Recreational Pond Management

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Natural Ponds

- Generally support 200-250 lbs fish/acre
- Relatively stable water quality
- Many AL ponds have low nutrients contents
- Most have low alkalinity
- Can be any color from clear -> Tea -> Green
Catfish Farm Pond

- More than 6500 lbs/acre
- High nutrient loading (feed)
- Volatile water quality
- Usually bright green
Components of Pond Management

- Water Source
- Water Quality
- Weed Control
- Fish Selection/Stocking
- Population Management

HARVEST !!!
Water Source

- Consider the Source
  - Well
  - Runoff
Water Source

- Spring
- Another Pond
- Stream

**How Much?**
- Match pond size to water volume
- Too much water
  - Hard to manage algae
- Too little
  - Excessive shallow area
Water Quality

- Dissolved Oxygen
- Total Alkalinity
- Total Hardness
- Turbidity
- Algae
Water Quality

- Pasture
- Unpopulated
- Forested
- Underground
- Populated
What Impacts Water Quality?

• Water Temperature
  – Not something you can control, but should consider in management decisions
• Photosynthesis/Respiration (Algae)
• Fertilization
• Aeration
• Can you exchange water?
How does temperature affect the amount of DO?

Figure 3: The effect of temperature on oxygen saturation in water.
Dissolved Oxygen

- Why is it important?
  - Fish respiration
  - Bacteria respiration

- Generally the first limiting factor in aquaculture production

- What % of the air is Oxygen?
- What % of the water?

21%

0.0008%
Where Does the Oxygen in the Water Come From?

- 90% comes from photosynthesis

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy} = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]

- 10% comes from the air water interface

- Diffusion
  - movement from an area of high concentration to an area of low concentration
Where Does the Oxygen Go?

- Respiration
- Oxidation

- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$

- Sugar + Oxygen = Carbon dioxide + water + energy
How do different levels of DO effect aquaculture organisms?

Figure 2: The effects of dissolved oxygen concentrations on pond fish. © Claude E. Boyd, by permission.
How will the density of the algae bloom affect the DO?
How will the density of the algae bloom affect the DO?
How will the density of the algae bloom affect the DO?
Depth vs Oxygen
Depth vs Oxygen

The graph shows the relationship between depth and dissolved oxygen in the water. There is a marked decrease in dissolved oxygen as the depth increases, indicating a lower availability of oxygen at greater depths. The term 'Heavy plankton bloom' is noted on the graph, which suggests that at this depth, there is a significant increase in plankton, possibly due to nutrient-rich conditions.
Depth vs Oxygen

The graph shows the relationship between depth (in meters) and dissolved oxygen (in mg/litre). There are two distinct regions:

- **Moderate plankton bloom** where dissolved oxygen levels are relatively low at certain depths.
- **Heavy plankton bloom** where dissolved oxygen levels decrease significantly with depth.

The graph indicates that as depth increases, dissolved oxygen levels decrease, with a notable drop in oxygen concentration in the heavy plankton bloom region.
Depth vs Oxygen

The graph illustrates the relationship between depth (in meters) and dissolved oxygen (in mg/litre). It shows three distinct zones:

- Heavy plankton bloom
- Moderate plankton bloom
- Light plankton bloom

The graph indicates that as depth increases, dissolved oxygen decreases, with notable changes at specific depth levels corresponding to different plankton blooms.
Aeration?

- Aspirator
- Defused air
- Pond aeration
- Paddlewheel
Oxygen Gains and Losses

Gains

- Photosynthesis by phytoplankton
- Diffusion

Losses

- Plankton respiration
- Fish respiration
- Respiration by organisms in the mud
- Diffusion

5 to 20 ppm
1 to 5 ppm
5 to 15 ppm
2 to 6 ppm
1 to 3 ppm
1 to 5 ppm
Example budget

- Day 1
  - am DO of 6 ppm
- bloom adds 10 ppm
- windy, diffusion adds 5 ppm
- Respiration by plants and animals in the mud 10 ppm
- Fish respiration 3 ppm
- Diffusion out of pond 2 ppm

- 6 ppm
- +10 ppm
- + 5 ppm
- = 21 ppm
- - 10 ppm
- - 3 ppm
- - 2 ppm
- = 6 ppm
Example budget - Day 2

- 6 ppm to start
- + 10 ppm photosynthesis
- + 1 ppm diffusion - calm day
- = 17 ppm available
- - 10 ppm respiration of phytoplankton and organisms in the mud
- - 3 ppm fish respiration
- - 1 ppm diffusion
- 3 ppm left on the morning of day 3
Correct Dissolved Oxygen Problem

- Signs of fish stress
- Steps you can take
  - Feed
    - Time of day
    - Amount
    - Do you feed at all?
  - Aeration
  - Stocking Rate
Stratification

- What is it?

- How does it happen?
Seasonal Changes

Early Spring:
- Mixing occurs - no stratification

Summer:
- Warm, less dense layer
- Cool, more dense layer
- Thermocline zone

Fall:
- Mixing occurs - no stratification

Winter:
- Ice cover
- Water near freezing
- Slightly warmer water – near maximum density of 39°F
Figure 7: A thermally stratified pond showing the two distinct layers of warmer and cooler water.
Alkalinity - What Is It?

- Measure of the total bases in water
- Buffering Capacity
- Ability of water to resist change
- Main bases in water are carbonate and bicarbonate
Alkalinity
Where Does It Come From

- Calcium Carbonate - \( \text{CaCO}_3 \) - Limestone
- Sodium Bicarbonate - Baking Soda
Alkalinity
What Is It Used For?

- Buffering Capacity

- Carbon is used by bacteria during growth

- Tends to decrease over time as it is incorporated into new bacteria
Alkalinity

What Is A Good Level

50 to 200 ppm
High Alkalinity

The graph shows the pH levels throughout the day, with the highest pH levels at noon and the lowest levels at 6am and 6pm.
Why is this important?

• Fish Condition
  - By itself, low alkalinity probably will not kill fish
  - Will act as a source of stress

pH Scale
- Logarithmic
- Each 1 point change is equivalent to 10X
- From 8 to 5 is 1,000 times more acidic
Total Alkalinity/Total Hardness

- Alkalinity
- Buffering Capacity of Water
- Hardness
- Calcium/Magnesium in water

Addition of Agricultural Limestone in winter will improve both water quality variables
Total Hardness

• A measure of the divalent salts Ca\(^{++}\) and Mg\(^{++}\)
  1. Improved osmoregulation
  2. Bone development
• Generally down here in our soils, Total Hardness measurements run very similar to Total Alkalinity
Total Hardness & Total Alkalinity

- When measured to be less than 20ppm
  - Indicates a pond/lake needs to be limed
  - USE AGRICULTURAL LIMESTONE
    - CaCO$_3$ and MgCO$_3$
    - (Ag Lime and Dolomitic Limestone)

- Other ‘lime’ can be very dangerous to fish
  - Hydrated lime
  - Burnt lime
  - Slaked lime
  - Quick lime
Turbidity

How Clear is the water?
- Secchi Depth
- Clay Vs Algal
- Fertilizer Determination
- Ideal levels
- Management options
Turbidity

- Clay Turbidity
  - Reduces productivity of pond
  - Several steps to clear clay
  - FIRST
    - Correct the source of the clay
      - Erosion
      - Fish Species (catfish/Common Carp)
      - Livestock?
Turbidity

- Algal Turbidity
  - Indication of the productivity of the pond
  - Try to maintain 18” visibility
  - More than 24” needs fertilizer
  - Less than 12” could be trouble with DO
Fertilization

organic

inorganic
Fertilization

- The first limiting nutrient in ponds is Phosphorus.
Fertilization: How does it work?

- Carnivore
- Small fish
- Zooplankton
- Phytoplankton

unfertilized

fertilized
What is the “Good Algae”

• Microscopic rootless plants that form the basis of an extensive food web.
• Primary aim of fertilization is to encourage growth of these organisms.
Types of Fertilizer

- Granular
- Liquid
- Super soluble
How do you apply Granular fertilizer?

- Phosphorus readily binds with clay in pond bottom
- Very important not to let the fertilizer granular touch the bottom
  - Granular can be placed on a platform
How do you apply Liquid Fertilizer?

- Dilute concentrate
- Maintain agitation
- Spray mixture into pond
How do you apply Super Soluble fertilizer?

- Dissolves quickly in water
  - Can be broadcast unlike granular or liquid
  - Ease of application increases the price
How Much Fertilizer do I Add?

- Depends on the formulation
- Granular varies widely
  - Example 20-20-5 is 40 pounds per acre per application
- Liquid
  - Several types, generally 10 pounds per acre per application which is about 1 gallon per acre
- Super Soluble
  - Varies, around 5 pounds per acre per application
When do I apply Fertilizer??

- This is important
- Fertilize on a schedule
- Check the pond (algal turbidity) before applying
  - More than 24” visibility add fertilizer
  - 18” do nothing
  - Less than 12” no fertilizer and prepare for DO problems
When do I apply Fertilizer?

- **The Schedule**

- **Begin the last week of February**
  - Unless you are heavily influenced by spring rains, delay 1 month
  - Every 2 weeks for 3 applications
  - Every 3 weeks for 3 applications
  - Every month thereafter

- **Stop at the end of October**

Remember: Every pond is different. Check to make sure you NEED fertilizer before adding it!
Can I Over Fertilize?

- Absolutely!
  - If you over fertilize
    - Pond Algal Turbidity will be too high
      - Visibility will be less than 18"
    - Can result in low dissolved oxygen
      - The algae produce the oxygen in the day (photosynthesis) but they consume at night (respiration)
  - Algal blooms that are too dense are unstable
    - Bloom “crash”
      - Oxygen producers die
      - Bacteria that break down dead algal cells consume oxygen
Feed

• How Much?
• How Often?
• Remember Water Temperatures
What kind of Fish for my Pond?

- Size of pond should be considered
  - Less than ½ acre
  - More than ½ acre
Ponds less than $\frac{1}{2}$ Acre

- Difficult to manage for Bass/Bream
- Consider Catfish
- Consider Trophy Bream
  - If pond can be drained easily, may be an opportunity for Hybrid Bream such as Georgia Giant
Ponds less than ½ Acre: Catfish

- Generally no fertilizer if fed
- 50-200 per acre
- Typically will not reproduce with bass in pond
- 8” fingerlings with adult bass
- Can muddy water
Ponds greater than $\frac{1}{2}$ Acre

- Bass/Bream
- Catfish
- Increasingly more difficult for hybrid bream
  - Difficult to drain and restart when bream stunt
Bass/Bream Unfertilized

- Bass
- 50 Per Acre
- Stock in June following bream stocking
- Harvest begins 1 year later
- 10 pounds per acre per year

- Bream
- 500 Per Acre
- Stock in November-January
- Harvest begins 1 year later
- 100 pounds per acre per year
Bass/Bream Fertilized

- Bass
  - 100 per acre
  - Stock in June following bream stocking
  - Harvest begins 1 year later
  - 25 pounds per acre per year

- Bream
  - 1000 per acre
  - Stock in November-January before Bass
  - Harvest begins 1 year later
  - 200 pounds per acre per year
Shell Cracker

- Shell Cracker
- Redear Sunfish
  - 20% of bream population can be Redear
  - Adopt a niche off shore
  - Less area of a pond/lake
Coppernose Bluegill

- **NOT** a hybrid
  - a subspecies
- Copper-color band across the head
- Can grow faster
  - With feed supplement
- Native to FL and GA
Bass Types

- Tiger Bass®
- Florida Bass
- Northern Bass
Tiger Bass ®

• Bred for “aggressive and fast growth”
• Cross of Northern Bass strain and Florida Bass
  - Northern Bass strain referred to as Gorilla Bass
Northern Bass “Gorilla Bass”

- “Aggressive” toward artificial lures
- Tolerant of colder waters vs Florida Bass
Florida Bass

- Grow faster after age 2
- Longer lived vs Northern Bass
- Can reach larger sizes
- Can be less aggressive as they get older
  - Particularly toward artificials
  - Some improved success on live bait
Crappie

• Very Popular
• Compete for feed with Bass
• Stocked **ONLY** in ponds with established bass populations
• Stocked only in ponds/lakes 25+ acres
  - Some down to 20 acres
• Very prone to overpopulate and stunt
• **NOT** suitable for small ponds
Fish Population States

• Balanced
  – Reproduction in both bass and bream
  – All size classes of bass and bream present
  – Bass and bream show a good condition index score
Fish Population States

- Bream Crowded
  - Extremely high numbers of 3-5” bluegill
  - NO large bluegill
    • Not enough food to grow to large size
  - Few large bass
    • Large bass in excellent condition
  - Small bass (<14”) in poor condition
    • Bream present too large to be eaten
Fish Population States

- **Bass Crowded**
  - Intermediate bream (3-5”) rare
    - All are eaten by bass
  - Very large bream
    - Reproductive
    - Too large to be eaten by bass
  - Small bream fry abundant
  - Most bass 8-12”
  - Bass have poor or very poor condition score
Fish Population States

- **How do you determine?**
  - Angling Data
  - Balance Checks (best done in June)
  - Electro fishing Data

- **What can be done if there is a problem?**
  - Adjust management plan
    - Harvest abundant species in size range
    - Supplemental stocking
  - Scrap pond and start over
Fish Condition Index

• How do my fish look?
  – With length and weight data
    – \( \log_{10} (\text{Standard Weight}) = \text{Intercept} + \text{Slope} \times \log_{10} (\text{total Length}) \)
  – Values generated
    • 80% + good
    • 60%-80% poor
    • <60% very poor

• If you are interested in a condition profile, we can help
Resources

• Water quality checks can be done by ACES
  – Not currently a charge, but this may change

• Sample prep
  – Rinse bottle (20oz) with screw top closure
  – Submerge in pond
    • Allow air to escape
  – Cap UNDER WATER
    • No air in sample
    • No dirt in sample
    • No plants in sample
  – Mail it in with your name and contact info
Resources on the web

- Alabama Cooperative Extension System
- [www.alearn.info](http://www.alearn.info)

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What is a weed?

- For our purposes:
  - Any plant which
    - Grows in quantities that cause problems
      - Aesthetic
      - Angling
    - Grows in undesired areas
      - Interfering with function of the pond/lake
Do you want plants in your pond?

- Visual appeal
- Provide Oxygen
- Provide food and cover
- Enhance fishing

- Visual eyesore
- Deplete Oxygen
- Provide too much habitat
- Hinder fishing

- Food, feed, & chemical products
- Wastewater treatment
Do you want plants in your pond?

Chop and Drop: Machine chopping water hyacinths
Weed Control

• A few weeds can be healthy
  – Textbook may tell you 20% coverage is good
    • Up to the individual pond/lake owner

• Uncontrolled weeds remove nutrients and make it difficult to establish a phytoplankton bloom
  – Established plants (weeds) much better at taking up nutrients than algae
  – Reduces productivity (numbers of fish) of the pond
Weed Control: When do you start?

- Start with construction
  - Deep edges
- Before it gets out of control
  - If you see a new crop of plants that you are concerned about, don’t wait
- Before fertilization program
  - Fertilization is contraindicated in lakes/ponds with weed problem
Weed Management Essentials

• Pond construction and *watershed mgt.*
  – Know what is in your watershed
    • Pastureland (cattle/crops) Fertilized?
    • Parking lot?
    • New subdivision?
    • Golf Course?
    • Recently cleared land?
  – Does your pond/lake have a buffer strip to slow runoff into?
  – Can you divert water around?
Weed Management Essentials

- Removal of unwanted species
  - Don’t let unwanted species become established
    - Cheaper to treat early
    - Higher success rate with early treatment
  - How do you know if it is an unwanted species?
    - Is it causing problems?
    - Contact your County Extension Office for help
Weed Management Essentials

• Species selection and stocking
  – Not all plants are bad
    • Provide habitat for fish
    • Provide habitat for insects (fish food)
  – When selecting plants research how they grow
    • If you have questions, ASK US, it is why we are here.
Weed Management Essentials

• Liming and fertilization
  – Liming is the first step in pond management
    • Total Alkalinitities less than 20ppm reduce the effectiveness of fertilizer
  – Fertilization prior to a weed problem can prevent a problem
    • A healthy algal bloom (colored tint to water) can block sunlight penetration
    • No Sunlight = no weeds
      – PARTICULARLY important in shallow areas
Fertilizer to Control Reduce Aquatic Plants?

• What is the ponds purpose?
  - Fishing vs Aesthetics
    • Fishing? How heavily?
      - Fertilized fish ponds produce more fish and need more harvest

• What are the goals of the pond owner?
  - Many ways to manage a pond, what is the best fit for you?
Weed Management Essentials

• Restrict livestock access
  - Livestock crush pond sides
    • More shallow water
  - Livestock fertilize ponds
    • Excess nutrients can lead to weed and algae problems
Pond Construction and Aquatic Plant Management

- Slope edges to 3 feet quickly
  - Minimize shallow areas (< 3 feet)
  - Minimizes sunlight penetration
Plant Categories

- Submerged
- Emergent
- Floating
- Algae
Submerged Plants

- Add oxygen to the water
- Serve as nutrient filters and sinks
Emergent Plants

- Provide Shade
- Remove Nutrients

Arrowhead
Floating Plants

- Provide Shade
- Excellent biological and particle filters

The roots of even a small water hyacinth (Eichhornia) can be as much as a foot long.
Algae (filamentous and planktonic)
Ornamental Species

• Some plants can be attractive additions
• Not all plants are legal
  - Hyacinth
  - Water lettuce
  - Parrot Feather
  - Etc.
Control Methods

- Mechanical
- Biological
- Chemical
Mechanical

- Hand pulling
- Rake
- Chains
- Choppers
- Nets
- Drain down
- Dye (Aquashade)
Mechanical
Biological
Using Grass Carp

- 5-8 per acre maintenance
- Up to 50 per acre depending on plant species and pond coverage
- Have a feeding preference and will not work on some plants.
- Some states require triploids
- Work well for about 5 years
- Prevent escapes
## Will Grass Carp Control It?

<table>
<thead>
<tr>
<th>Easily controlled</th>
<th>Species of Plant</th>
<th>Stocking Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hydrilla, elodea, najias, bladderwort, egeria, potomageton</td>
<td>Stock at standard rate. Control is usually within one season except with severe problems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controlled with difficulty</th>
<th>Species of Plant</th>
<th>Stocking Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>watermilfoil (parrot feather, eurasian, watermilfoil, etc.), slender spikerush, duckweed, red ludwigia</td>
<td>Stock at 1 to 2 times standard rate. Control may take more than one season.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Controlled with extreme stocking rates</th>
<th>Species of Plant</th>
<th>Stocking Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>filamentous algae (lyngbya, Pithophora, etc.)</td>
<td>Stock at 25 to 50 per acre.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Not usually controlled with grass carp</th>
<th>Species of Plant</th>
<th>Stocking Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cattails, alligator weed, watermeal, water shield, American lotus, waterlillies, willow, water primrose, water lettuce, water hyacinth</td>
<td>Use other control measures and stock grass carp at standard rates. Grass carp will help prevent other weeds from replacing these, plus they will sometimes suppress growth of even these resistant forms by eating the young shoots.</td>
</tr>
</tbody>
</table>
Figure 3. The spillway barrier should be firmly anchored using steel or creosoted wood posts in concrete.
What about tilapia?

- 15-20 lbs of mixed sex tilapia per acre
- 10-15 lbs of 1-2” fish
- Generally will not survive the winter
  - Can in warm winters
  - Must prevent escapes
- Results Variable
Chemical
Chemical Control

- Water approved chemicals expensive
  - Up to $500+ per acre
- To be approved for use in water, must have an Aquatic Label
  - The Label is the Law
    - Read, Understand and Follow the Labeling instructions
Chemical Control

• Need positive weed identification
  - No chemical treatment is cheap
    • Positive weed identification helps to match weed to an effective chemical
    • Reduce amount needed
    • Reduce mistakes
    • Save time and $$
Chemical Controls

- Band Aid treatment unless root of problem is addressed.
  - If livestock have access...
  - If excessive fertilization...
    - Runoff
    - Direct input
  - If excessive shallow water...
- **Must address source of problem first**
Using Copper Sulfate

- Need to Check Alkalinity
- Copper very toxic in water with low alkalinity
- Rate = $1 \text{ ppm} \times \frac{\text{alkalinity}}{100}$
# Chemical use restrictions

**Table 1. Water-Use Restrictions for Various Herbicides**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Number of Days Restricted After Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fishing</td>
</tr>
<tr>
<td>Copper sulfate</td>
<td>0</td>
</tr>
<tr>
<td>Chelated copper compounds</td>
<td>0</td>
</tr>
<tr>
<td>Diquat</td>
<td>3**</td>
</tr>
<tr>
<td>Endothall</td>
<td>14*</td>
</tr>
<tr>
<td>2,4-D</td>
<td>*</td>
</tr>
<tr>
<td>Fluridone</td>
<td>Not within 1 mile</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Not within ½ mile of intake</td>
</tr>
</tbody>
</table>

*Varies with formulation and rate used; read label.
**Restricted for some plants; read label.
***Irrigation of food crops—5 days.
### Table 3. Response of Common Aquatic Weeds to Herbicides

<table>
<thead>
<tr>
<th>Aquatic Group and Weed</th>
<th>Copper Sulfate Complexes (various)</th>
<th>2, 4-D (various)</th>
<th>Diquat (various)</th>
<th>Endothall (various)</th>
<th>Fluridone (various)</th>
<th>Glyphosate (various)</th>
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<tbody>
<tr>
<td><strong>Algae</strong></td>
<td></td>
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<tr>
<td>Planktonic</td>
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<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Filamentous</td>
<td>E</td>
<td>P</td>
<td>G</td>
<td>G</td>
<td>P</td>
<td>P</td>
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<tr>
<td>Chara</td>
<td>E</td>
<td>P</td>
<td>G</td>
<td>G</td>
<td>P</td>
<td>P</td>
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<tr>
<td>Nitella</td>
<td>E</td>
<td>P</td>
<td>G</td>
<td>G</td>
<td>P</td>
<td>P</td>
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<tr>
<td><strong>Floating Weeds</strong></td>
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<tr>
<td>Watermeal</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>F-G</td>
<td>P</td>
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<tr>
<td>Duckweeds</td>
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<td>G</td>
<td>G</td>
<td>P</td>
<td>E</td>
<td>P</td>
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<td>Water hyacinth</td>
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<td>E</td>
<td>P</td>
<td>P</td>
<td>E</td>
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<td><strong>Emerged Weeds</strong></td>
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<td>Alligatorweed</td>
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<td>P</td>
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<tr>
<td>American lotus</td>
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<td>E</td>
<td>P</td>
<td>P</td>
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<td>G</td>
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<td>Arrowhead</td>
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<td>E</td>
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</table>
So you have a plant you aren’t sure of…

- Submit a weed sample
  - Clean weed sample
    - Flowers, roots, stems
  - Wrap in damp paper towel
  - Place in zip-top bag
  - Mail to specialist for ID
  - INCLUDE YOUR CONTACT INFO