AQUATIC HABITAT MANAGEMENT ON PRIVATE LAND

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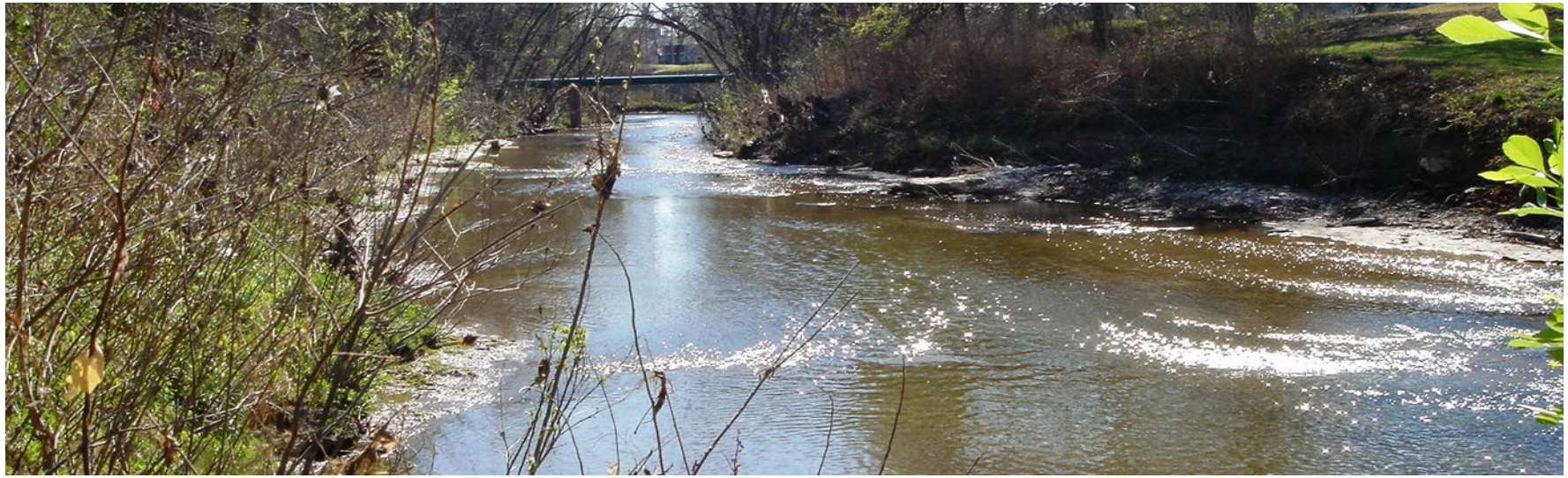
Lotic Systems

- **Rainfall in watershed ↑ flow in stream**
- **High flow velocities**
- **Flowing waters transports nutrients, sediments, & aquatic organisms**
- **Aquatic organisms living in lotic environments must…**



Poll Question!

What is the average life span of a pond?

a) 10-50 years

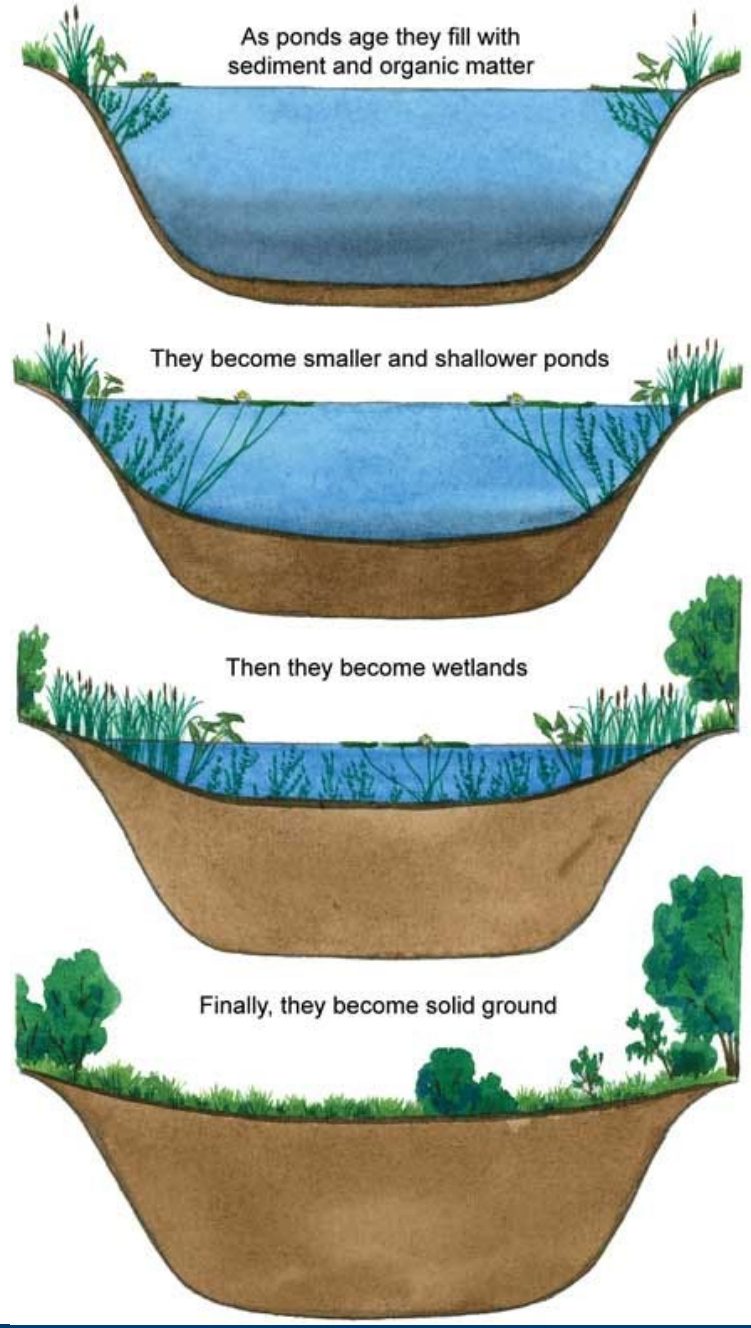
b) 25-100 years

c) 50-200 years

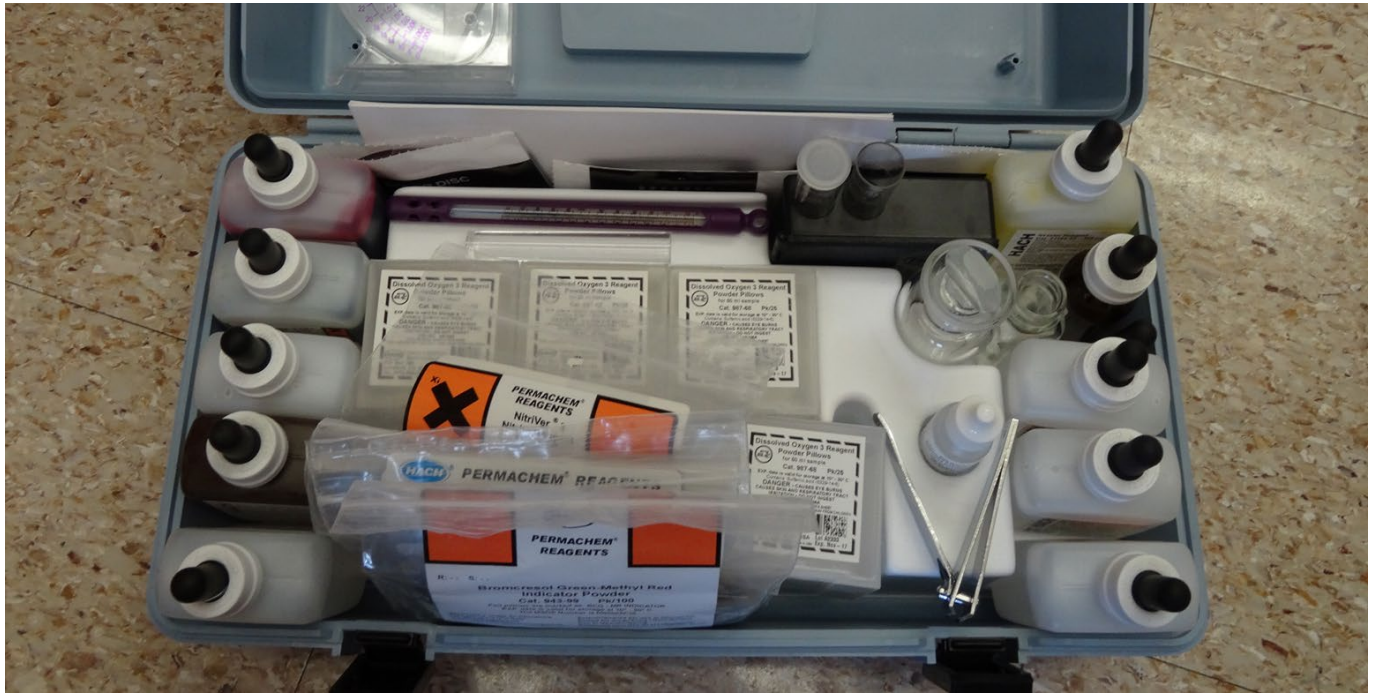
d) None of the above

Lentic Systems

- Systems overflow from precipitation
- Lentic systems accumulate nutrients & sediment over time
- Become shallower from edges inward
- Expected life of pond only 25 - 100 years
- Watershed characteristics determine life of water body



Missouri Department of Conservation



WATER CHEMISTRY

TEXAS A&M AGRILIFE EXTENSION

Water Quality (A&M Labs)

For Fisheries

For Livestock/Irrigation

Dissolved Oxygen

- D.O. single most important water quality factor
- Water obtains O2 from 2 sources
  - Photosynthesis by aquatic plants & algae
  - Atmospheric O2 diffuses into water from air

Dissolved Oxygen

- O2 dissolves in water at very low concentrations
- D.O. < 3 ppm stresses most warmwater species
- D.O. < 2 ppm for prolonged periods kills many species & larger fish
- Many fish stressed by low D.O. also become more susceptible to diseases

Dissolved Oxygen

- Microscopic algae (phytoplankton) primary source of O2 in lentic systems
- Submerged rooted plants produce O2, but not high quantity like phytoplankton
- In sunlight algae & submerged plants produce O2 through photosynthesis & expel O2 into water

Dissolved Oxygen

- At night, no O2 produced from photosynthesis
- Algae, higher plants, fish, & decomposers consume O2 for respiration
  - Many AV species are considered net consumers
- D.O. cycles up & down daily with photosynthesis & respiration
- More oxygen produced by photosynthesis than removed by respiration under normal conditions

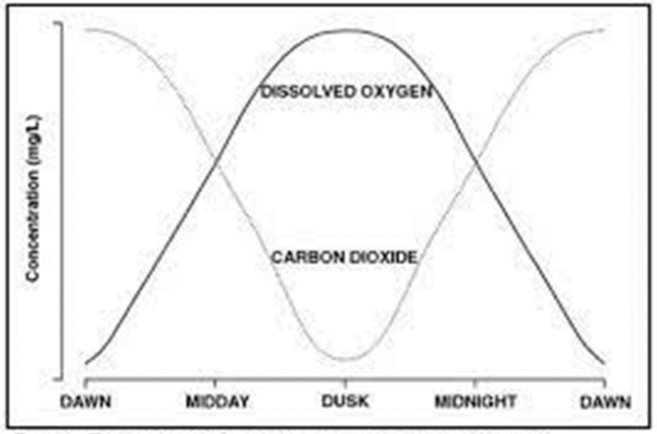
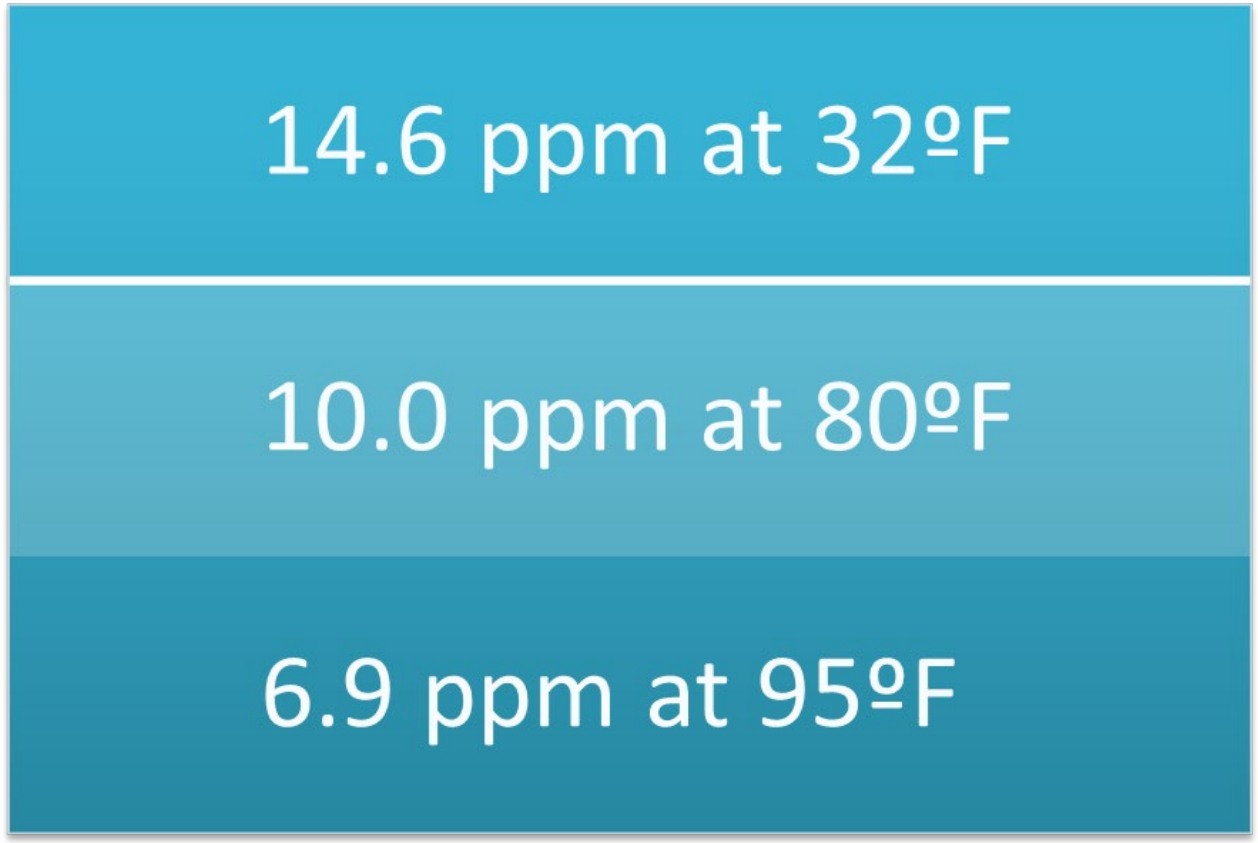


Figure 1. The daily cycle of oxygen and carbon dioxide in a fish pond.



Dissolved Oxygen

- Cold water holds more O2 than warm water
- As temp ↑, less O2 will dissolve & is present in water

Dissolved Oxygen

1. Too many pounds of fish (biomass) present

2. Season-summer higher water temps capable of holding less O_2

3. Extremely high oxygen demands due to high nighttime respiration

Caused by dense algal blooms or dense stands of submerged vegetation plus fish & waste decomposition

4. Excessive decomposition from algae bloom or plant die-offs

Sometimes associated with aquatic weed control efforts

5. Turn-overs due to rapid temp & weather changes such as rain and cold air

6. Reduced O_2 from photosynthesis

Due to reduced sunlight from cloud cover, fog, or haze

7. Lack of agitation from wind/waves

Total Alkalinity

- Alkalinity is capacity of water to neutralize acid
- Important in order to maintain a stable pH
- Rapid or large pH shifts stress fish & can cause death in some circumstances.
- Alkalinity, if sufficient, reduces rapid pH changes
- Primarily productivity becomes limited when alkalinity falls below 30 mg/L
- Implications for algaecide/herbicide

- Desired Range: 50 to 150 mg/L
- Acceptable Range: Greater than 20 mg/L
- Greater than 400 mg/L may become detrimental

Total Alkalinity

- If alkalinity is too low:
  - Add crushed ag lime (calcium carbonate) to raise alkalinity
  - Alkalinity in ponds naturally decreases
  - Benefit from addition of lime every 5-7 years to maximize pond's fishery
  - Some ponds need limed more frequently
- If alkalinity is too high, but hardness acceptable or low:
  - Add gypsum (calcium sulfate)
  - Precipitates excess bicarbonate as calcium carbonate (limestone) thus lower alkalinity

INTRODUCTION

Adding crushed agricultural limestone (calcium carbonate), or "liming," is a relatively inexpensive, well-known, and highly discussed management practice to enhance crop productivity in both acidic soil and water. Similar to vegetable crops, fish crops may also need to have their water fertilized to improve primary food production from the pond and stabilize water chemistry.

The soil type and associated soil chemistry within a pond system and surrounding ecosystem strongly influence the overall water chemistry found in an established pond. Most ponds on the eastern side of Texas are located in regions containing acidic soils. In this region, common soil types are various combinations of loam containing sand, silt, and clay particles, with added clay to seal the pond when necessary. This composition, combined with the acidic soils in the watershed, leaves ponds slightly acidic and typically needing a liming product on a regular basis—generally, every 2 to 5 years, depending on soil type and pH. Central and western areas of Texas commonly have limestone bedrock, which is basic on the pH scale, and ponds in these regions less commonly need to be limed.

Liming directly increases alkalinity, and the total concentration of bases is usually made up of bicarbonate and carbonate. Alkalinity concentrations are important in any fishery because they indicate the water's ability to neutralize acid and stabilize pH.

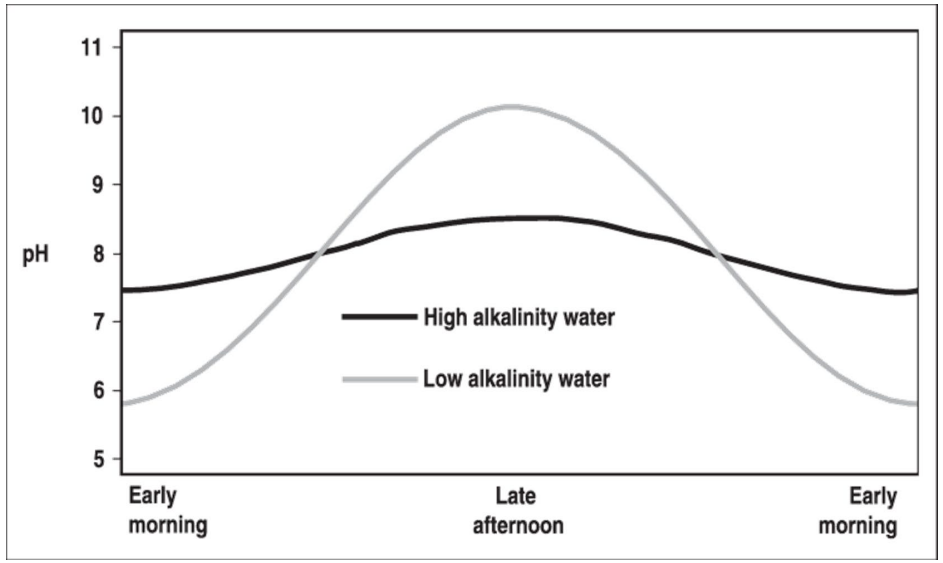
Figure 1. The green color of this pond indicates high primary productivity, which is a measure of planktonic algae production that forms the basis of a pond's food chain. Adequate alkalinity of greater than 30 ppm is required to maintain good primary productivity.
Photo courtesy of Bob Lusk, www.pondboss.com.

falls below 30 parts p
only is alkalinity impo
phytoplankton (micro
photosynthesis, it als
during fertilization pr
with food and subseq

The desired alkalinity
ppm and a pH of 6.5 t

pH

- pH changes in body of water during a 24-hour cycle
- Alkalinity & pH strongly linked, but pH not measure of alkalinity & alkalinity not indication of pH
- Water pH can be modified by adding lime, gypsum, alum, or bicarbonate



Poll Question!

What is the #1 cause of fish kills in ponds?

a) Dissolved oxygen

b) Herbicides

c) Acidic water

d) None of the above

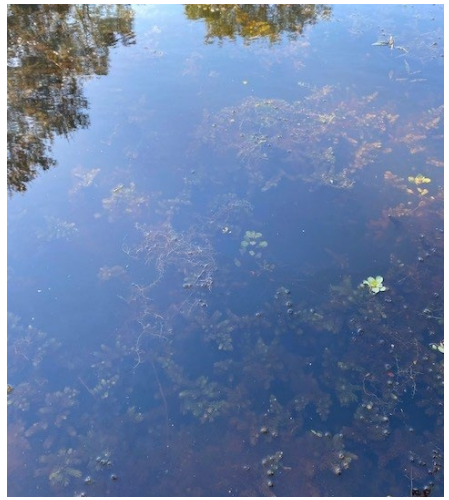
AQUATIC VEGETATION

Can range from microscopic to large stemmed plants with bright, showy flowers

TEXAS A&M AGRILIFE EXTENSION

IDENTIFICATION

Algae	• primitive, non-seed bearing plants & no roots, stems, or true leaves
Floating	• all parts of plant floats (including roots)
Submerged	• mostly underwater, rooted with flaccid (limp) stems
Emergent	• rooted with stiff or rigid stems with all or parts standing above surface



What Causes Aquatic Vegetation Issues?

- Excess nutrients
- Increased water clarity
- Adaptive reproduction
- Introductions

Reasons for Management

Ecological Effects

- Degrade water quality
- Reduce species diversity
- Suppress desirable native plants
- Alter animal community interaction
- Increase detritus build up
- Change sediment chemistry
- Increases evapotranspiration

Degrade Water Quality

- #1 cause of low dissolved oxygen fish kills in ponds
  - Vascular plants do not have net gain
    - Respiration by living plants at night, overcast conditions, rain, etc. decreases DO
    - Decomposition also decreases DO
      - When AV dies off in the water column, it requires beneficial bacteria to help it break down during the decomposition process, which also requires oxygen
      - Consideration for management*
  - Phytoplankton- blooms can be too dense (water clarity <12")
    - Population exceeds carrying capacity, not enough DO to support life
    - Large amounts die off all at once
- Change in pH
  - pH increases during day
    - Carbon dioxide removed by plants for photosynthesis
    - Oxygen produced by plants bonds with free H+ to form water
  - pH decreases at night
    - Carbon dioxide from respiration reacts with water to form carbonic acid (releases H+)
- Precipitate calcium carbonate- *Chara* ("stoneworts")
  - heavily calcified-more than 50% (as $CaCO_3$) of the total plant biomass dry weight (Królikowska, 1997)
- Cyanobacteria- Produce toxins

AUSTIN

Austin begins blue-green algae treatments in Lady Bird Lake

by: Billy Gates
Posted: Jun 13, 2022 / 04:01 PM CDT
Updated: Jun 13, 2022 / 07:14 PM CDT

SHARE

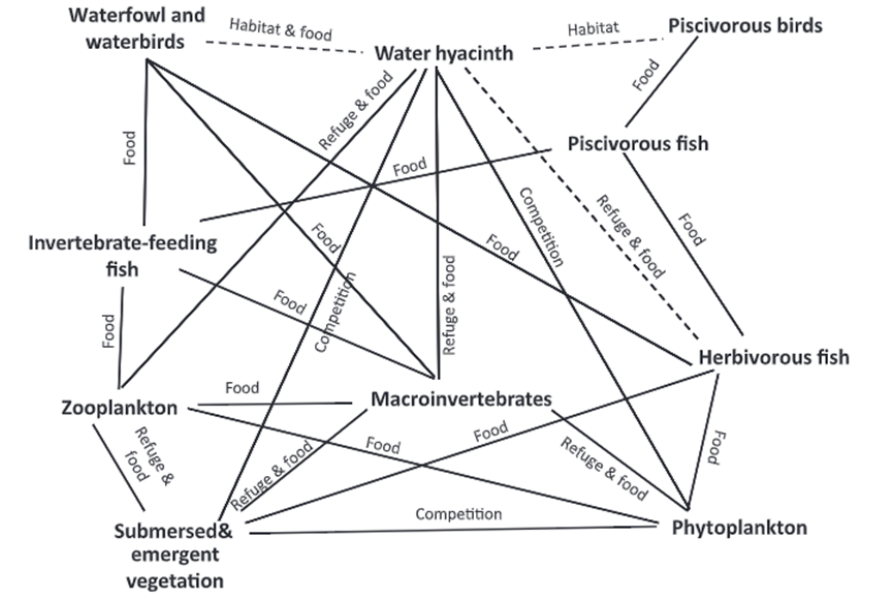
AUSTIN (KXAN) — Austin's Watershed Protection Department sent crews Sunday to treat toxic blue-green algae blooms after an area tested positive June 9.

They'll be out there Monday and Tuesday as well, using a chemical called Phoslo to bind phosphorus — a key nutrient for algae blooms — so the plants can't use i positive test was for an area around Red Bud Isle, but the blooms that secrete th can kill animals have been found throughout Lady Bird Lake and Lake Austin in t

TEXAS A&M AGRILIFE EXTENSION

Alter Animal Community Interaction

- Dense stands can cause increase high numbers of fish but…
  - Small fish that rarely become large adults
- Inverse relationship between plant abundance and bass growth
  - Dense plant communities inhibit the feeding efficiency of insectivorous fishes
  - Lowest average weight of fish caught during LMB fishing tournaments occurred during peak macrophyte coverage (Maceina and Reeves 1996)



Villamagna, A.M. & B.R. Murphy. 2010. Ecological and socio-economic impacts of invasive water hyacinth (Eichhornia crassipes): a review. Freshwater Biology 55,282–298. doi:10.1111/j.1365-2427.2009.02294.x

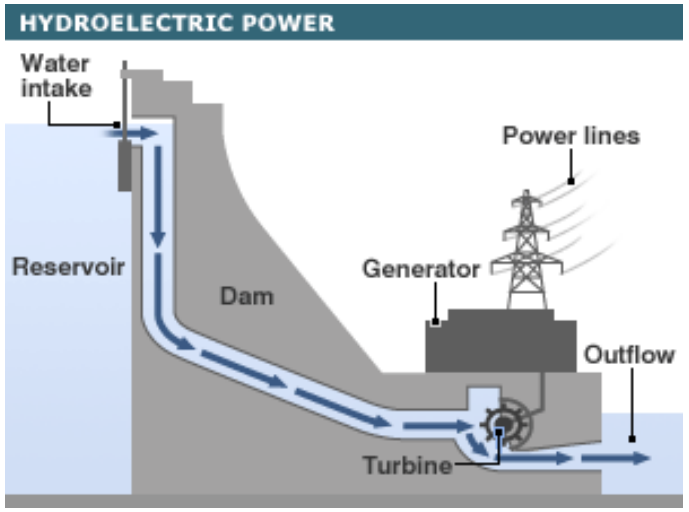
Reasons for Management

Economic Impacts

- Impair commercial navigation
- Disrupt hydropower generation
- Increase flood frequency, duration and intensity
- Impair drinking water (taste & odor)
- Habitat for insect-borne disease vectors
- Recreational navigation impairment
- Interfere with safe swimming
- Interfere with fishing
- Reduce property value
- Increase drowning risk

Disrupt Hydropower Generation

- Reduce flow
- Clog water control structures
  - Dam
  - Intake
- In 1991, hydrilla blocked the intakes on a hydroelectric facility in Lake SC
  - Forced the shutdown of the dam
  - Loss of $4 million in power generation
  - $1.2 million for emergency treatment



Navigation Impairment

- Commercial* and recreational
- *Economic incentive that started AV management efforts in the US
  - River and Harbor Act of 1899
    - USACE to remove water hyacinth
  - Expanded Project for Aquatic Plant Control (1959)
    - Introduction of alligator weed and other spp. put pressure on this
  - Aquatic Plant Control Research Program (1975)
  - Center for Aquatic Plant Research and Technology (1993)
  - Led to MANY advances in AV knowledge and management

TEXAS A&M AGRILIFE EXTENSION

THE MONTHLY BULLETIN. 77

SW 343

WATER HYACINTH.

A Menace to Navigation in the South.

By ETHELBERT JOHNSON,' Sacramento, California.

Florists in southern California offer for sale a beautiful aquatic plant called water hyacinth, *Eichhornia crassipes* Solms. This plant, so highly prized in aquaria, and its near relatives, the pickerel weeds, have come into ill repute among navigators in tropical and subtropical waters, and more especially in the Gulf States, where the enormous sums expended in clearing streams of this pest have earned it the name

Reduce Property Value

- Reduced tourism = reduced buyers
- Tied closely to recreation impacts
  - Scenic views
  - Fishing quality
- In WI lakes experienced a 13% decrease in land values after milfoil invasion

Interfere with Recreation

- Access issues
- Swimming
  - Increased drowning risk
    - Mats get tangled like strands of a rope, swimmers panic
    - Thrashing can cause suspended sediments making it hard to know which way is up/down
- Fishing & hunting
  - Tied to ecological effects
  - Snagged lines
- Boating

KMPH

Two dead in drowning in Avocado Lake in Fresno County

"The subjects were in the water swimming and then went under. Avocado Lake has plant life in it called Hydrilla that can tangle you up and if...

Jun 5, 2022

Union-Recorder

Officials field questions on hydrilla concerns | News ...

"Generally, water level fluctuations at Lake Sinclair don't have much effect on the amount of hydrilla present in the lake," Kraft said, based...

May 10, 2022

KVUE

City addresses hydrilla concerns after man drowns in a Central Texas lake

There has been speculation that hydrilla -- an invasive plant species found in Lake Pflugerville -- may have caused the man to drown.

May 23, 2018

Poll Question!

True or False:
All aquatic vegetation is problematic and should be managed accordingly.

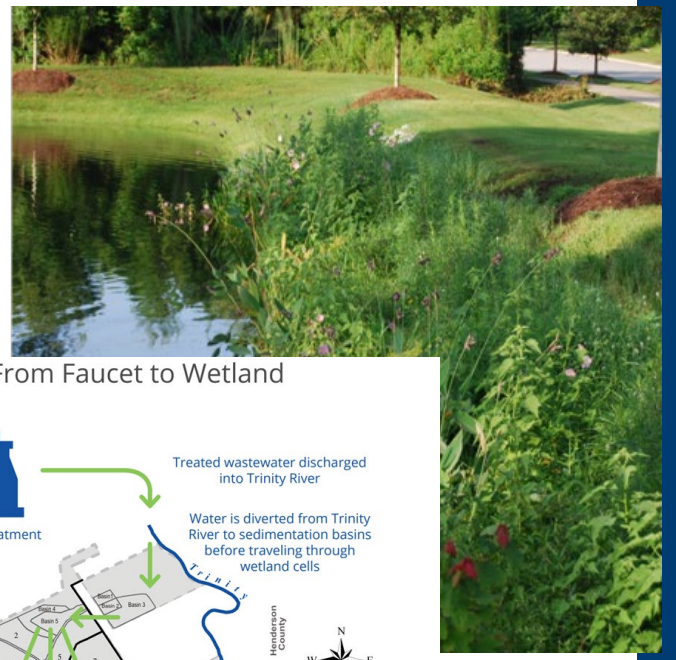
Benefits

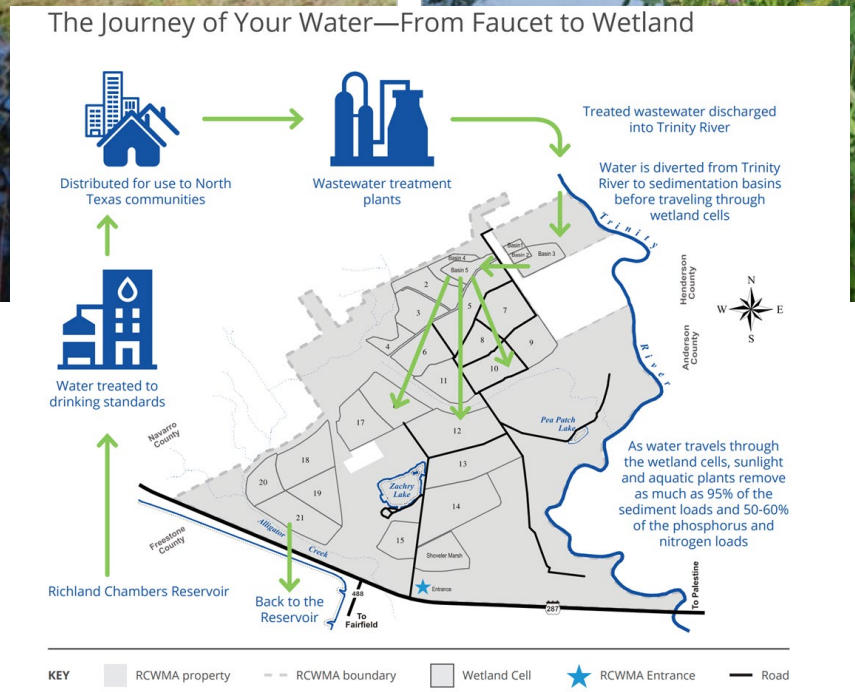
In Moderation

- Increase water clarity
- Limit erosion
- Provide food to waterfowl
- Enhance aesthetics
- Create buffer for run-off nutrients
- Oxygen production

Creates Buffer for Run-off

- Slow down water
- Absorbs nutrients and filters pollutants from runoff
- Limits erosion
- Increases water clarity
  - Prevent hypereutrophic conditions
  - Reduce re-suspension of sediments
- Daniels and Gilliam (1996) found that over a range of rainfall events, the buffer reduced sediment loads by 60-90%, runoff loads by 50-80%, and total phosphorus loads by 50%



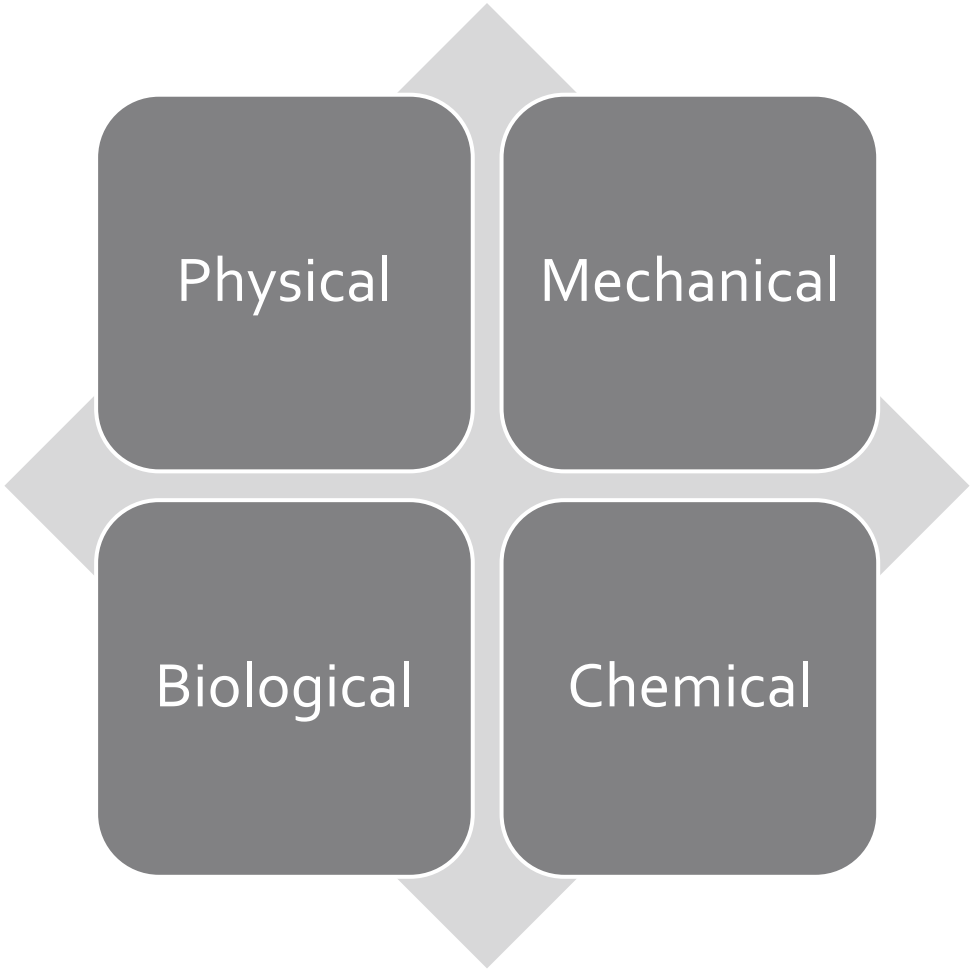


What Does “Management” entail?

Control

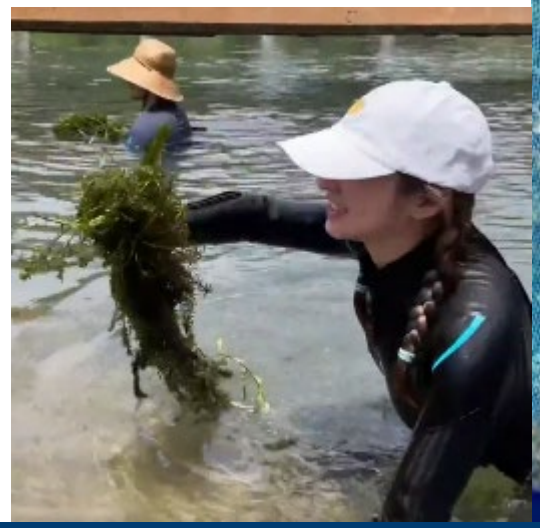
Restoration

Control



PHYSICAL/CULTURAL CONTROL

- **Alter the environment/attitudes rather than direct control**
  - Cultural control focuses on education and preventing introductions
    - Public awareness: Boat ramp monitoring and wash stations
  - Physical control focuses on non-chemical, non-motorized techniques



MECHANICAL CONTROL

- **Direct control using large power-driven equipment**
- **Shredder and cutter boats**
  - Used in early AV management in US along navigable waters by USACE
  - Can create many fragments
  - **$$**

BIOLOGICAL CONTROL

- **Using one organism to control another**
  - Insects, herbivorous fish
- **Insects not commercially available**
  - Best used as an IPM strategy
- **No silver bullet**

Triploid Grass Carp
TPWD permit
Effective control for 5-7 years
7- 15 per acre recommended Max 10/permit 36 months to stock
Hydrilla Bushy pondweed American pondweed Illinois pondweed

BIOLOGICAL CONTROL

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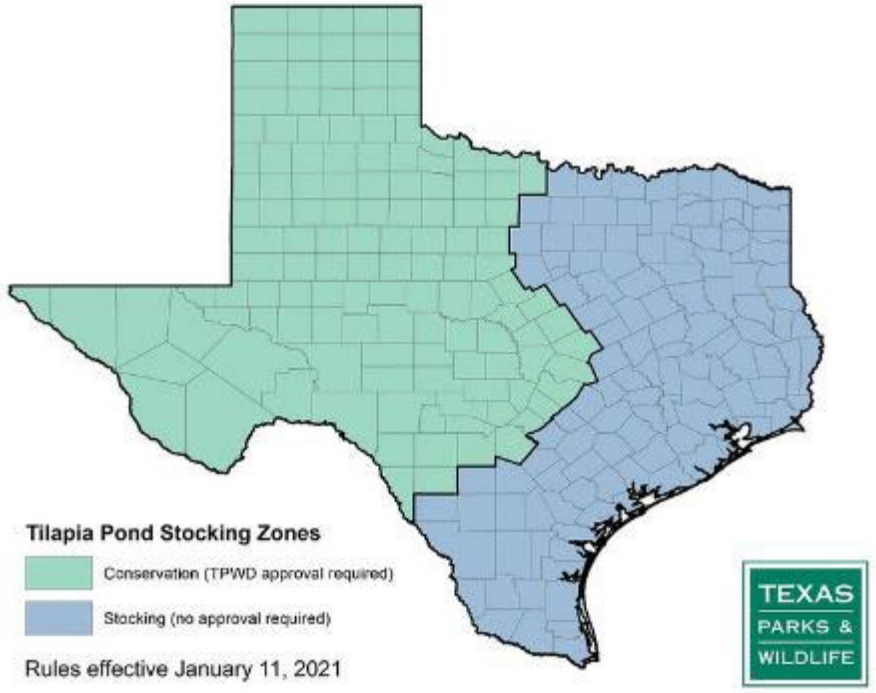
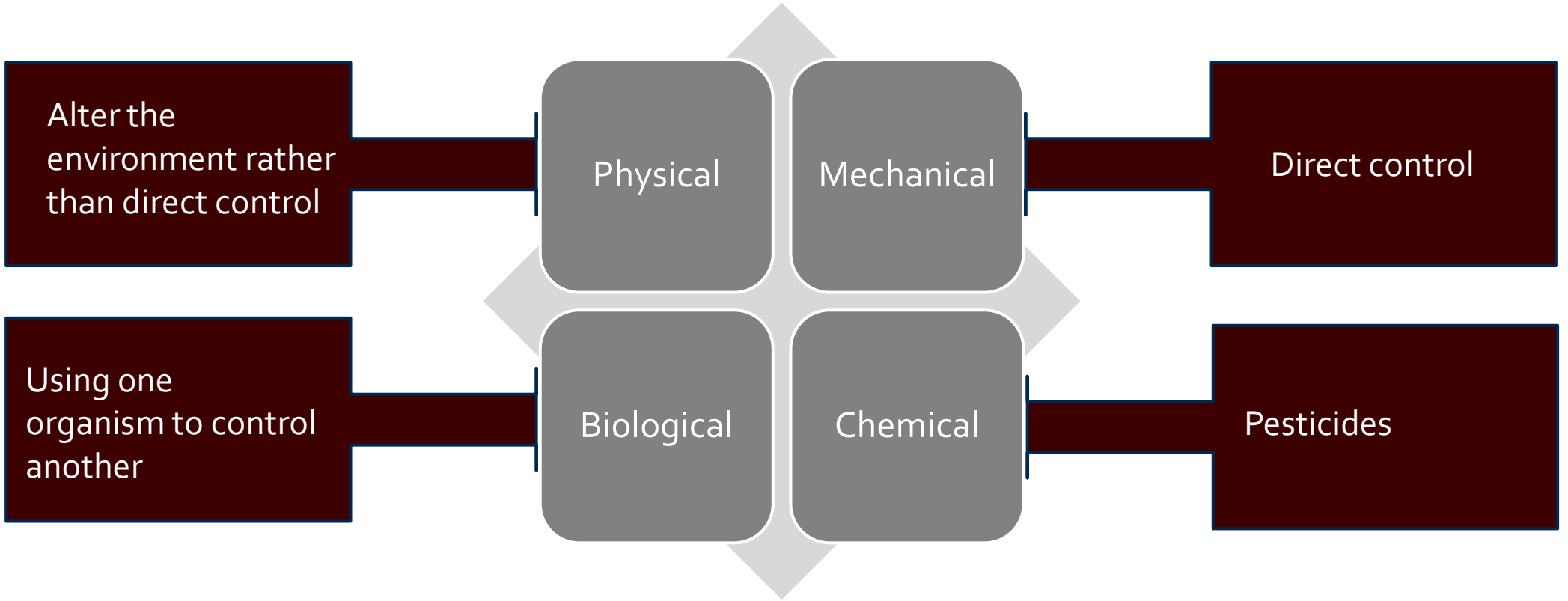
Triploid Grass Carp	Mozambique Tilapia
TPWD permit	Look for your zone
Effective control for 5-7 years	Stock yearly (die off when water temperature < 55°F)
7- 15 per acre recommended Max 10/permit 36 months to stock	15-20 lbs. mixed sex recommended
Hydrilla Bushy pondweed American pondweed Illinois pondweed	Filamentous algae Duckweed Azolla

MOZAMBIQUE TILAPIA: REGULATIONS



- TPWD has identified two management zones
- TPWD approval of stocking required in "conservation zone"
  - Specific to pond
  - Transferrable with property sale
  - Invalidated if pond modified in a way that increases escape risk
- **Unlawful for tilapia stocked in private ponds to escape anywhere**

Control


Alter the environment rather than direct control
Using one organism to control another
Physical
Mechanical
Biological
Chemical
Direct control
Pesticides

Poll Question!

True or False:
Pesticides must have a special aquatic label to use in aquatic environments.

Chemical Control

- **Using pesticides to control nuisance species**
  - **Herbicides and algaecides**
- Must be labelled for aquatic use to use in or around water

Aquatic Vegetation Management: Unique Considerations

- Water volume
- Water depth
- Water flow
- Legality

Resources

Upcoming Webinars

3/19: Algae ID & Control
4/16: Fish Management Strategies
5/21: ID & Control of Submerged Aquatic Vegetation
6/18: Diagnosing Fish Kills
7/23: Cyanobacteria: Concerns & Management
8/20: Liming & Clearing Ponds
9/17: Controlling Emergent Vegetation
10/15: Pond Management Myths

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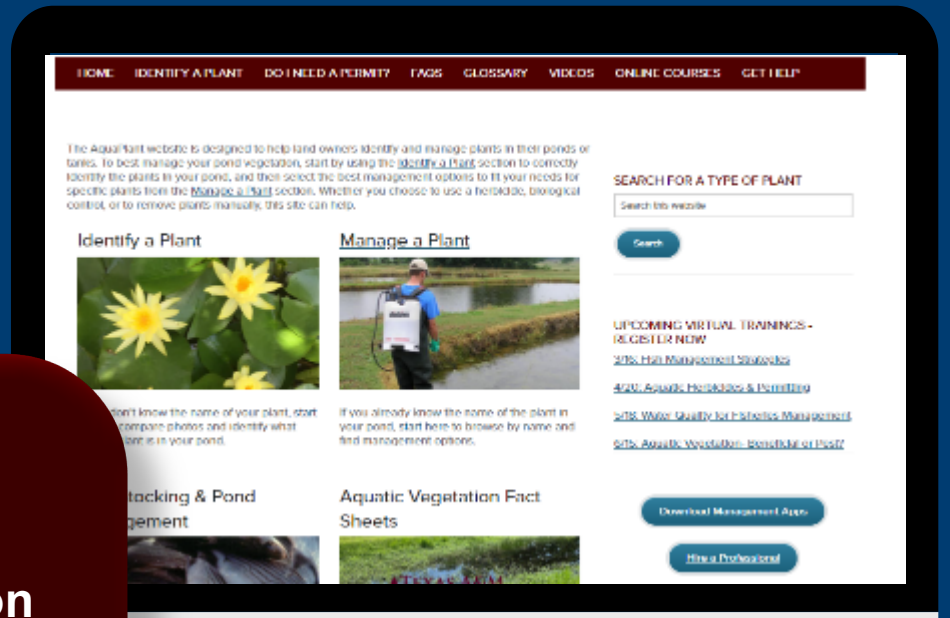

https://aquaplant.tamu.edu/