, acts in 7 days</b>
<b>Endothall</b>	<b>Short (12-36 hours)</b>	<b>Rapid action, limited drift</b>	<b>Does not affect underground portions</b>	<b>Shoreline, localized treatments, higher exchange rate areas</b>	<b>Broad spectrum, acts in 7-14 days</b>
<b>Fluridone</b>	<b>Very long (30-60 days)</b>	<b>Very low dosage required, few label restrictions, systemic</b>	<b>Very long contact period</b>	<b>Small lakes, slow flowing systems</b>	<b>Broad spectrum, acts in 30-90 days</b>
<b>Glyphosate</b>	<b>Not Applicable</b>	<b>Widely used, few label restrictions, systemic</b>	<b>Very slow action, no submersed control</b>	<b>Nature preserves and refuges; Emergent and floating-leaved plants only</b>	<b>Broad spectrum, acts in 7-10 days, up to 4 weeks</b>
<b>Triclopyr</b>	<b>Intermediate (12-60 hours)</b>	<b>Selective, systemic</b>	<b>Not currently labeled for general aquatic use</b>	<b>Lakes and slow-flow areas, purple loosestrife</b>	<b>Selective to broad-leaves, acts in 5-7 days, up to 2 weeks</b>

## *Characteristics of U.S. Environmental Protection Agency-approved aquatic herbicides.*

Compound	Trade Name	Company	Formulation; Contact vs. Systemic	Mode of Action	Bluegill 96 hr. LC <sub>50</sub> (mg/L)
Complexed Copper	Citrine-Plus Komeen Koplex K-Tea	Applied Biochemists (Citrine) Griffin Corporation	Various complexing agents with copper, superior to CuSO <sub>4</sub> Systemic	Plant cell toxicant	1250
2,4-D	Aqua-Kleen Weedar-64 Wee-Rhap A-6D Several Others	Applied Biochemists Rhone-Poulenc Inter-Ag	BEE salt DMA liquid IEE liquid Systemic	Selective plant-growth regulator	1.1-1.3 123-230
Diquat	Reward	Zeneca	Liquid Contact	Disrupts plant cell membrane integrity	10-140
Endothall	Aquathol K Hydrothal 191 Aquathol granular	Elf Atochem (All Formulations)	Liquid or granular Contact	Inactivates plant protein synthesis	125 0.06-0.2
Fluridone	Sonar AS Sonar SRP	SePRO	Liquid or granular Systemic	Disrupts carotenoid synthesis, causing bleaching of chlorophyll	9-12.5
Glyphosate	Rodeo	Monsanto	Liquid Systemic	Disrupts synthesis of phenylalanine	4.2-14
Triclopyr	Garlon 3A (EUP) Renovate (EUP)	SePRO	Liquid Systemic	Selective plant growth regulator	148



## *Application restrictions of US Environmental Protection Agency-approved aquatic herbicides.*

Compound	Persistence (half-life, in days)	Maximum Application Rate	Maximum water concentration	Safety Factor	Application Notes	WES Recommended for
Complexed Copper	3	1.5 gal/ft/acre	1.0 mg/L	>50	Algicide / Herbicide	Hydrilla, other submersed spp.
2,4-D	7.5	0.5 gal/acre	2.0 mg/L	>25	Some formulations for special permits only	Eurasian watermilfoil, water-hyacinth, and others
Diquat	1-7	2 gal/acre	2 mg/L	5	Binds with particles (suspended solids) in water	All
Endothal	4-7	13 gal/acre	5.0 mg/L	>10 (Aquathol) <1.0 (Hydrothal)	Fish are sensitive to Hydrothal 191 - over 1 mg/L may cause fish kill	All submersed spp.
Fluridone	21	1.1 qt/acre	0.15 mg/L (150 ppb)	>20	Applications have been successful below 10 ppb	Most submersed spp.
Glyphosate	14	2 gal/acre	0.2 mg/L	>20	Aerial portions only - not for submersed plants	Most emergent and floating spp.
Triclopyr	na	na	2.5 mg/L	>50	EUP/Special Needs only - US EPA label expected in 1997	Eurasian watermilfoil, water-hyacinth, others

## ***Characteristics of physical management techniques.***

<b>Management Method</b>	<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Systems where used effectively</b>	<b>Plant Species Response</b>
<b>Dredging/ Sediment Removal</b>	<b>Use mechanical sediment dredge to remove sediments, deepen water</b>	<b>Creates deeper water, very long-term results</b>	<b>Very expensive, must deal with dredge sediment</b>	<b>Shallow ponds and lakes, particularly those filled in by sedimentation</b>	<b>Often creates large usable areas of lake, not selective</b>
<b>Drawdown</b>	<b>"De-water" a lake or river for an extended period of time</b>	<b>Inexpensive, very effective, moderate-term</b>	<b>Can have severe environmental impacts, severe recreational/ riparian user effects</b>	<b>Only useful for manmade lakes or regulated rivers with a dam or water control structure</b>	<b>Selective based on perennation strategy; effective on evergreen perennials, less effective on herbaceous perennials</b>
<b>Benthic Barrier</b>	<b>Use natural or synthetic materials to cover plants</b>	<b>Direct and effective, may last several seasons</b>	<b>Expensive and small-scale, nonselective</b>	<b>Around docks, boat launches, swimming areas, and other small, intensive use areas</b>	<b>Nonselective, plant mortality within one month underneath barrier</b>
<b>Shading / Light Attenuation</b>	<b>Reduce light levels by one of several means: dyes, shade cloth, plant trees (rivers)</b>	<b>Generally inexpensive, effective</b>	<b>Nonselective, controls all plants, may not be aesthetically pleasing</b>	<b>Smaller ponds, man-made waterbodies, small streams</b>	<b>Nonselective, but may be long-term</b>
<b>Nutrient Inactivation</b>	<b>Inactivate phosphorus (in particular) using alum</b>	<b>Theoretically possible</b>	<b>Impractical for rooted plants limited by nitrogen</b>	<b>Most useful for controlling phytoplankton by inactivating water column P</b>	<b>Variable</b>

## *Characteristics of mechanical management techniques.*

<b>Management Method</b>	<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Systems where used effectively</b>	<b>Plant species response</b>
<b>Hand- Cutting/ Pulling</b>	<b>Direct hand pulling or use of hand tools</b>	<b>Low-technology, affordable, can be selective</b>	<b>Labor-intensive, cost is labor-based</b>	<b>Most of the undeveloped world, volunteer labor pools</b>	<b>Very effective in very localized areas</b>
<b>Cutting</b>	<b>Cut weeds with mechanical device (typically boat-mounted sickle bar) without collection</b>	<b>More rapid than harvesting</b>	<b>Large mats of cut weeds may become a health and environmental problem, may spread infestation</b>	<b>Heavily-infested systems</b>	<b>Nonselective, short-term</b>
<b>Harvesting (Cut and Remove)</b>	<b>Mechanical cutting with plant removal</b>	<b>Removes plant biomass</b>	<b>Slower and more expensive than cutting; resuspension of sediments</b>	<b>Widespread use with chronic plant problems</b>	<b>Like cutting, it is cosmetic, non-selective short-term</b>
<b>Grinder or "Juicer" (Cut and Grind)</b>	<b>Mechanical cutting with grinding of plant material and in-lake disposal</b>	<b>Immediate relief of plant nuisance, no disposal</b>	<b>Resuspension of sediments, decomposition of plants in lake, floating plant material</b>	<b>Useful for chronic plant problems where disposal of plants is problematic</b>	<b>Like cutting and harvesting, it is cosmetic, non-selective short-term</b>
<b>Diver-Operated Suction Harvester</b>	<b>Vacuum lift used to remove plant stems, roots, leaves, sediment left in place</b>	<b>Moderately selective (based on visibility and operator), longer-term</b>	<b>Slow and cost-intensive</b>	<b>Useful for smaller nuisance plant populations in which plant density is moderate</b>	<b>Typically have minimal regrowth for Eurasian watermilfoil; not effective for tuber-setting hydrilla</b>
<b>Rotovating</b>	<b>Cultivator on long arm for tilling aquatic sediments</b>	<b>Disrupts Eurasian watermilfoil stem bases, intermediate-term results</b>	<b>May spread large numbers of fragments; resuspension of sediments</b>	<b>Used extensively in the Pacific Northwest and British Columbia, with mixed results</b>	<b>Effective in disrupting Eurasian watermilfoil dense stands; not selective and only intermediate-term</b>