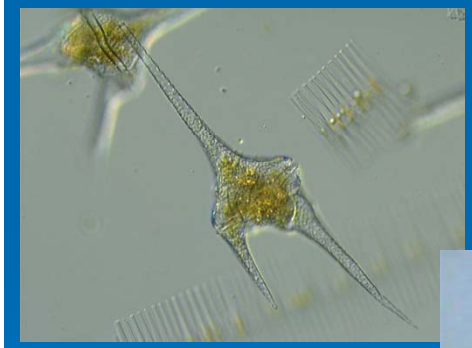
Algae and Aquatic Weed ID, Biology Control

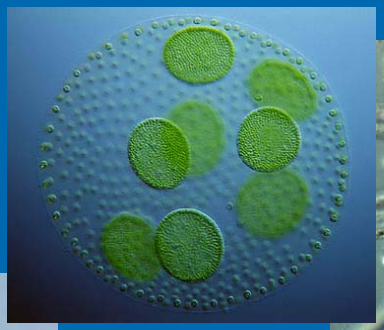
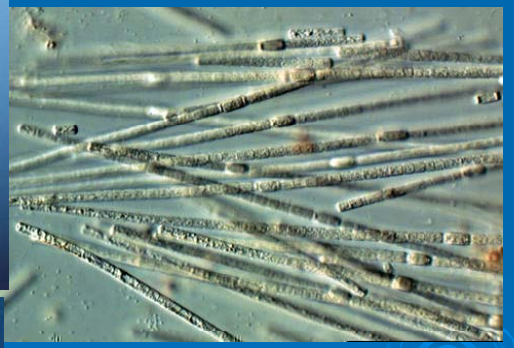
Salinas Weed School

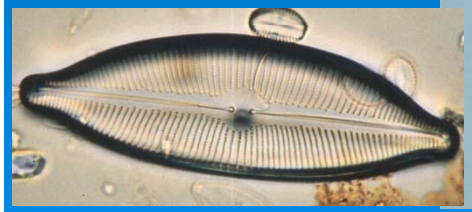
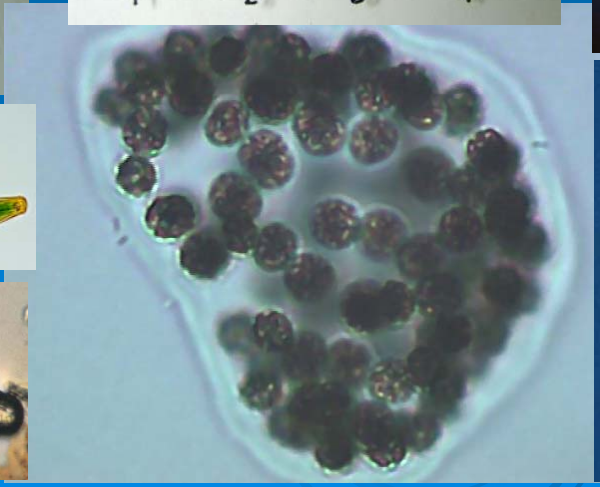
November 9, 2010

“Algae” refers to a loose group of organisms that have all or most of these characteristics:

- aquatic
- photosynthetic
- do not have conducting structures
- the reproductive structures do not have layers of protective cells around them



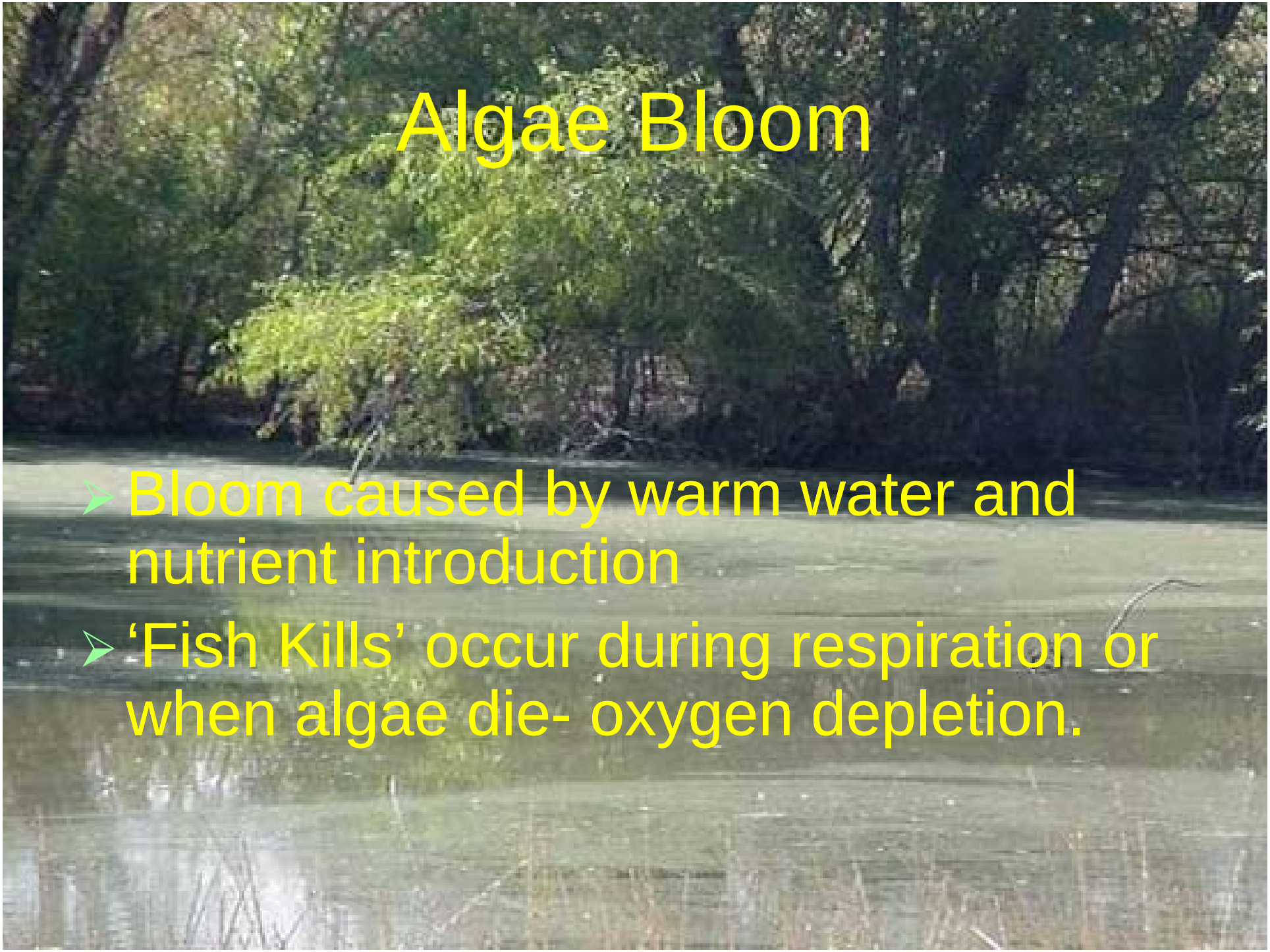




Microscopic or Planktonic
Algae

Microscopic or Planktonic Algae

- Not really algae, actually bacteria.
- Microscopic algae: *Anabaen, Aphanizomenon, and Microcystis*
- AKA ‘Annie, Fanny and Mike.’
- Produce toxins, but poisonings rare.


Algae Bloom



Algae Bloom

- Bloom caused by warm water and nutrient introduction
- ‘Fish Kills’ occur during respiration or when algae die- oxygen depletion.

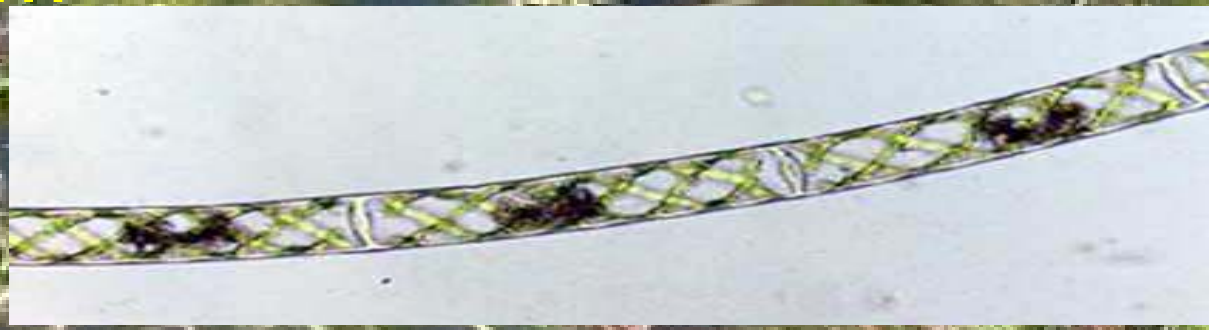

Filamentous Algae-
Floating Mats

Filamentous Algae- Floating Mats

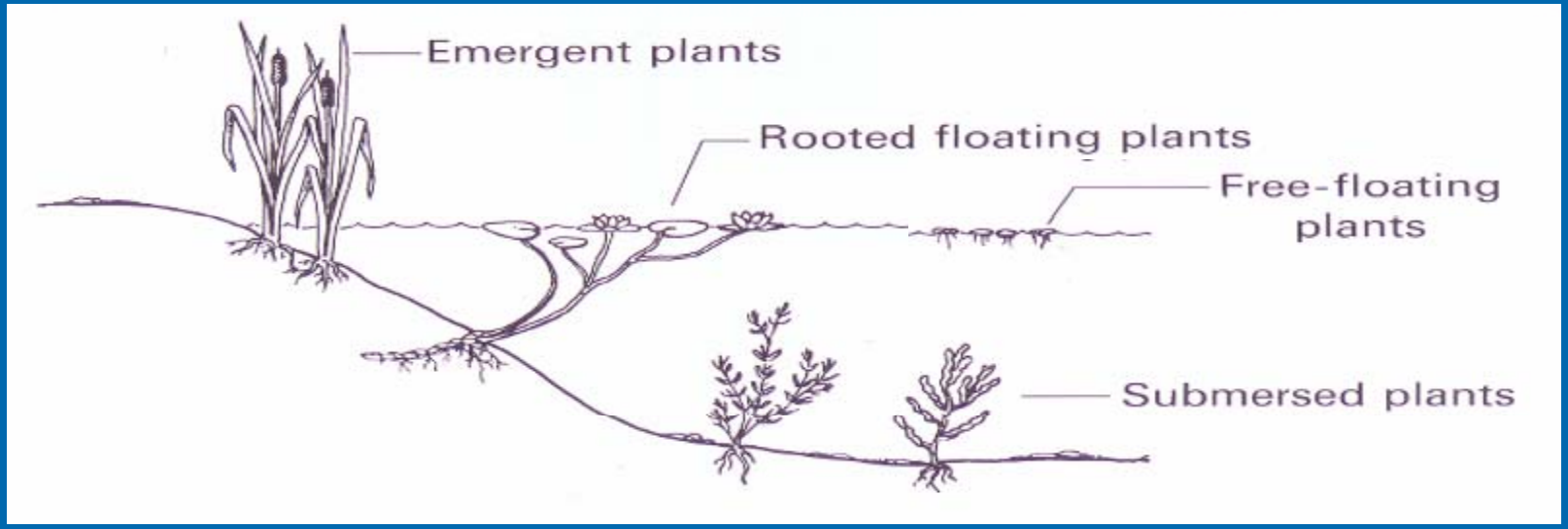
- Often incorrectly called ‘moss’
- Growth usually starts on edges and bottoms of pond in spring

Filamentous Algae- Floating Mats

- Often incorrectly called ‘moss’
- Growth usually starts on edges and bottoms of pond in spring
- Segments are single cells.
- Common Species: Cladophora, Rhizoclonium



Types of Aquatic Plants



Free-floating plants

Each of the four types of aquatic plants favors a certain water depth. Typically the growth areas are not sharply divided. Expect to see overlap in growth--submerged plants interspersed among floating-leaf varieties.


Pacific mosquitofern
Azolla filiculoides

Pacific mosquitofern
Azolla filiculoides

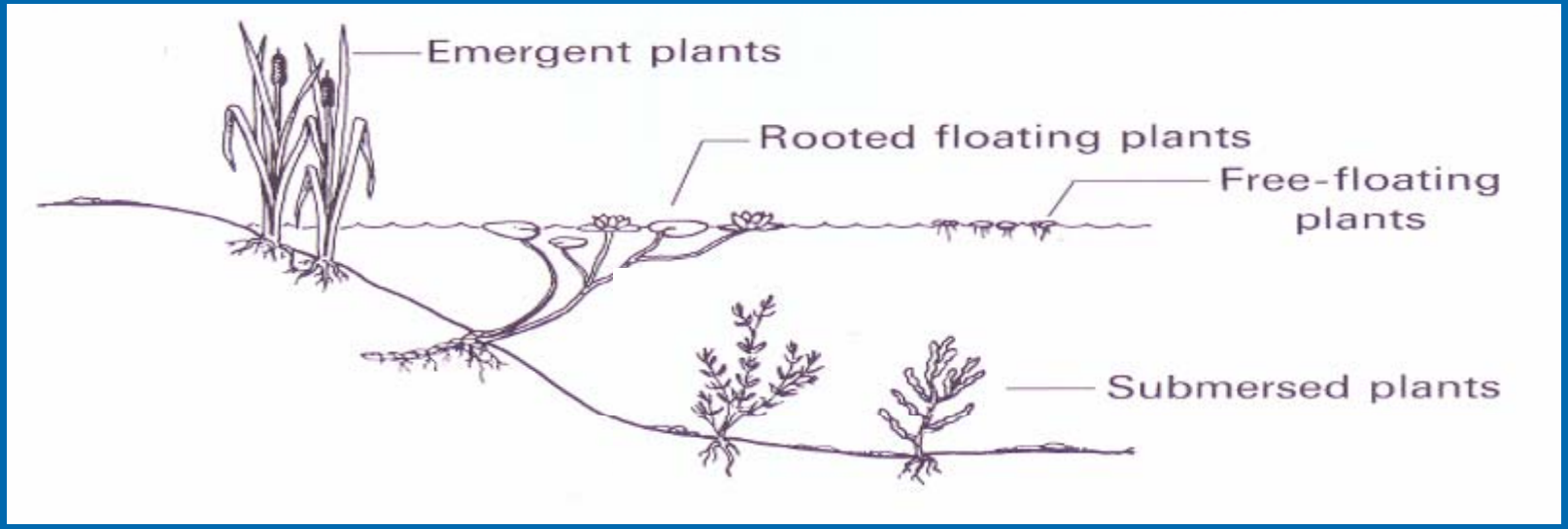
- Fern- reproduces by spores and stem fragments
- Desirable native species in natural habitat
- Often grow in eutrophic water-
- Still sold in aquarium trade- careless disposal of water may introduce into new areas.


©2003 Regents of the University of California
Common duckweed
Lemna minor
©2003 Regents of the University of California

Common duckweed

- Very small floating perennial native
- In high fertility site can double in number every 3 days
- Reproduces by budding (daughter plant)
- One root per frond

Types of Aquatic Plants



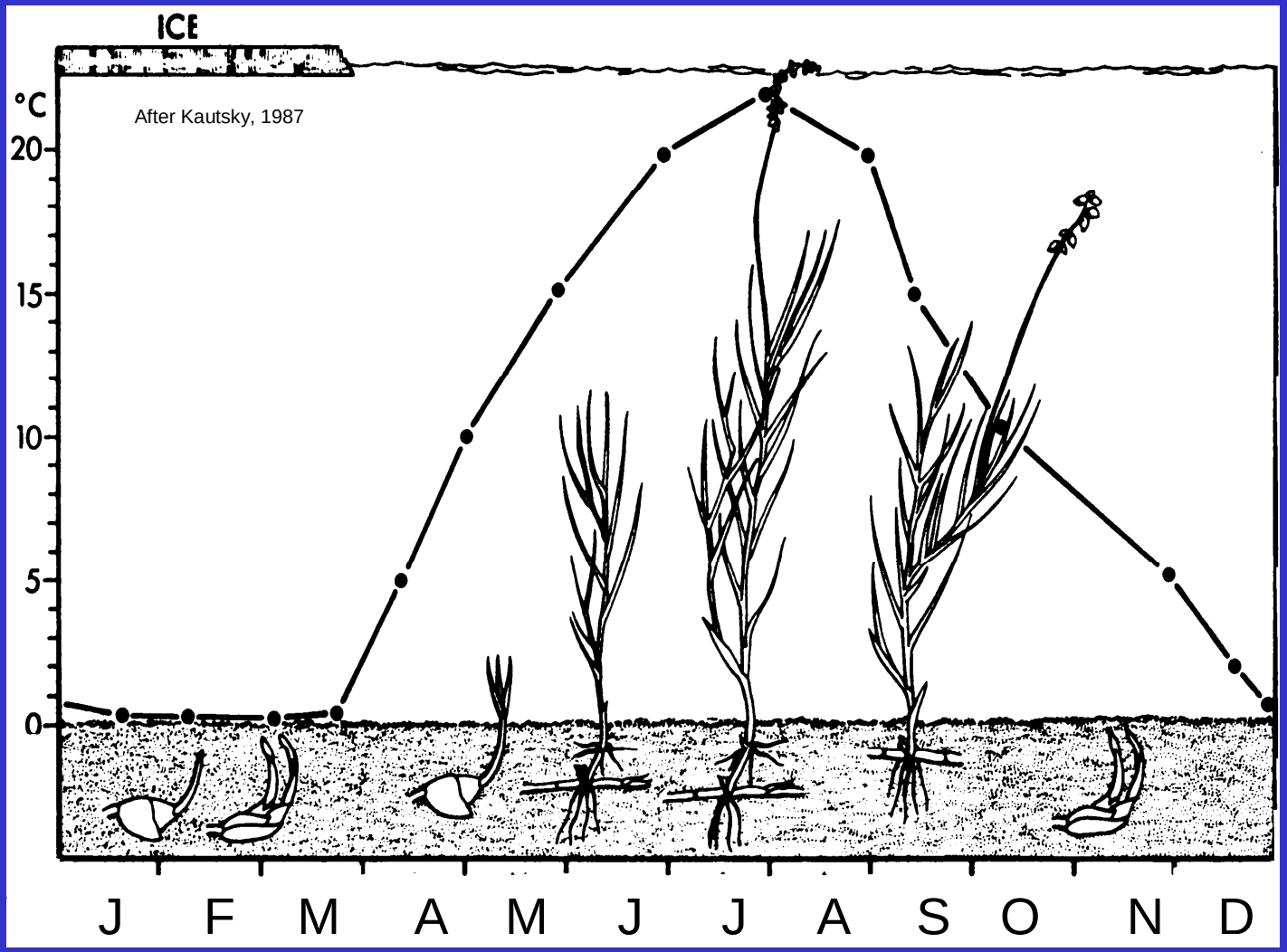
Submersed plants

Pondweeds

- All Potamogeton and Stuckenia species are native to the Western US, except Potamogeton crispus-curlyleaf pondweed (Eurasia)
- Important components of wildland aquatic habitats-
- Perennials most with rhizomes
- Curlyleaf produces turions and Sago produces tubers

Sago pondweed
Stuckenia pectinatus

Seasonal Development of Sago Pondweed

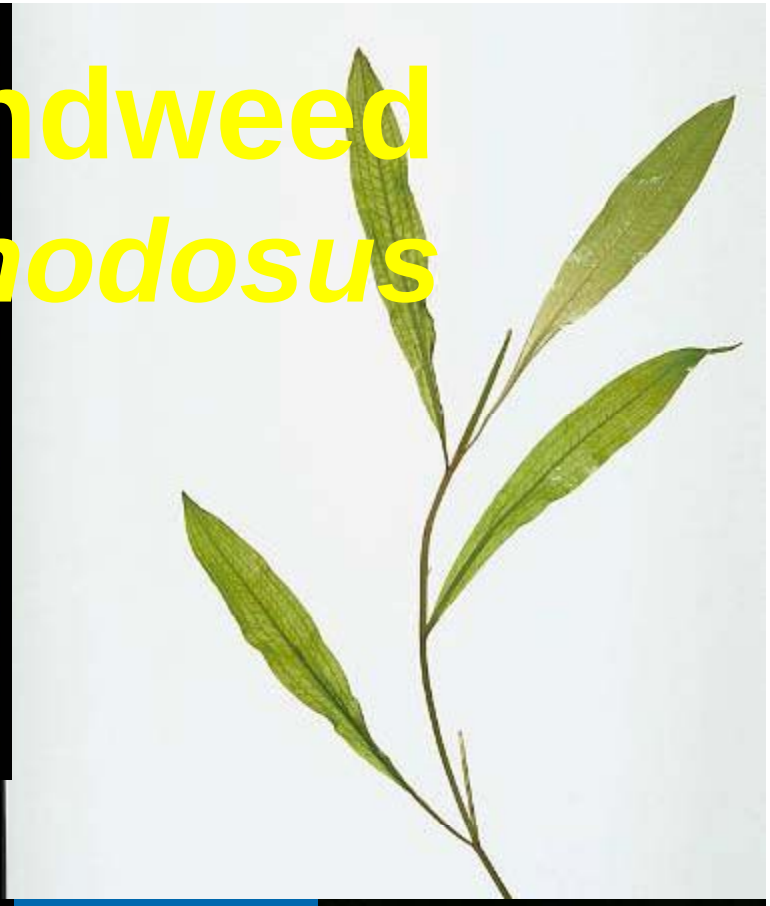


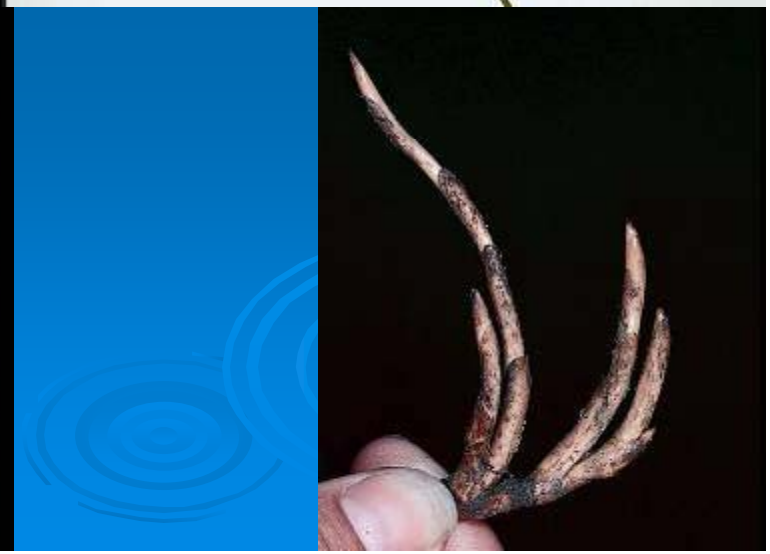
Curlyleaf pondweed
Potamogeton crispus

Leafy pondweed
Potamogeton foliosus

Floatleaf pondweed
Potamogeton natans

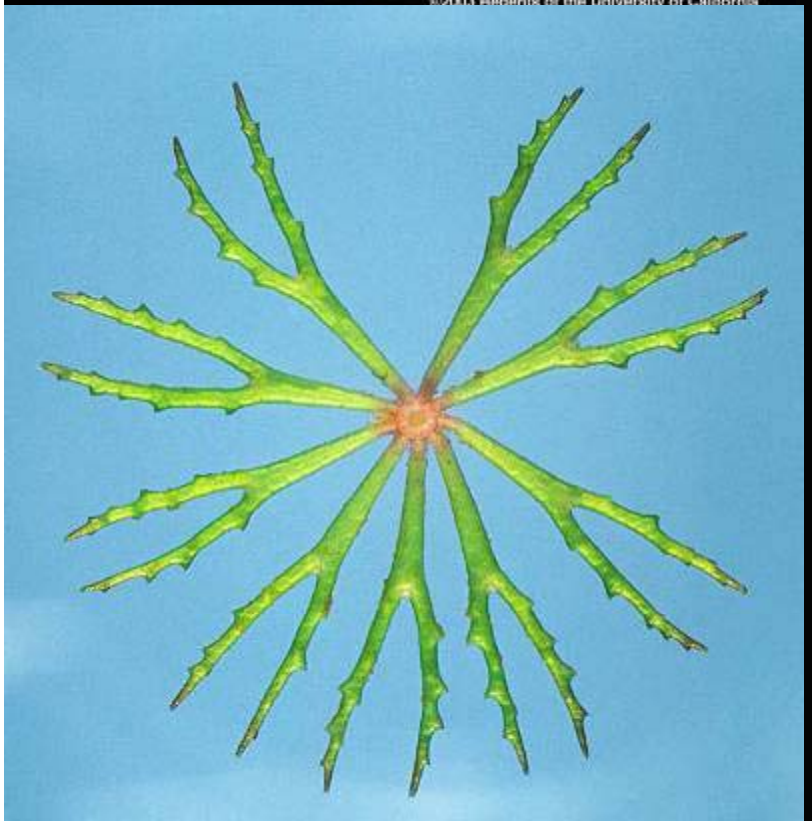
American Pondweed
Potamogeton nodosus

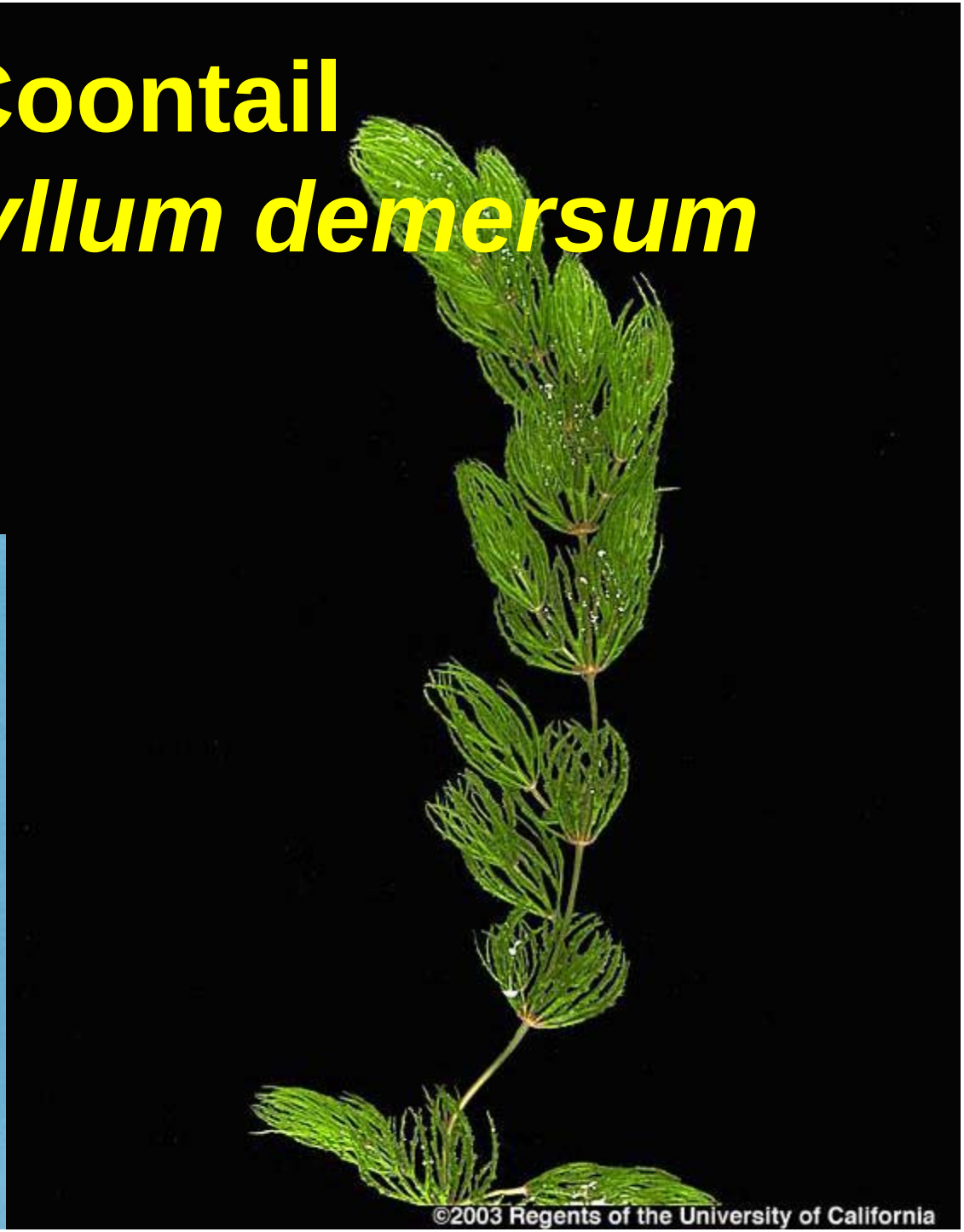




Coontail, Parrotfeather and Milfoils

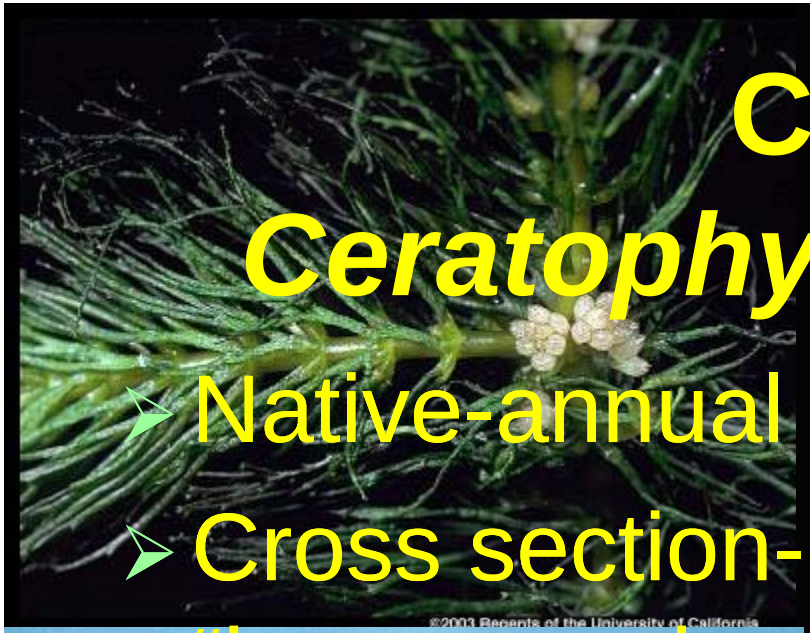
Coontail
Ceratophyllum demersum



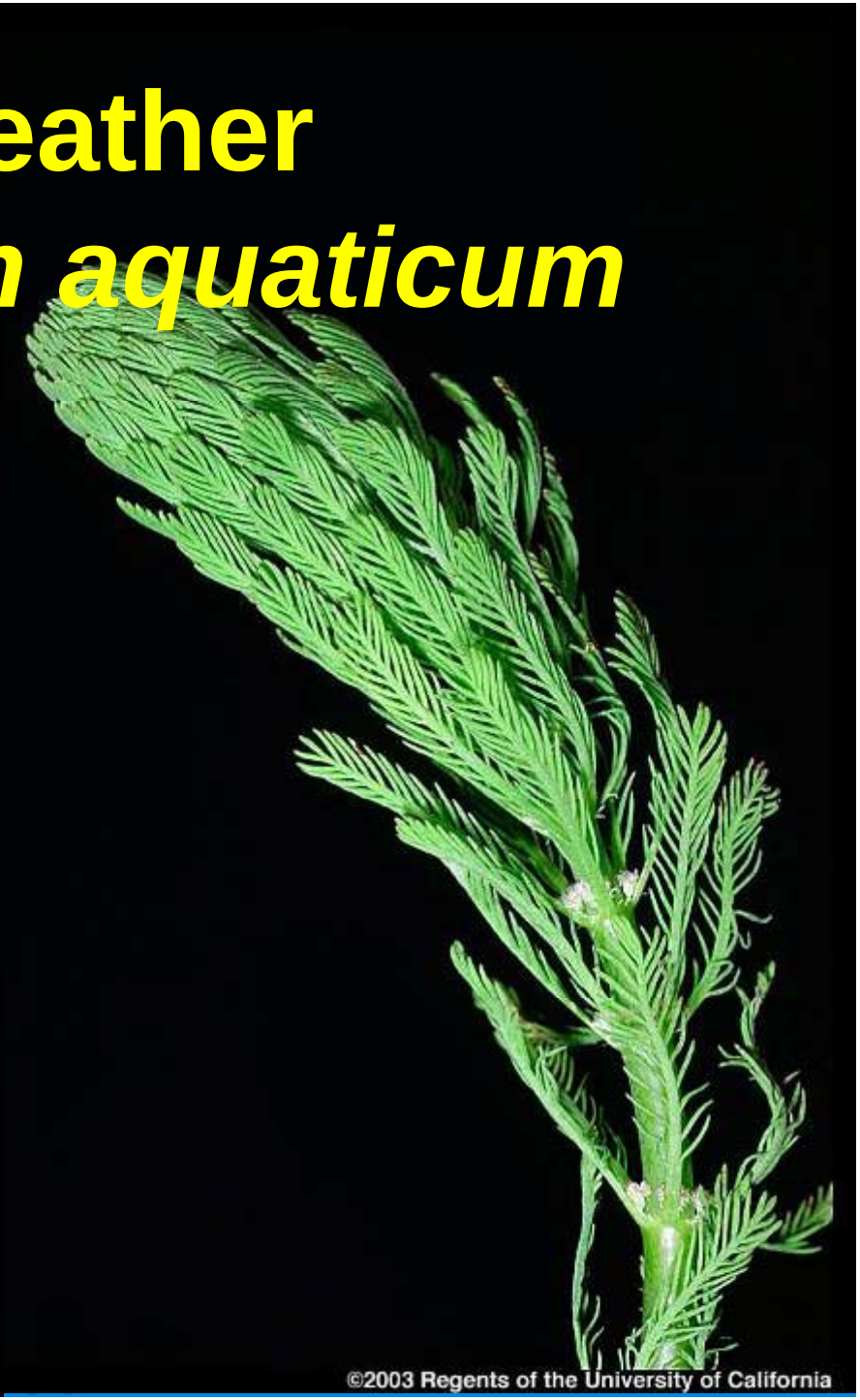


Coontail
Ceratophyllum demersum

- Native-annual to perennial
- Cross section- leaves look like "bumpy tuning fork"
- Modified stem-not roots lightly hold plant- easily dislodged

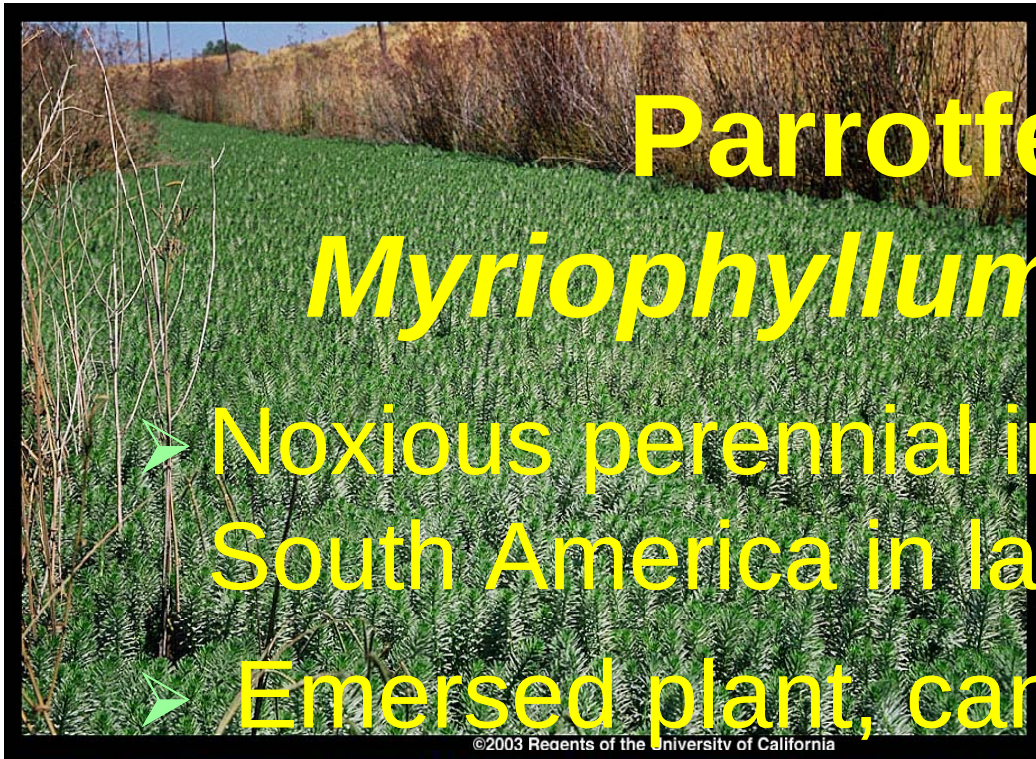


Parrotfeather
Myriophyllum aquaticum



Parrotfeather

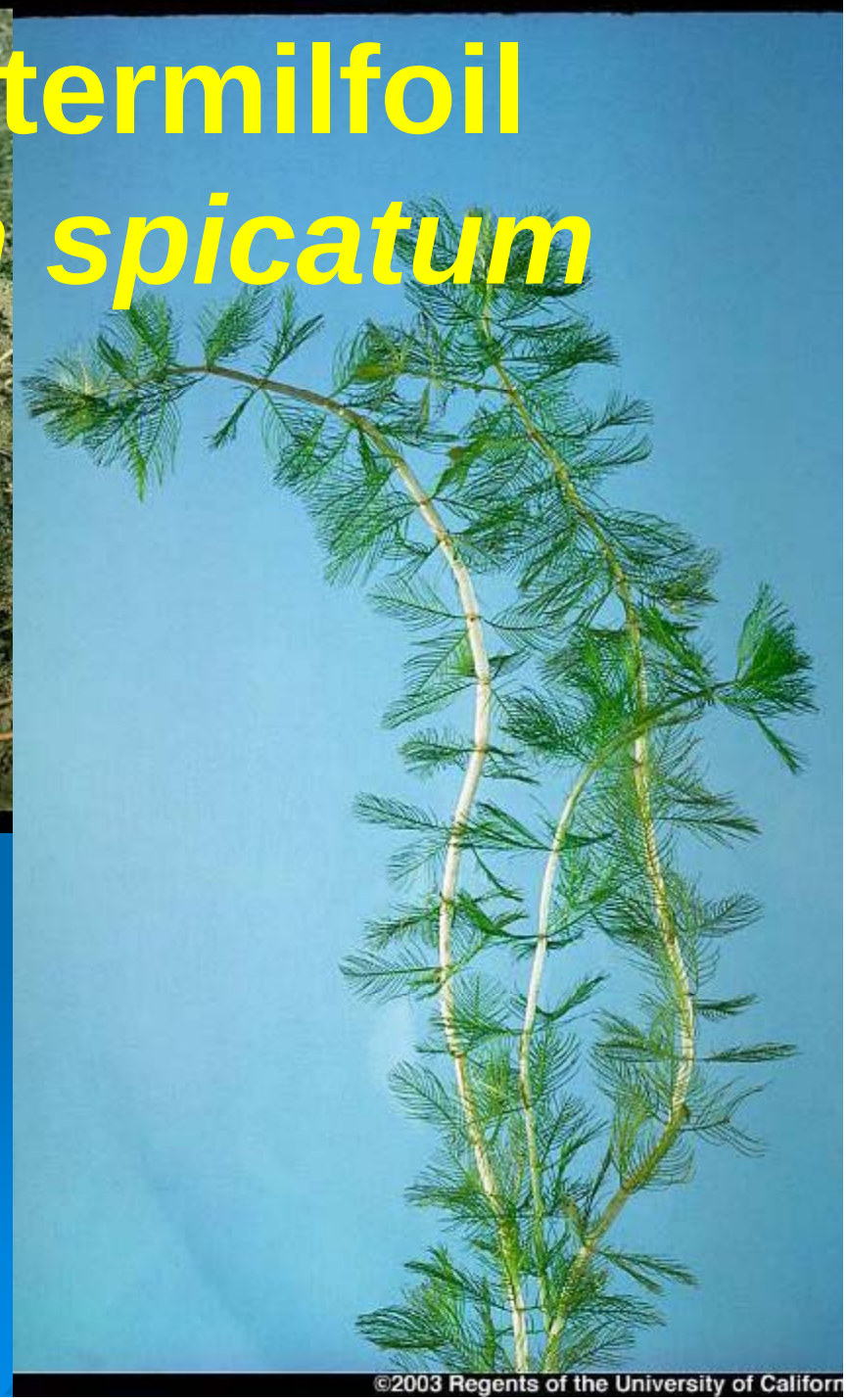
Myriophyllum aquaticum



- Noxious perennial introduced from South America in late 1800's
- Emersed plant, can become semi-terrestrial

- Reproduces vegetatively only- by rhizome and stem fragments

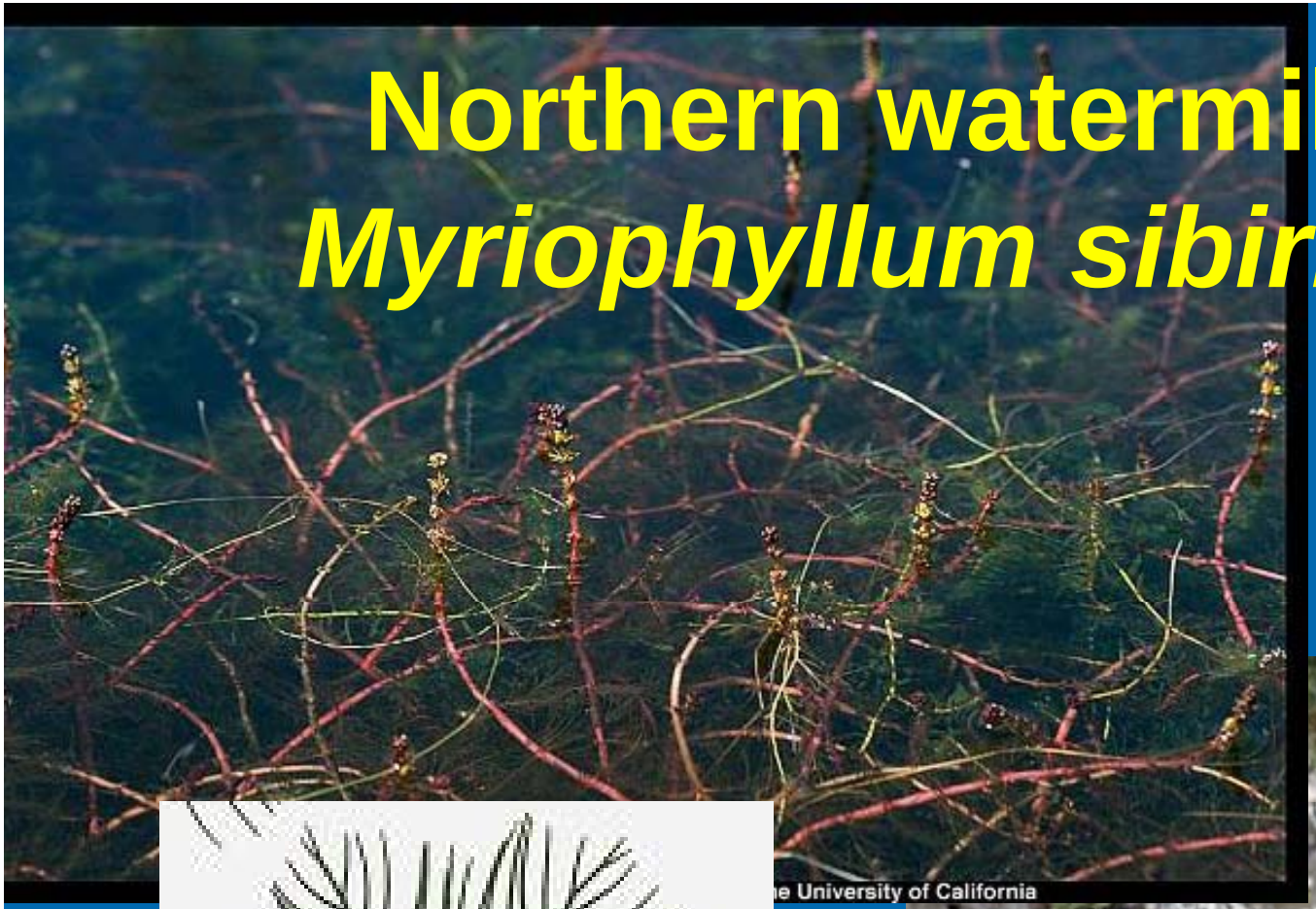
Eurasian watermilfoil
Myriophyllum spicatum



Eurasian watermilfoil
Myriophyllum spicatum

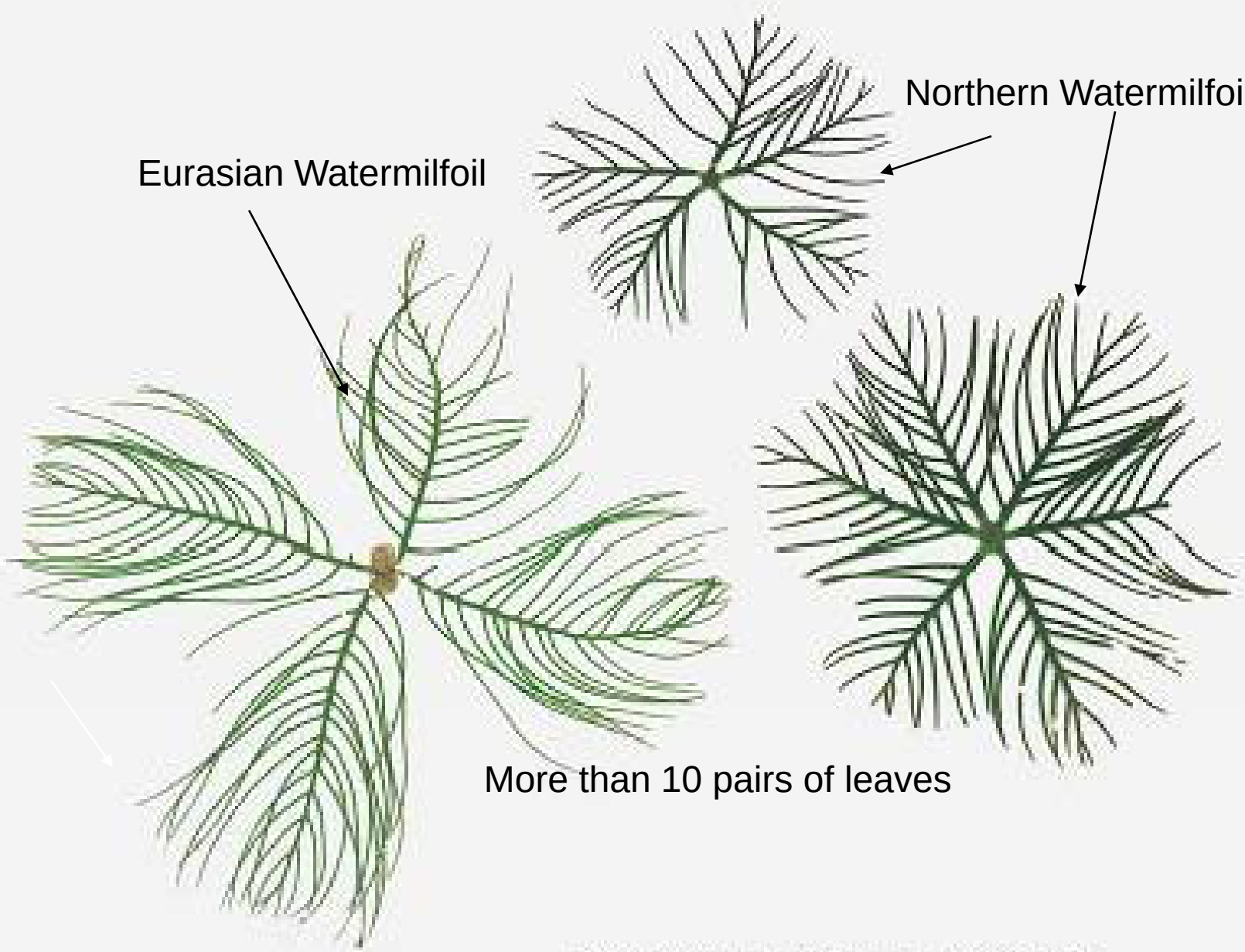
- Noxious perennial propagated by rhizomes, axillary buds and seeds.
- Seeds can survive dormant for 7 years under dry conditions and are eaten and spread by birds.
- Introduced from Eurasia, probably late 1940's in aquarium trade.

Northern watermilfoil
Myriophyllum sibiricum



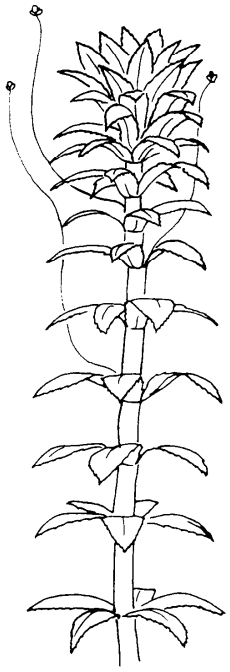
Northern watermilfoil
Myriophyllum sibiricum

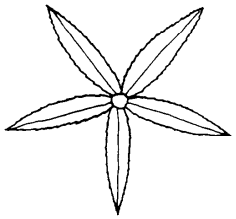
- Widespread native
- Produces turions-EWM does not
- Looks very similar to EWM- leaf lobes different-


Northern Watermilfoil
Eurasian Watermilfoil
More than 10 pairs of leaves

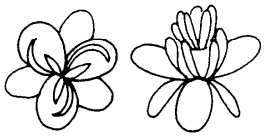
Elodea, Egeria, Hydrilla

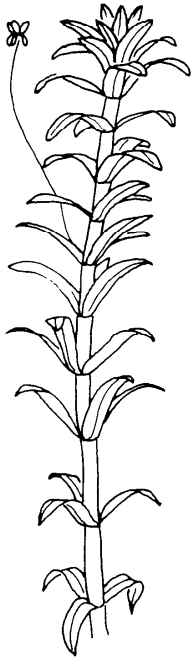
HYDRILLA

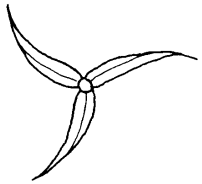




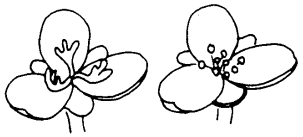
ELODEA

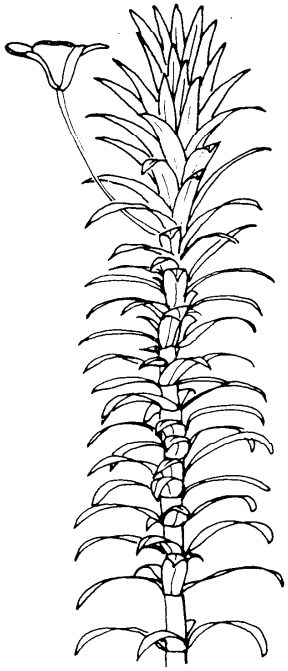






EGERIA





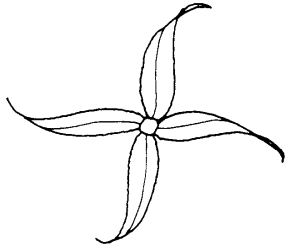
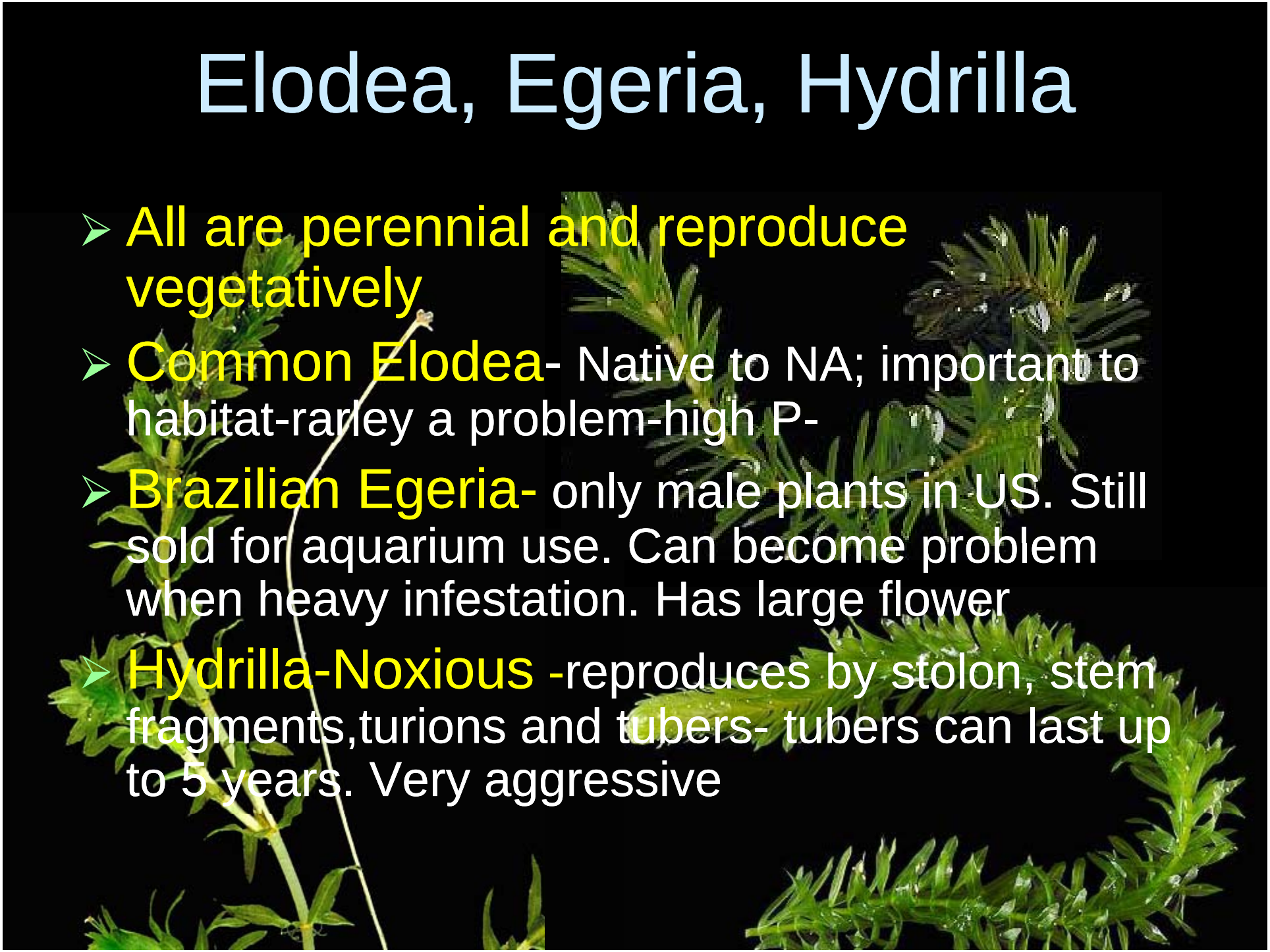


illustration provided by:
IFAS, Center for Aquatic Plants
University of Florida, Gainesville, 1990

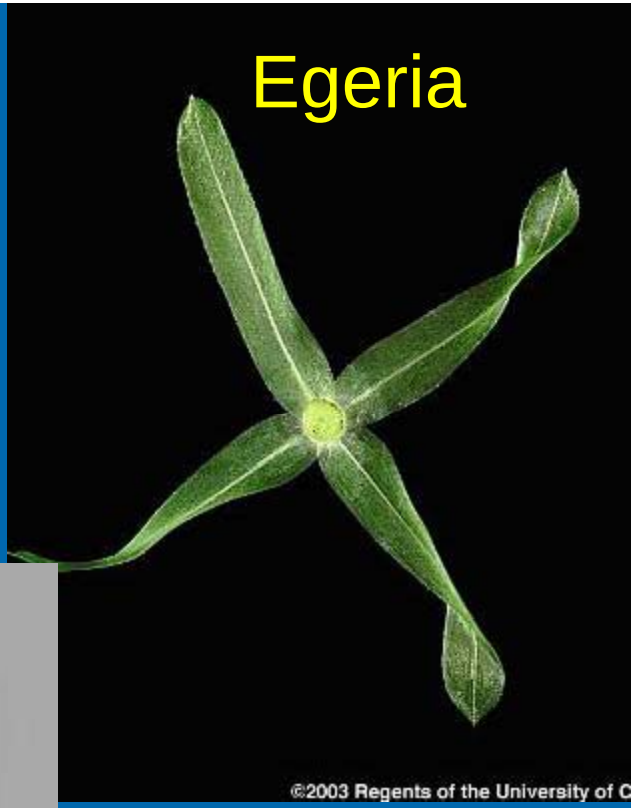
Elodea, Egeria, Hydrilla



- All are perennial and reproduce vegetatively
- Common Elodea- Native to NA; important to habitat-rarley a problem-high P-
- Brazilian Egeria- only male plants in US. Still sold for aquarium use. Can become problem when heavy infestation. Has large flower
- Hydrilla-Noxious -reproduces by stolon, stem fragments,turions and tubers- tubers can last up to 5 years. Very aggressive

Hydrilla

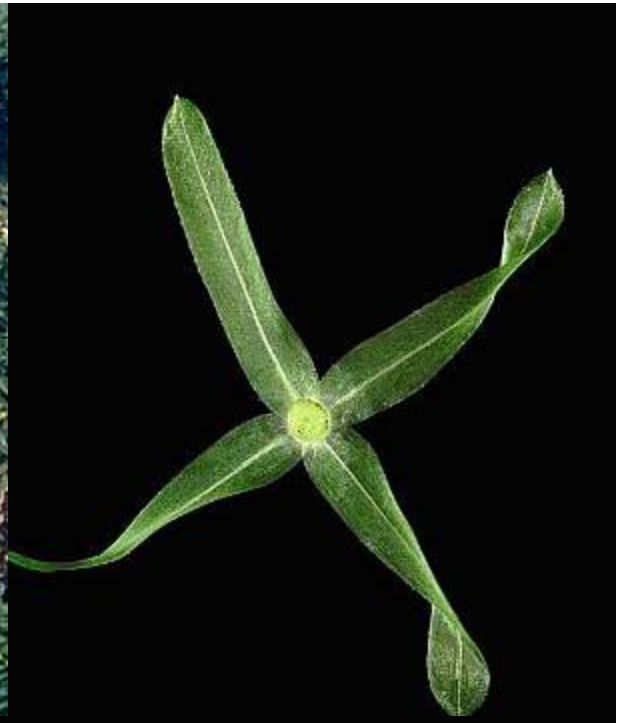
Egeria



Elodea

Common Elodea
Elodea canadensis

Brazilian Egeria
Egeria densa

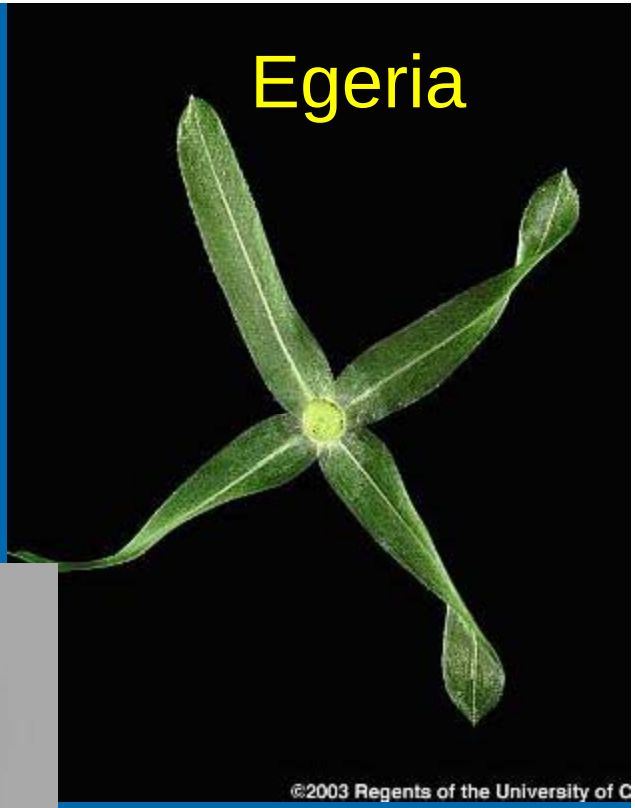


Hydrilla-*Hydrilla verticillata*

Hydrilla at Wakulla Springs, Florida
Hydrilla verticillata
Photo by Vic Ramey

Hydrilla

Egeria



Elodea

Southern Naiad

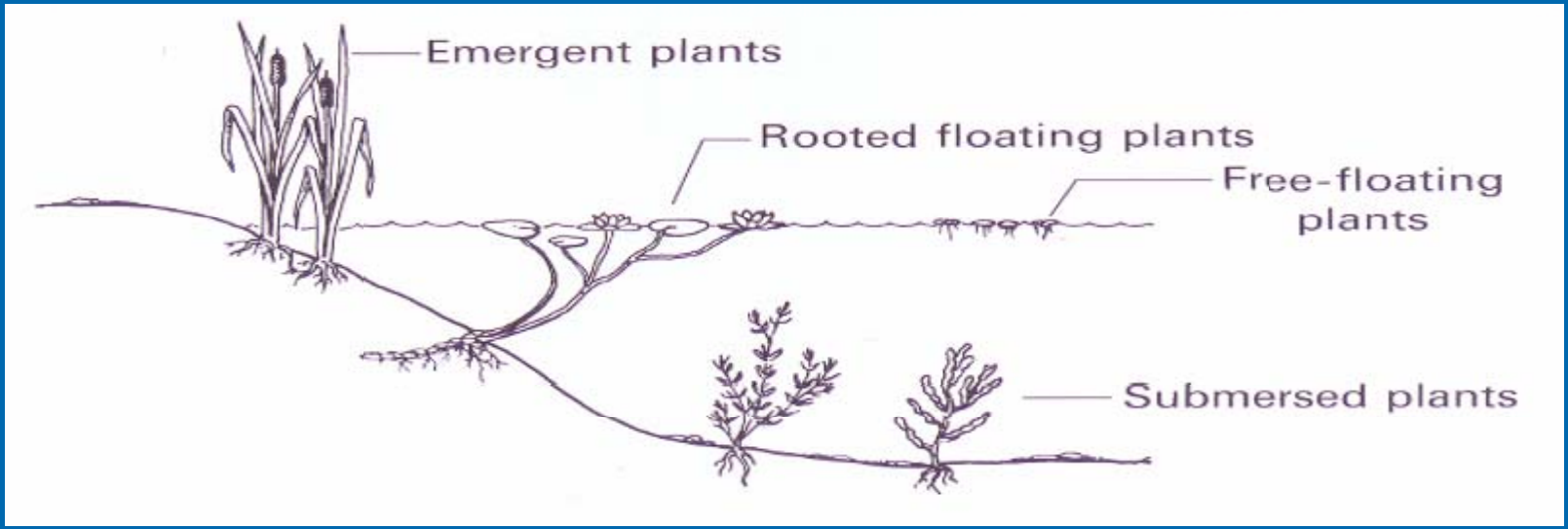
Najas guadalupensis

Photo by Brian Nelson
Copyright 1998 Florida Department of Environmental Protect

Southern Naiad

- Same Family as Hydrilla, Egaria, and Elodia
- Annual- Spreads primarily by seed
- Seeds and foliage important food source for Birds
- Not usually considered a weed in natural habitat
- Will tolerate polluted water

Types of Aquatic Plants



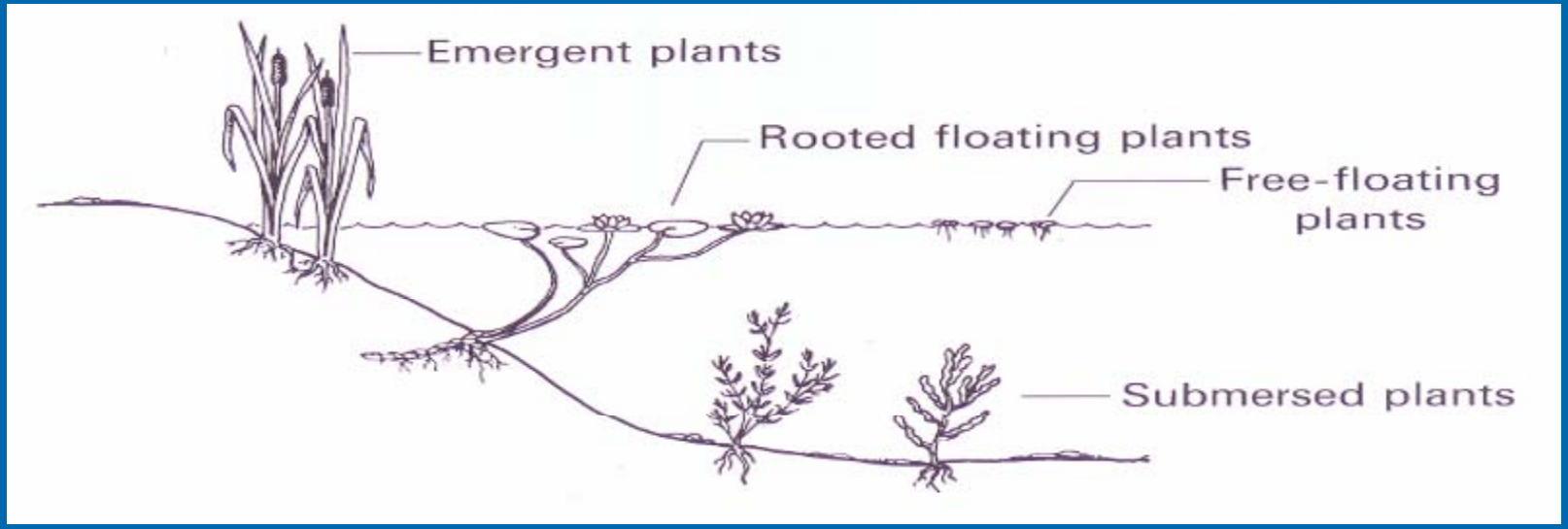
Rooted floating plants

Creeping waterprimrose
Ludwigia species…

Creeping waterprimrose *Ludwigia species…*

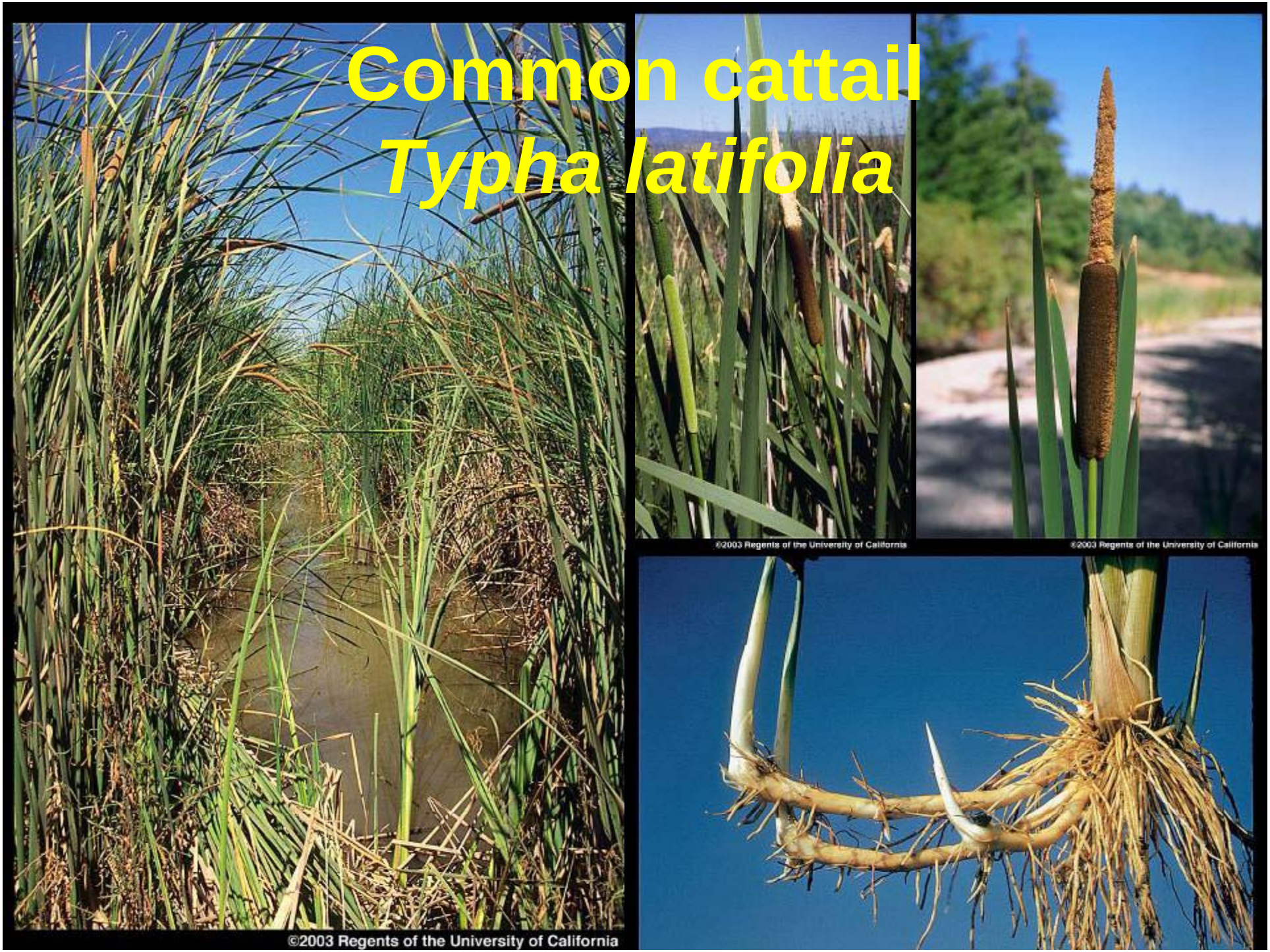
- 3 species- one native to California
- Can develop thick mats that interfere with water flow
- Rooted in side of pond or canal
- Reproduces by seed, creeping stems and stem fragments

Types of Aquatic Plants



Emergent plants

Common cattail
Typha latifolia



Common cattail
Typha latifolia

- Widespread desirable native – valuable source of food and shelter for wildlife- prevent shoreline erosion, and help remove excess nutrients from water.
- Spreads by seed and extensive rhizome system-
- "Everybody wants 2 feet of cattail- nobody wants 10 feet!"

Algae
&
Aquatic Weed Control

Aquatic Systems: Multiple uses

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

Costs of aquatic weed management

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

Costs of aquatic weed management

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<u>What</u> 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 (Nat'l Pollutant Discharge Elimination System)**
  E-monitoring and compliance (sampling equipment, training, analysis, documentation, record storage)

Algae Control

Management Techniques Related to Nutrient Reduction

- Dredging: remove nutrient-rich sediments
  expose nutrient poor layers
- Reduce obvious nutrient inputs
- Alter P availability through treatment with alum???


Buffer Strip
Reduce obvious nutrient inputs

Reduce obvious nutrient inputs

In our example, over 6500 Canada geese and 4200 ducks (mostly mallards) added 616 pounds of nitrogen, (N) and 194 pounds of phosphorus (P) per year to Wintergreen Lake in southwestern Michigan, mostly during their migration.

These amounts were 27% of all N, and 70% of all P that entered the lake from external sources.

Our procedure showed that waterfowl caused low water quality in Wintergreen Lake.

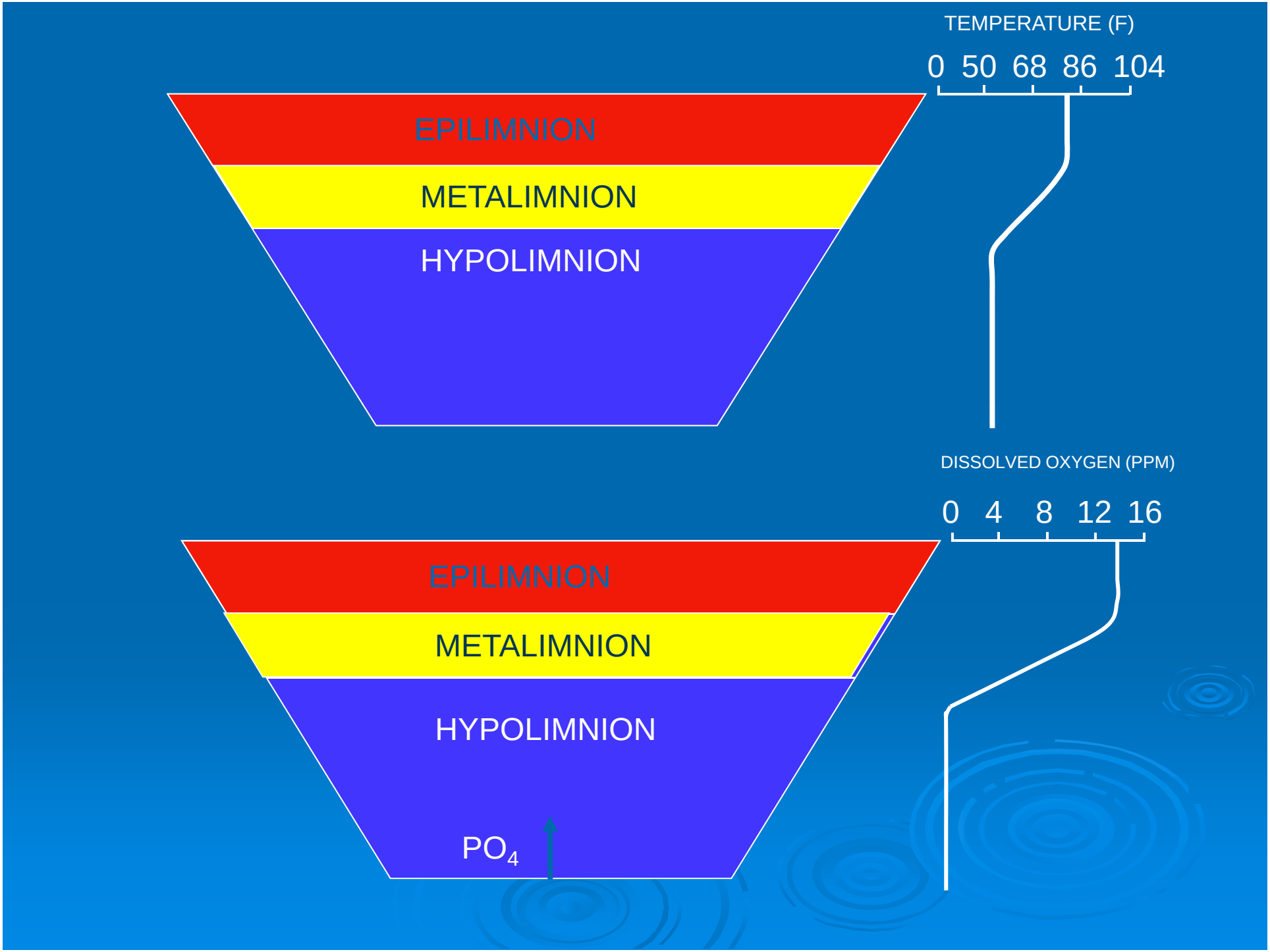
Manny *et al*. 1994. Hydrobiologia 279/280: 121.

Nutrient Inactivation

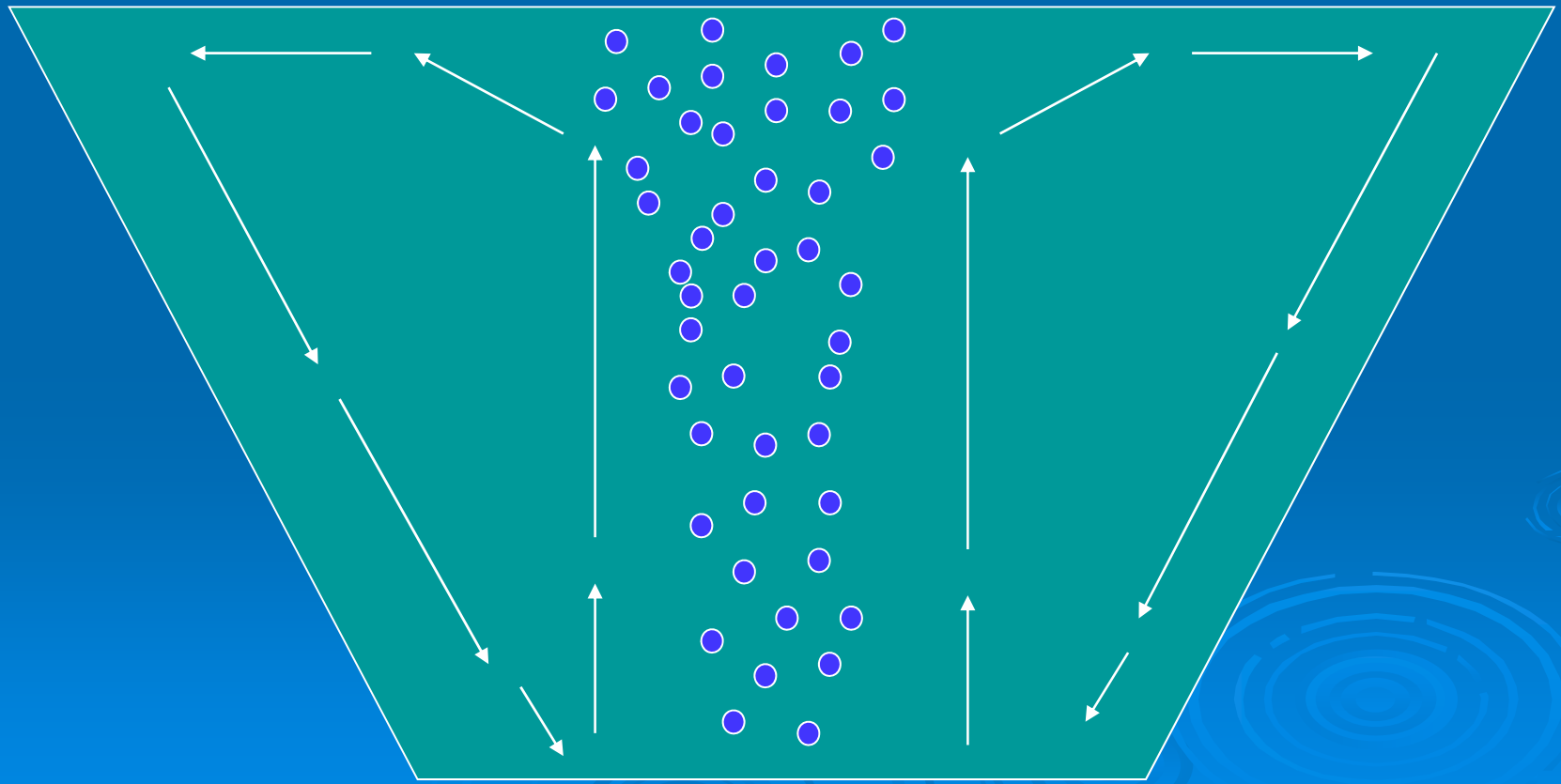
- Complex P with
  - Alum
  - Iron
  - Other
- Controls algae relatively inexpensively and can clarify water
- May not effect plants, particularly rooted ones
- Can adversely effect fish and other organisms

Aeration

Pictures from http//:pondguyinc.com


TEMPERATURE (F)
0 50 68 86 104
EPILIMNION
METALIMNION
HYPOLIMNION
DISSOLVED OXYGEN (PPM)
0 4 8 12 16
EPILIMNION
METALIMNION
HYPOLIMNION
PO4

Aeration results in water movement and the addition of oxygen to deeper water. This inhibits release of nutrients from the sediments.



Do bacteria compete with algae?

- The growth of planktonic algae and bacteria may be limited by the amount of phosphorus (P) in the water.
- One approach to managing algal blooms is to “increase” the abundance of bacteria so that they can take up the phosphorus in the water, thus reducing the growth of algae?

The Centre for Aquatic Plant Management (CAPM) in the United Kingdom is promoting a method of controlling algae that involves the application of barley straw to lakes. As the straw decomposes in the lake, it releases a chemical which inhibits algal growth.

Algae Control -- Barley straw can be packed in onion mesh bags (7 lbs / bag). Photo courtesy Steve McComas, Blue Water Science, St. Paul, MN

http://ohioline.osu.edu/a-fact/0012.html

THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

A-12-02

School of Natural Resources, 2021 Coffey Road, Columbus, OH 43210-1085

Algae Control with Barley Straw

William E. Lynch Jr.
Extension Associate, Aquatic Ecosystem Management

Filamentous algae is the most common aquatic weed problem in Ohio ponds. Its "sudden" appearance as it floats off the bottom causes consternation to pond owners as it degrades the aesthetic and recreational value of their ponds. Additionally, large amounts of filamentous algae can lead to a fish kill if specific climatic conditions occur (see Ohio State University Extension Fact Sheet A-8-01, *Winter & Summer Fish Kills*). A number of mechanical, biological, and chemical control measures are available, each with their own advantages and disadvantages. A review of these measures can be found in Ohio State University Extension Fact Sheet A-3-98, *Controlling Filamentous Algae in Ponds*.

Barley straw has received considerable attention as an algaecide based on research done in England. Results showed that barley straw prohibits the growth of many types of algae, but not all. ***However, recent research in the United States has not yielded conclusively positive results.*** While research results are inconclusive, the use of barley straw to control pond algae has grown. The purpose of this fact sheet is to provide pond owners with application guidelines ***should they decide to try barley straw as an algae control technique.***

How Barley Straw May Work

The decomposition of barley straw in water produces and releases many compounds, one of which *may* control algae populations. The chemical compound does not eliminate existing algae cells but interferes with and prevents the growth of new algae cells. As "old" algae cells naturally die off, few new algae cells are produced and the algae population is controlled as long as the compound is being produced.

There are a number of other types of straws available, including wheat, linseed, and oil seed. However, research in England has shown that barley straw is the most effective straw and provides control for a longer period of time.

Note: pond owners should use dried straw, not barley hay or fresh barley. The addition of those materials actually releases nitrogen and phosphorus into the water which promotes algae growth. These fresher materials also decompose very quickly and can cause low oxygen problems in ponds.

How Much to Apply

The amount of straw to apply is based on pond surface area rather than volume (for calculation tips, see Ohio State University Extension Fact Sheet A-2-98, *Pond Measurements*). It is generally recommended that about 0.025 pounds of straw be used for every square yard of pond surface area. In a small ornamental pond of four square yards (about 100 square feet), only 0.01 pounds is needed. In a one-acre pond, the amount required would be about 107 pounds of straw or 2-3 standard bales. In a pond with a history of algae problems, a higher initial amount of 225 pounds per surface acre may be warranted.

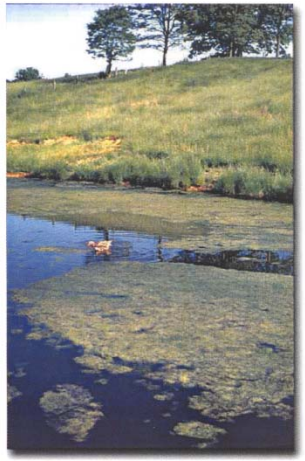
How and Where to Apply

The production of the critical compound during straw decomposition must occur in the presence of oxygenated water. In small ornamental ponds, simply place the small amount required loosely in a mesh bag and place in the water. A weight of some sort should be added so the bag is on the pond bottom.

In larger ponds, more effort is needed. Each bale should be broken up as much as possible so that nearly all decomposition will occur in the presence of oxygen. About 1/3 of a bale should be placed in a large, weighted permeable bag of some sort. If an intact bale is placed in the pond, only the decomposition occurring along the outside of the bale will occur in the presence of oxygen. Decomposition inside the "tight" bales will occur in the absence of oxygen and will not produce the chemical. In a one-acre pond, this will result in 6-9 loosely filled separate

APM-1-W

Aquatic Plant Management



Barley Straw for Algae Control

Carole A. Lembi, Professor of Botany
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The use of barley straw for algae control has received a lot of publicity in recent years. It is now common to find small barley bales being sold in nurseries and garden shops for use in water gardens and small pools to control algae. The word-of-mouth reports of success with this method have led many people to suspect that barley might also control algae in ponds and lakes. What has research so far told us about the potential for barley to control algae in these larger bodies of water? And, what does the Environmental Protection Agency (EPA) say about using barley straw as an algicide? These topics will be addressed in this publication.

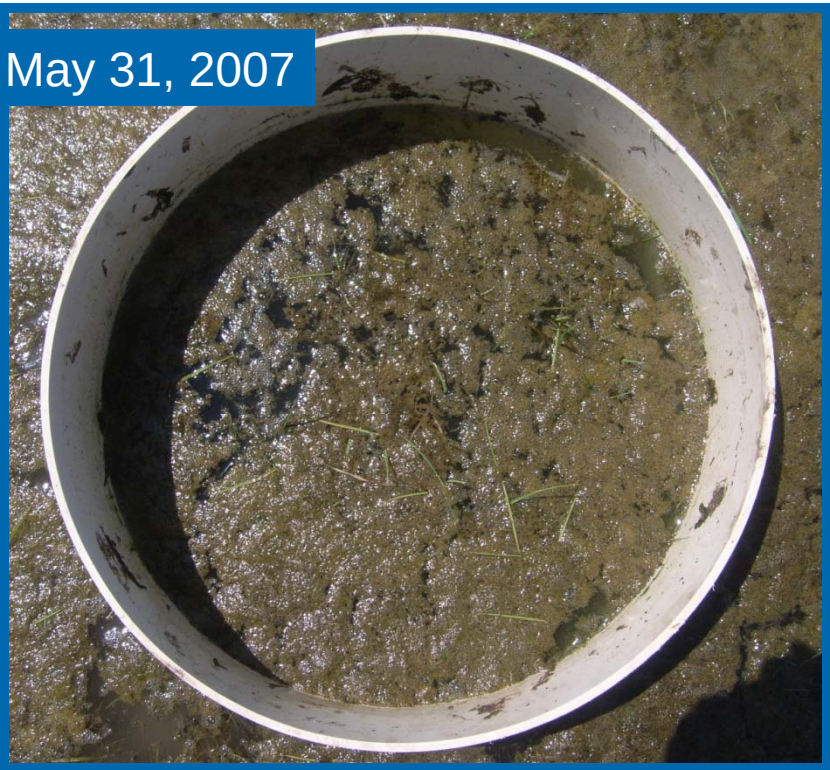
Where It All Started

The technique of using barley for algae control was developed in the early 1990s in England, where it is widely used in many bodies of water, including large reservoirs and canals. In general, it is thought that fungi decompose the barley in water, which causes a chemical to be released that prevents the growth of the algae. The specific chemical(s) has not been identified (oxidized polyphenolics and hydrogen peroxide are two decomposition products that have been suggested), and it is not clear whether the chemical is exuded from the barley itself or if it is a metabolic product produced by the fungi. The activity of barley straw is usually described as being algistatic (prevents new growth of algae) rather than algicidal (kills already existing algae).

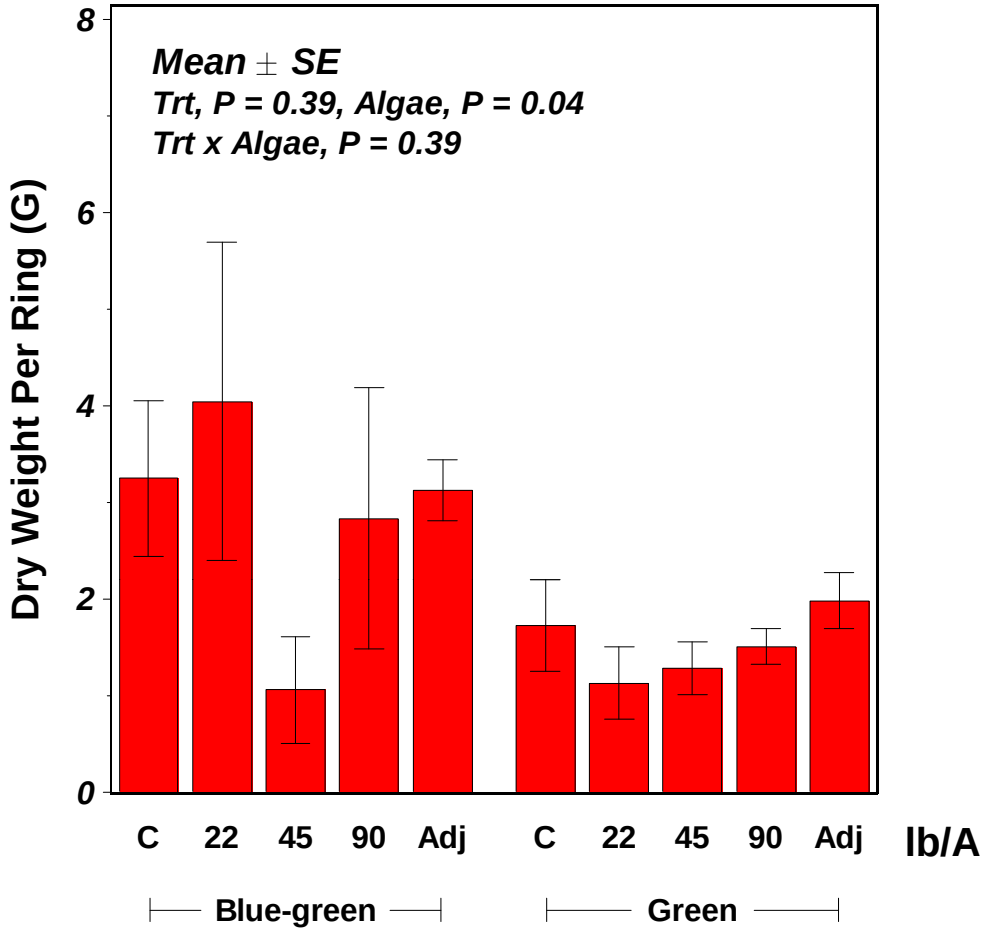
Laboratory studies conducted by English researchers suggest that barley will not control the growth of all species of algae. In fact, some of the studies are contradictory, claiming that certain types of algae are susceptible while other studies claim that those algae are not susceptible. But, the field evidence from England does suggest that, in most cases, water clarity will improve over time and that this is due to reduction in algal populations.

http://www.btny.purdue.edu/Pubs/APM/APM-1-W.pdf

May 31, 2007



June 1, 2007



Applied sodium carbonate peroxyhydrate @ 90 lb / acre-ft.

This non-copper-based algaecide eliminates a broad spectrum of algae on contact. Designed for lakes, ponds and other large bodies of water as well as for unpainted surfaces, such as beaches, docks and walkways. Its active ingredient, sodium carbonate peroxyhydrate, creates a powerful oxidation reaction that destroys algal cell membranes and chlorophyll, providing immediate control of algae. Fast-acting (within 60 sec of application), it biodegrades completely and adds 13% bio-available oxygen to the water. Can be applied for spot or perimeter treatment. For spot treatments apply at a rate of 20-50 lbs/acre-foot; for algae blooms apply at a rate of 9-30 lbs/acre-foot; for filamentous algae blooms treat at a rate of 50-90 lbs/acre-foot. Safe for use with koi and trout. EPA-approved. Now sold in 50 lb bags.

http://www.aquaticeco.com

Treatments are based on volume of water to be treated.

Algicides used for algae management

Name	Example Trade Name	Formulation	Plant Response
Complexed copper	Captain Clearigate Cutrine-Plus K-Tea Nautique	Liquid Liquid Liquid or Granular Liquid Liquid	Plant Cell Toxicant
Copper	Triangle copper sulfate crystal	Granular	Plant Cell Toxicant
Endothall (N,N-dimethylalkylamine salt)	Hydrothol 191	Liquid or Granular	Nonselective, contact
Sodium Carbonate Peroxyhydrate	GreenClean Pro	Granular	Nonselective, contact

Only pesticides specifically labeled for aquatic sites and approved by the US Environmental Protection Agency for application should be applied. Pesticides should be applied only by or under direct supervision of properly registered, certified, and trained personnel. All pesticide use should comply strictly with local, state, and federal regulations. Following label recommendations, obtaining certification to apply pesticides, and training in the appropriate pesticide application techniques are essential.

Use considerations for U.S. EPA-approved algicides

Compound	Exposure time (Water)	Advantages	Disadvantage	Systems where used effectively	Plant response
Complexed Copper	Intermedate (18-72 hours)	Rapid action, approved for drinking water	Does not biodegrade, but biologically inactive in sediments	Lakes as algicide, as herbicide in higher exchange areas; moving and still water	Broad spectrum, acts in 7-10 days or up to 4-6 weeks
Endothall (N,N-dimethylalkyl-amine salt)	Short to Intermediate (12-36 hours)	Rapid action, limited off-target movement	Toxic to fish	Shoreline, localized treatments, higher exchange rate areas; Moving and still water	Broad spectrum, acts in 7-14 days
Sodium Carbonate Peroxyhydrate	Short	Rapid action, approved for drinking water	Do not tank mix with herbicides containing copper or bromides	Lakes, ponds, moving and still water	Bubbling, bleaching/ discoloration

Application restrictions of US EPAgency-approved aquatic algicides.

Compound	Persistence (half-life)	Maximum Application Rate	Maximum water concentration	Safety Factor
Complexed Copper	3 days	1.5 gallons / acre-foot	1.0 mg / L	> 50
Endothall (N,N-dimethyl-alkylamine salt)	4-7 days	13 gallons / acre-foot	5.0 mg / L	Fish are sensitive to Hydrothal 191, > 1 mg / L may cause fish kill
Sodium Carbonate Peroxyhydrate	Short	90 pounds / acre-foot		Toxic to birds, non-target plants, bees

Use considerations for copper sulfate

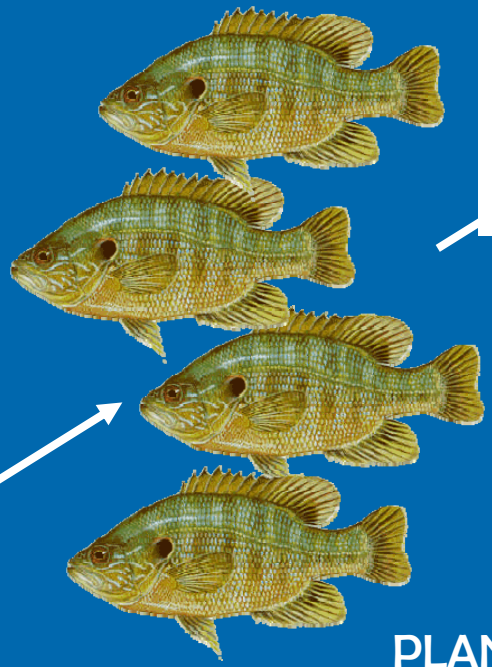
$$CuSO_4 \longrightarrow Cu^{2+} + SO_4^{2-}$$

Total Alkalinity (ppm)	Copper Sulfate (ppm)
0-40 ppm	**Do not use**
40-60 ppm	0.33
60-90 ppm	0.5
90-200 ppm	1.0

A given concentration of copper is more toxic at low pH (< 6).

Biomanipulation

FISH FEEDERS



PLANKTON FEEDERS

ZOOPLANKTON

ALGAE

Aquatic Plant Management

- 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

Dredging

Removes nutrient-rich sediments

Exposes nutrient poor layers;

Deepens resulting in less light penetrating to the bottom.

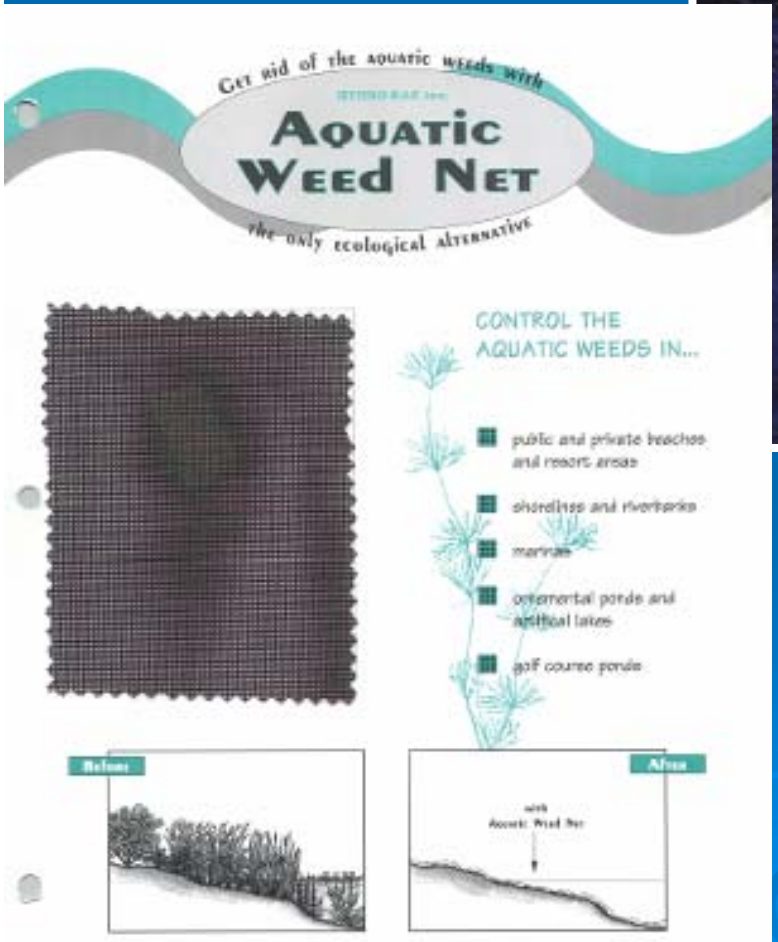
Cultural Control

- 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
- Must have ability to control water inflow

Benthic Barrier



Light Alteration as a Management Approach

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.

Shading

- Water-soluble dye
- Inexpensive
- Discoloration appears artificial

AQUASHADE
AQUATIC PLANT GROWTH CONTROL
FOR ALL SEASONS

U.S. Pat. No. 4,042,367 EPA Reg. No. 33068-1 EPA Est. No. 33068-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-BLUE AND ENHANCES THE AESTHETIC QUALITIES OF A WATER BODY

ACTIVE INGREDIENTS:
Acid Blue 9 ..... 23.63%
Acid Yellow 23 ..... 2.39%
INERT INGREDIENTS 73.98%
TOTAL 100.00%

KEEP OUT OF REACH OF CHILDREN

CAUTION

STATEMENT OF PRACTICAL TREATMENT:
Avoid contact with skin, eyes, and clothing. Wash after handling.
Do not reuse empty container. Wrap and place in trash collection.

SPECIMEN

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 Turf.

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

PRECAUTIONARY STATEMENTS

May be used for swimming AFTER COMPLETE DISPERSAL. Do not apply to water for swimming pools if chlorine is used, as this will cause the color to be lost.

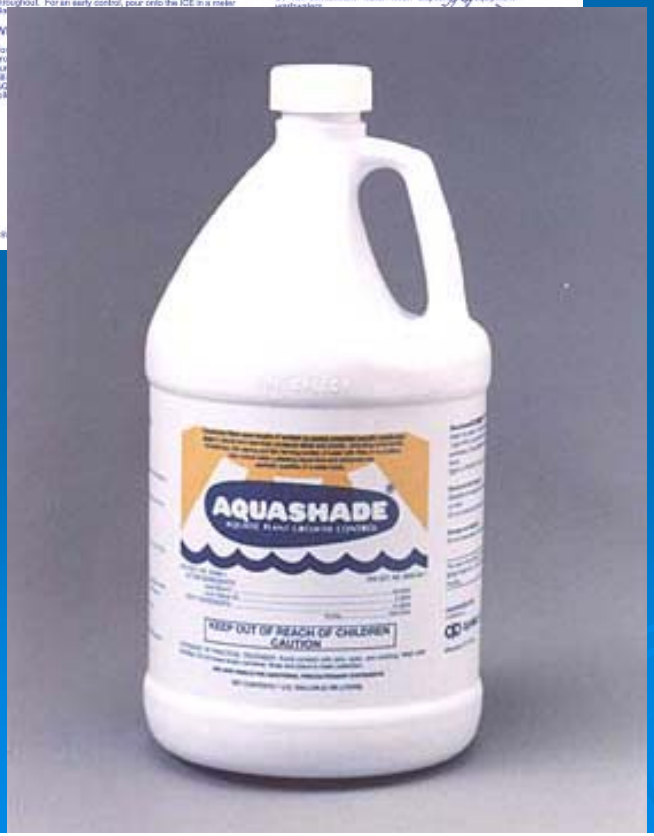
RECOMMENDED DOSAGE RATES

Add 3 one gallon (1ppm) per acre of water with 4 foot average depth (one foot deepest point).

1 ppm - When submersed weeds and algae are growing at depths greater than two feet, such as Leafy Pondweed, Chara, Slender Naiad, Filamentous Green and Bluegreen algae, Spikerush, Watermilfoil (Treat early)
2 ppm to PREVENT Tuber production of HYDRILLA.

ENVIRONMENTAL HAZARDS

Shoreline non-target plants (cattails, water lilies) may suffer contact burn if material is accidentally poured on them. Do not contaminate water when disposing of equipment



PRECISION
PRODUCTS FOR GROWTH

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 hazards.

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 (3.8TL) 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.

WARRANTY INFORMATION:

The information contained in this bulletin is based on information which is believed to be reliable. However, Precision Laboratories does not warrant either expressly or by implication the accuracy thereof. In presenting 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 137
Northbrook, IL 60065
800-323-0280 • 312-498-0880
Fax: 312-498-1176

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AQUASHADE

AQUATIC PLANT GROWTH CONTROL ®

FOR ALL SEASONS

U.S. Pat. No. 4,042,367 EPA Reg. No. 33068-1 EPA Est. No. 33068-OH-1

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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 COLOR
ENHANCES THE

ACTIVE INGREDIENTS:
Acid Blue 9 .....
Acid Yellow 23 .....
INERT INGREDIENTS.....
TOTAL.....

KEEP OUT

SPECIMEN

STATEM
Avoid contact with
Do not reuse empt

DIRECTIONS FOR USE

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HOW TO APPLY

Pour from the container near shoreline into water. throughout. For an early control, pour onto the ICE diameter circle. It will melt a hole & disperse unde

WHEN TO APPLY

For best results, apply before growing season start growth is on the bottom. Less effective when grow surface (2 ft.), in that case, physical removal or killing of growth already above surface may be do AQUASHADE is applied. When using an aquatic follow all label restrictions, precautions and directio

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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 (3.87L) 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:

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P.O. Box 127
Northbrook, IL 60065
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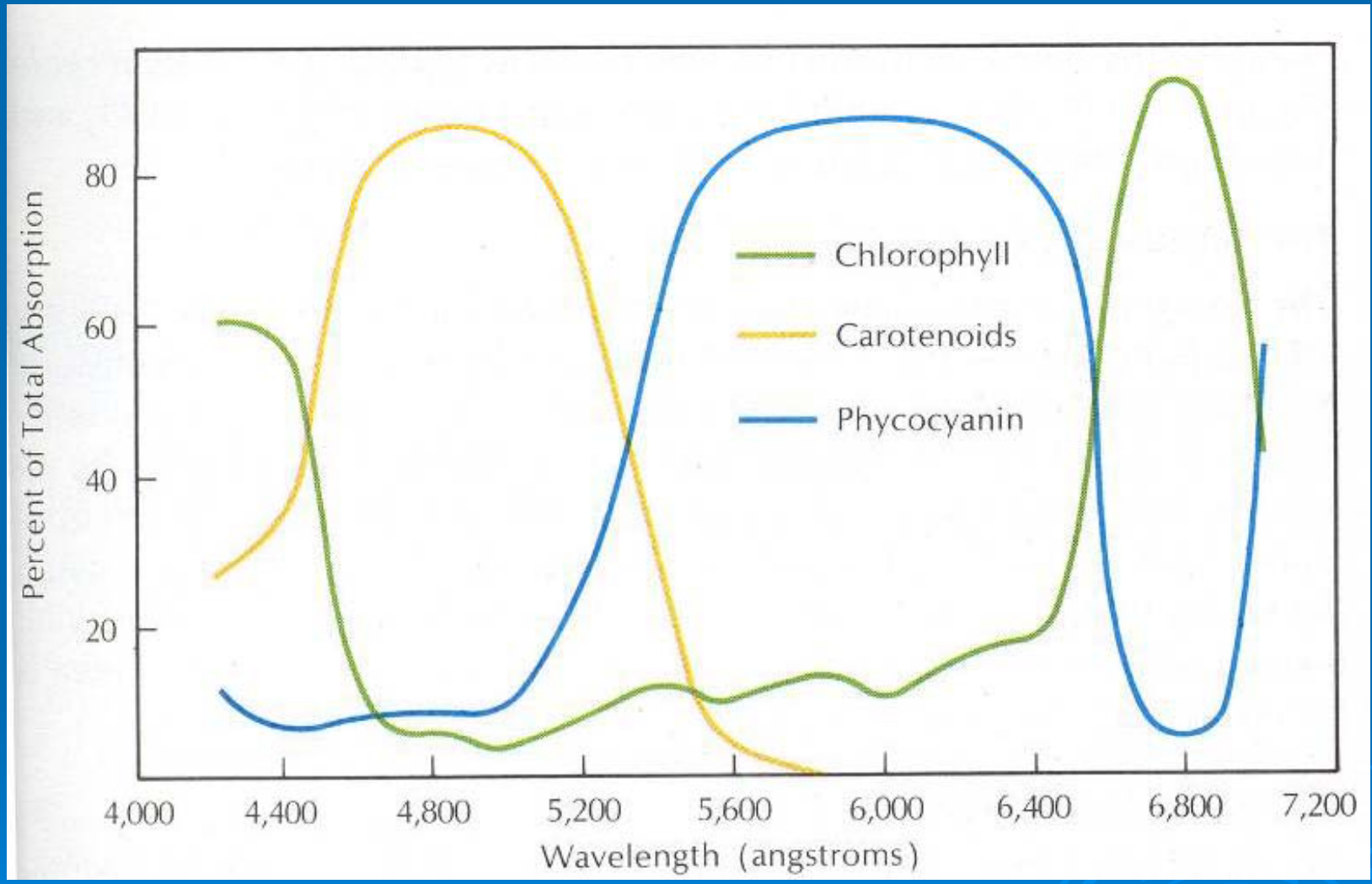
FAX: 312-498-1176

Use light absorbing dyes. Best with slow water turnover, dilution, apply early in growing season, most effective in clear water, requires minimum depths of > 0.5 to 2 m.

1 gallon per acre foot of water yields 1 part per million (ppm).

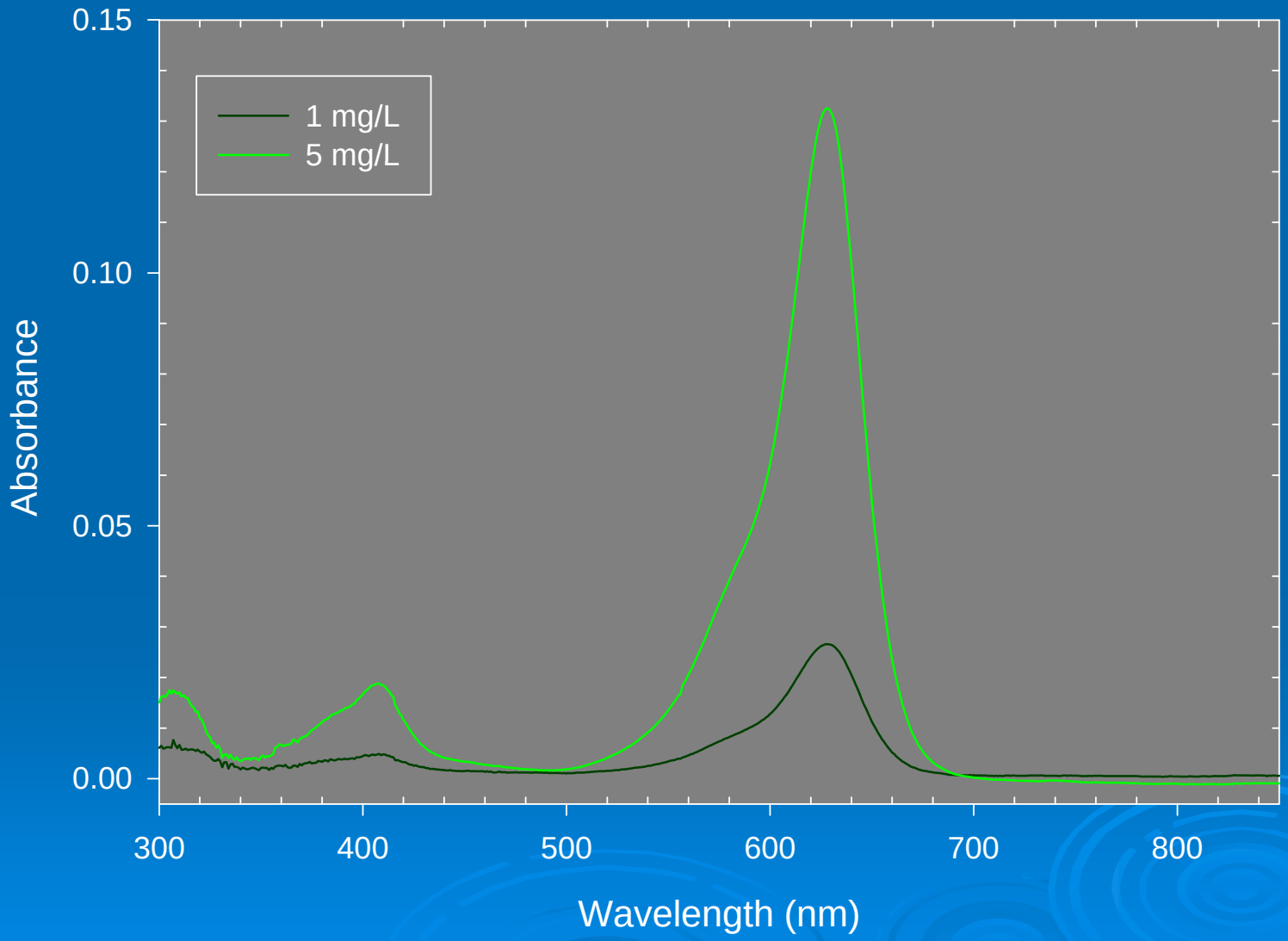
How colorants work



Block light wavelengths that plants need for growth

Light absorbance by Aquashade

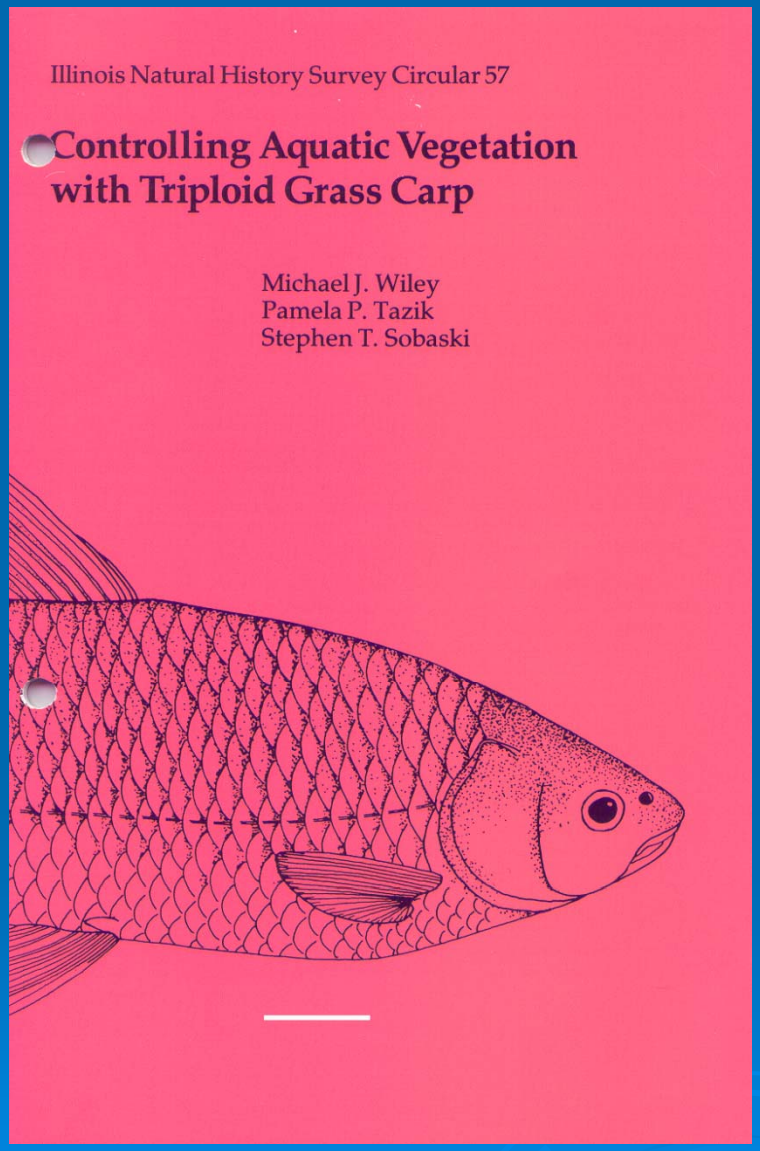
TM



Madsen et al. 1999

Biological Control

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



Many states require permits.

Triploid grass carp will consume filamentous algae

The most common rates are 25 to 60 fish per hectare using fish approximately 300 mm long (0.5 kg per fish). Stocking rates should be based on the amount of vegetation (for example, number of fish per vegetated acre) rather than using the size of the water body as a determining factor.

http://www.wvu.edu/~agexten/aquaculture/triploid.htm#Stocking

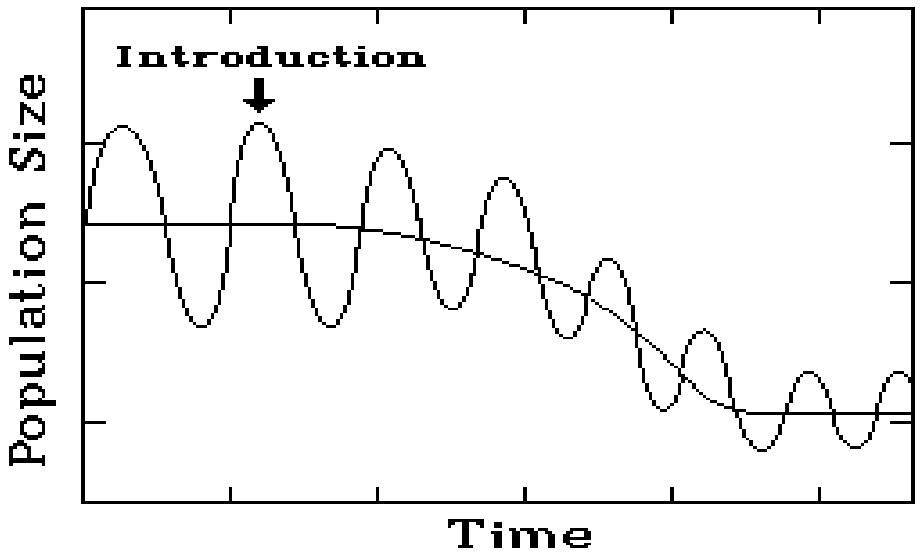
Grass Carp

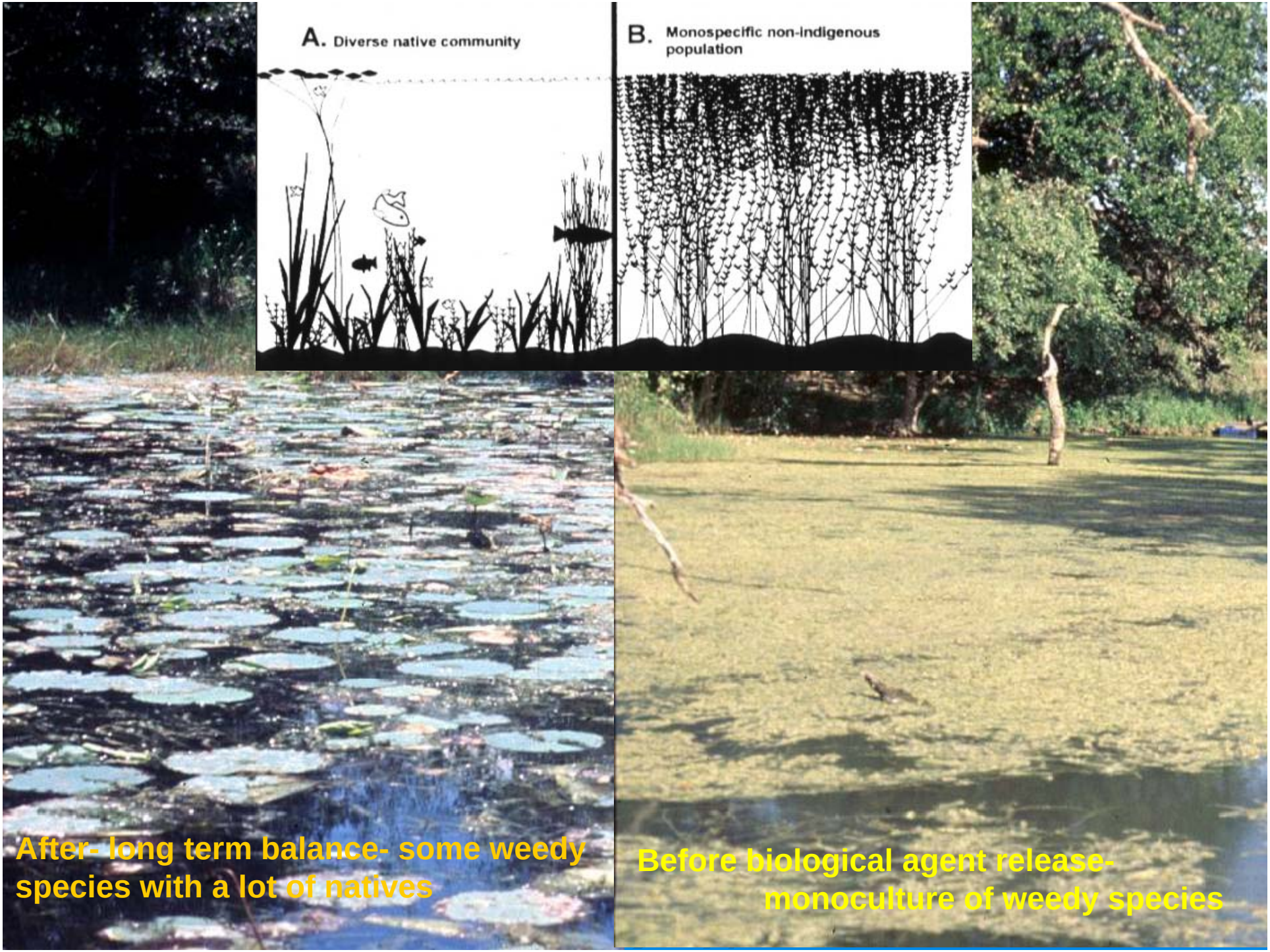
- Advantages
  - Effective
  - Inexpensive
  - Long-term

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

Classical Insect Control

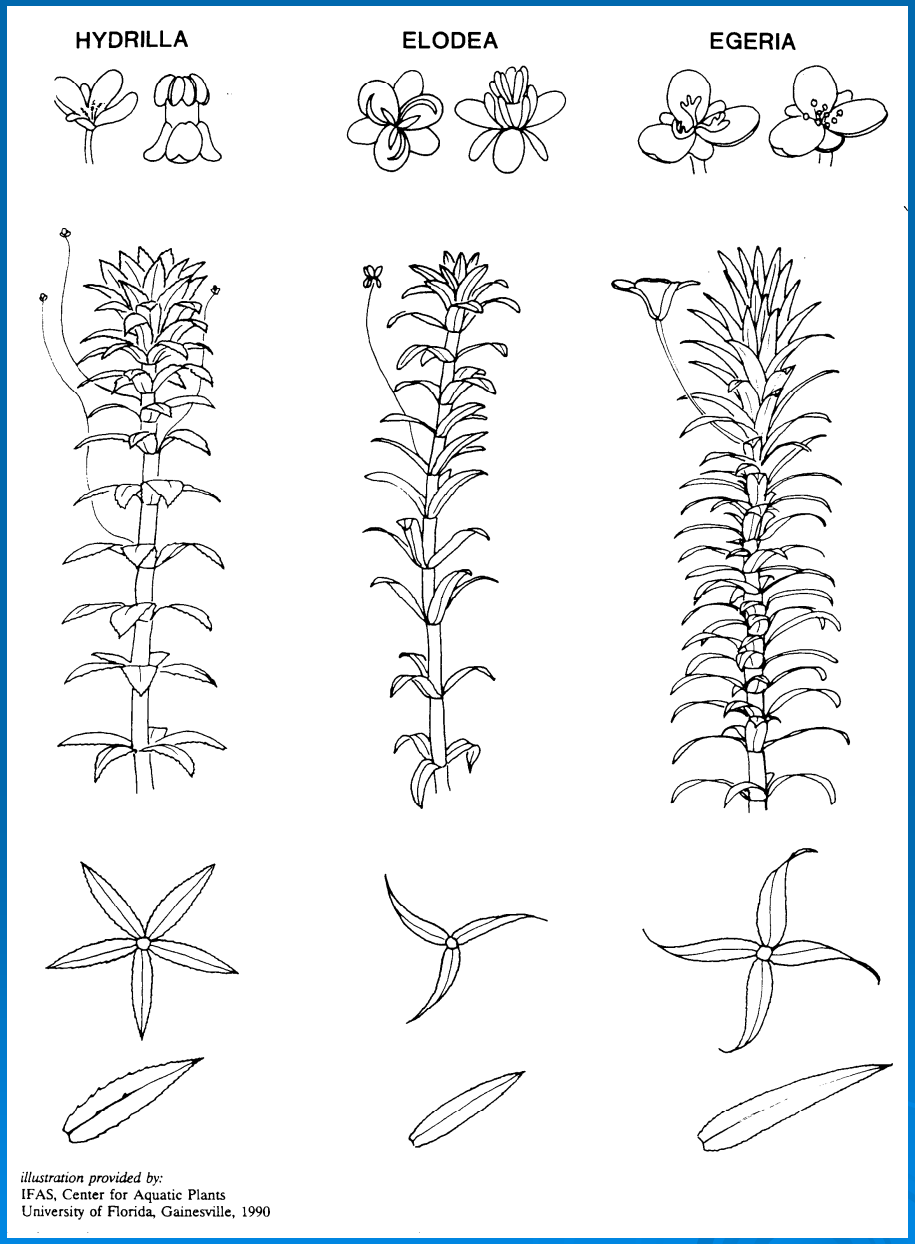
- Advantages
  - Public perception
  - Low cost after R&D
  - Long-term
- Disadvantages
  - No agents for several target nonindigenous plants
  - Long time for R&D
  - Unpredictability of results




A. Diverse native community
B. Monospecific non-indigenous population
After- long term balance- some weedy species with a lot of natives
Before biological agent release- monoculture of weedy species

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

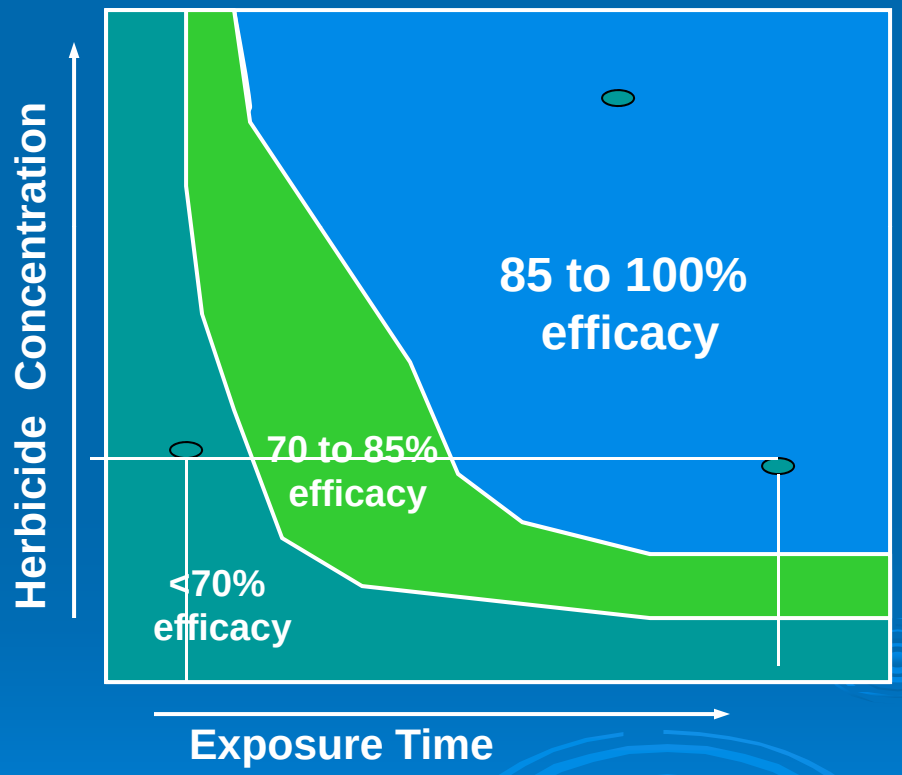
Aquatic Herbicides

Read and follow the label!

Check with Ag Commissioner for local use restrictions.

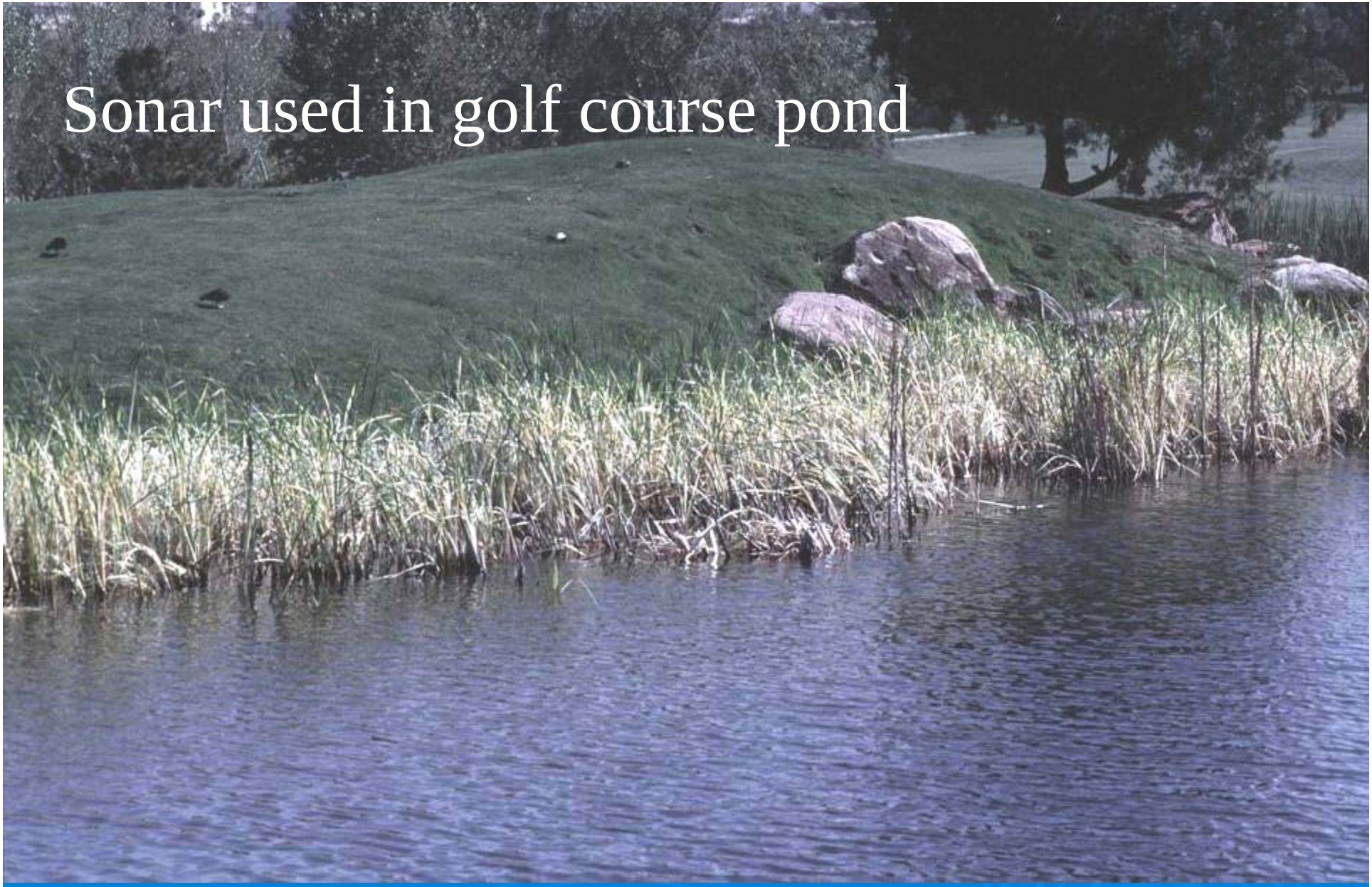
Submersed Plants: Dose & Exposure

- 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



Undesired effect –White Cattails

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

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