Restoration Techniques: Vegetative Restoration of Aquatic Ecosystems

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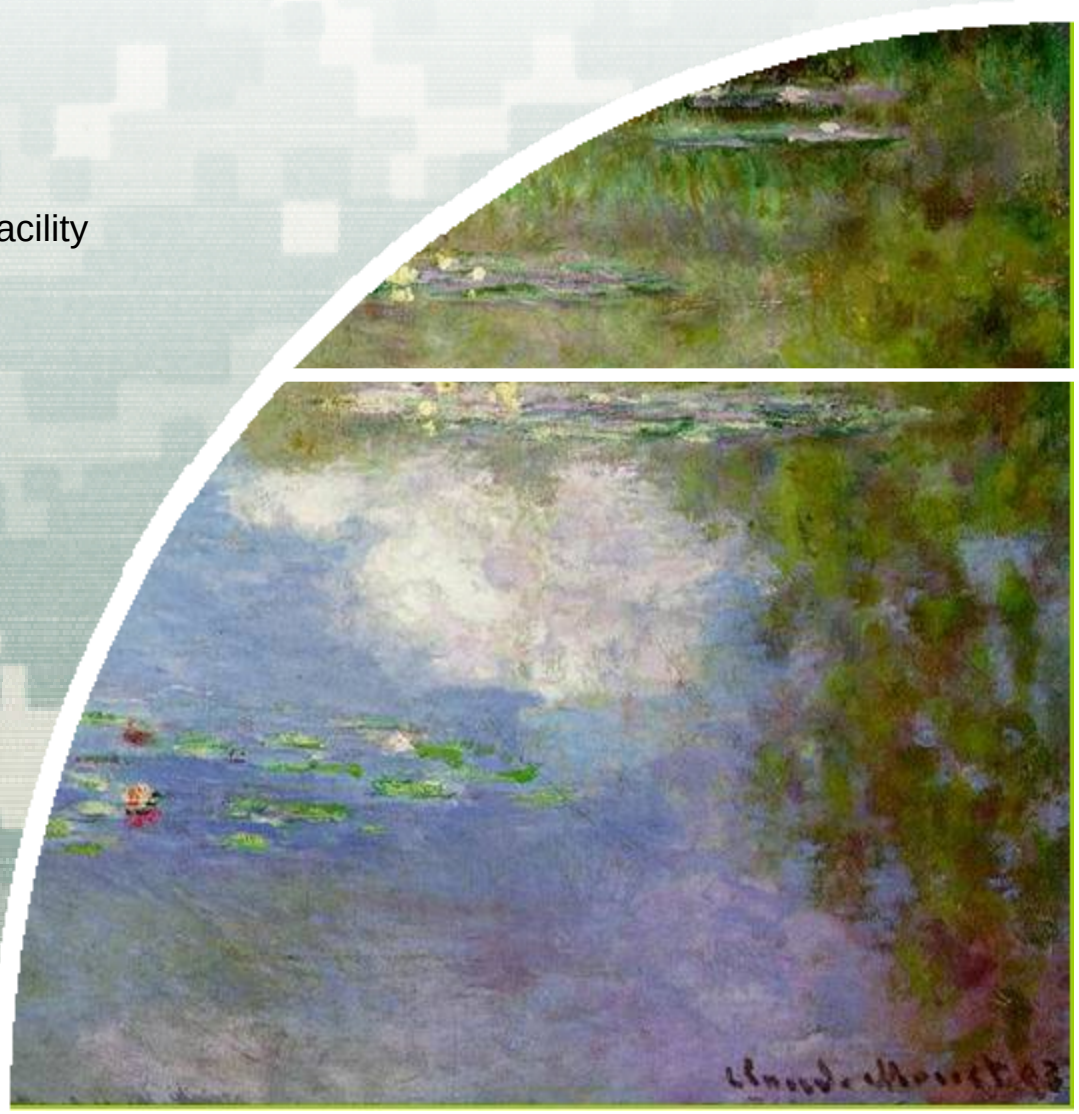

US Army Corps of Engineers

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The Problem

The Corps is the Nation's largest provider of water resources

Man-made systems do not come equipped with aquatic plant communities

Flooded terrestrial systems

- **Ecologically young**
- **Remote from sources of propagules**

Natural establishment can be slow to occur

Major obstacles to natural establishment

Lack of propagules

Adverse environmental conditions

- **Water quality (turbidity, eutrophication)**
- **Water level fluctuations**

Herbivory

- ***Introduced* common carp, nutria, grass carp**
- **Turtles, crayfish, beaver, terrestrial herbivores (cattle, deer, hogs)**

In the past, we have built dams, not reservoir ecosystems

If we want diverse native plant communities, and the benefits that these provide …

in many cases we will have to plant them

Other situations arise that require aquatic plant establishment

Many natural systems have lost their vegetation due to chronic disturbance

Shoreline erosion

Loss and replacement of littoral vegetation by chronic algal blooms

Mitigation of unavoidable wetland losses also requires vegetative restoration

Wetland mitigation planting

Plants are critical for aquatic ecosystem function

"Restored" plant communities will provide an abundance of environmental benefits

- **Improve habitat and water quality, clarity**
- **Stabilize sediments and protect shorelines**
- **Remove pollutants**
- **Absorb excess nutrients**
- **Improve aesthetics**
- **Deter the growth of nuisance algal blooms and invasive aquatic plants**

***Inaction** may result in poor ecosystem health and unwanted consequences..a common occurrence in U.S. waters is…*

Weedy exotic species arrive first and grow to excess – pre-empting later arriving plants

Exotic species may cause navigation, flood control, and recreational use issues

Exotic species also pose serious ecological threats

The good (native plants) vs. the bad (exotic plants)

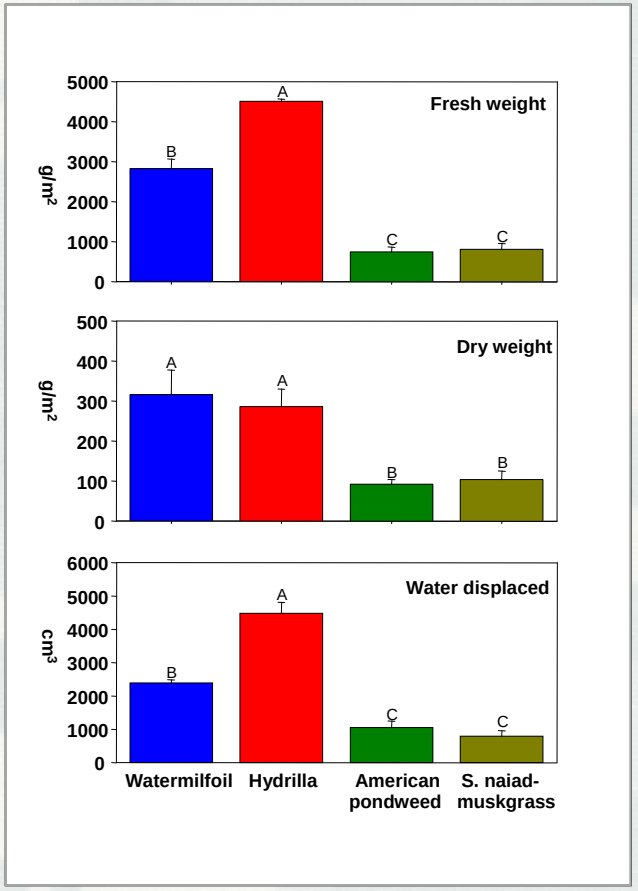
Most native species are desirable components of aquatic ecosystems

- **Examples: Pondweeds, naiads**
- ***Biomass distributed evenly***
- **Natural checks and balances**
- **Provide benefits previously listed**

Many exotic species are weedy and problematic

- **Examples: Hydrilla, Eurasian watermilfoil**
- ***Biomass concentrated at the surface***
- **No natural checks and balances**
- **Negate some benefits previously mentioned**

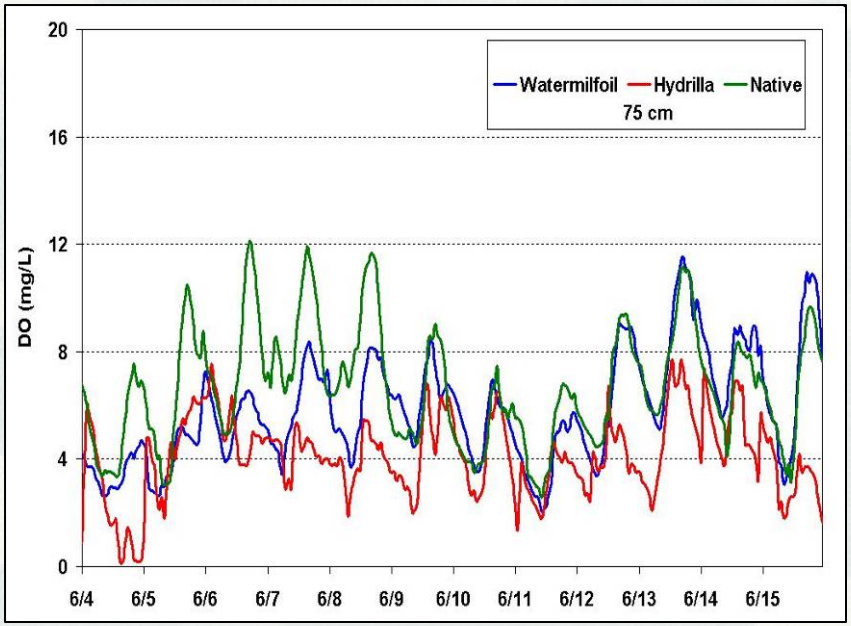
Canopy development by exotics is a major factor



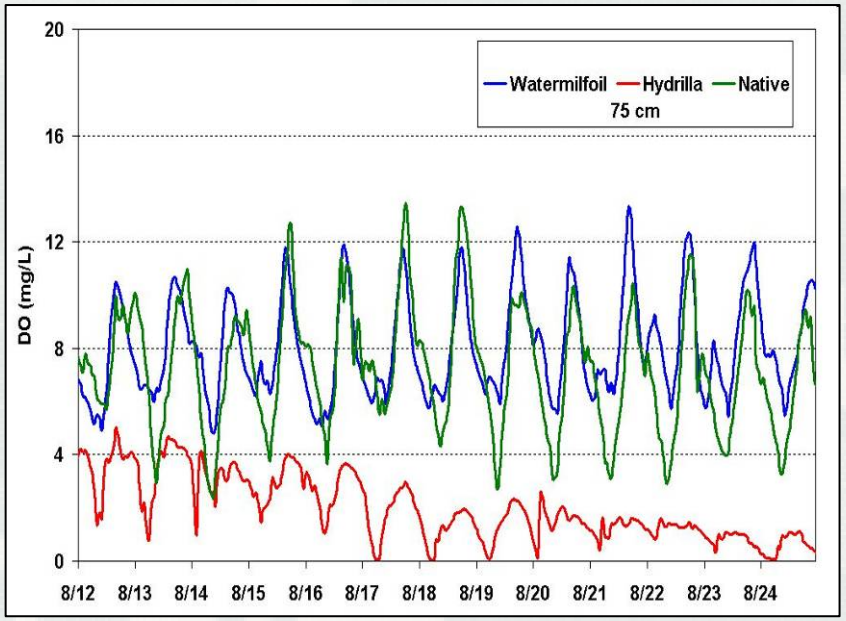
Excessive biomass (e.g. high stem densities) also causes problems

Native plants vs. exotic plants

Example: In a pond study, water quality (especially dissolved oxygen) declined with canopy development by hydrilla



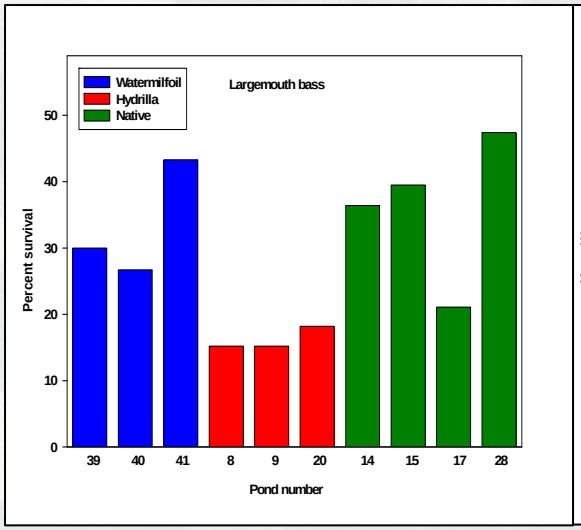
June---vegetation has just reached surface



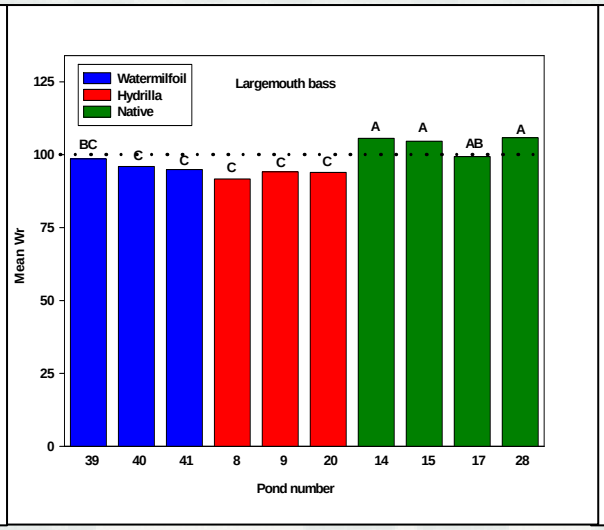
August---two+ months of canopy development

Native plants vs. exotic plants

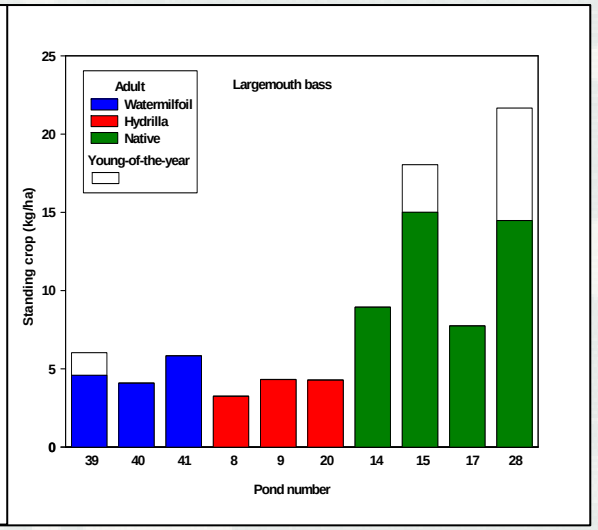
Example: Declining water quality & other factors (excessive cover) impaired largemouth bass fishery development in exotic species-dominated ponds



Survival



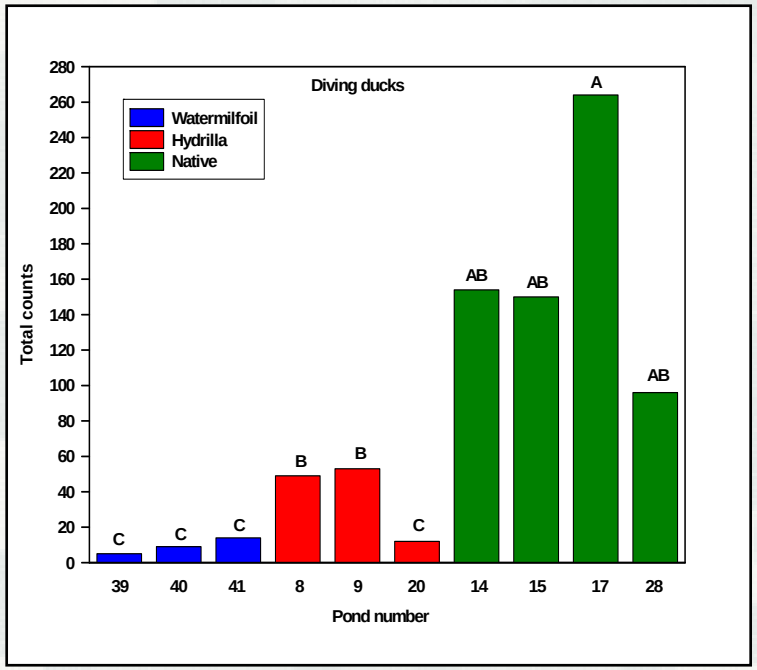
Condition



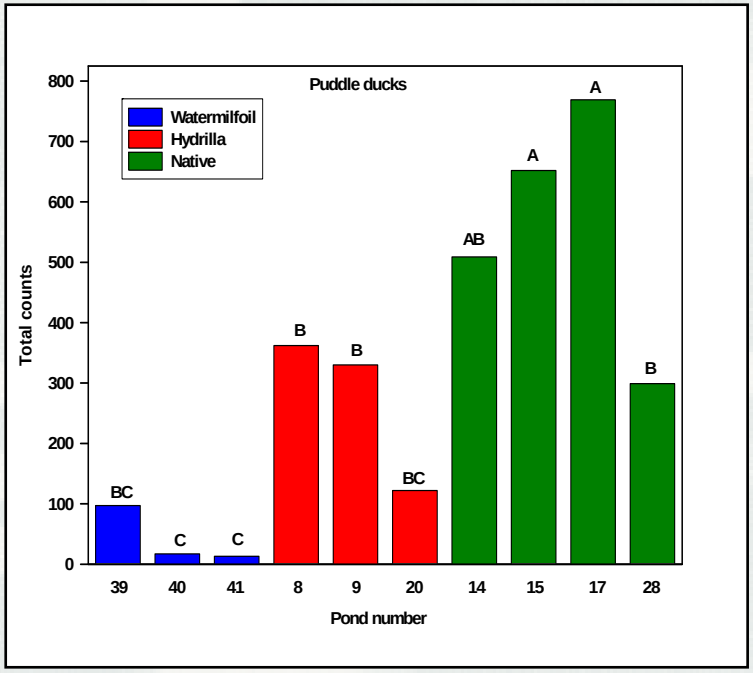
Productivity

Native plants vs. exotic plants

Example: Vegetation is important to more than just fish…



When presented a choice, most duck species and individuals preferred native ponds; many shunned hydrilla and Eurasian watermilfoil ponds



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Restoring/establishing native aquatic plants

In summary…

- **Many situations arise in which efforts to establish plants is needed to appropriately manage an aquatic ecosystem**

- **In addition to establishing native plants in systems devoid of vegetation, incorporating native plant establishment in systems managed for nuisance plants must be considered**

- **No aquatic plants (in most systems) is unacceptable**

But, how do you restore (or establish) native aquatic vegetation?

Under the Corps' Aquatic Plant Control Research Program (APCRP)

Developing ecological approaches to aquatic plant management

- **Integrated chemical, biological, mechanical, and restoration**

Numerous aquatic vegetation restoration projects

- **Sections 1135/206**
- **Specifically authorized projects**
- **"Work for Others"**

EMRRP Guidance Tech Note

- **"Propagation and Establishment of Native Plants for Aquatic Ecosystem Management" (Dick, Smart & Dodd 2010)**

Lewisville Aquatic Ecosystem Research Facility (LAERF)
Lewisville, Texas

Native vegetation establishment approaches

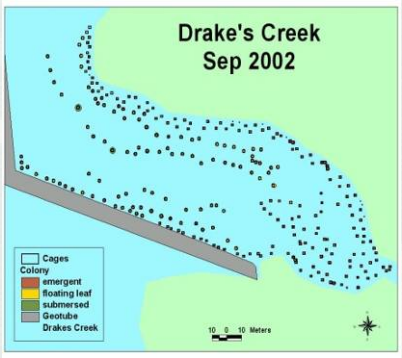
Build it and they will come

- •Self-design (inaction)
- •Natural establishment may take years
- •Exotics usually win the race

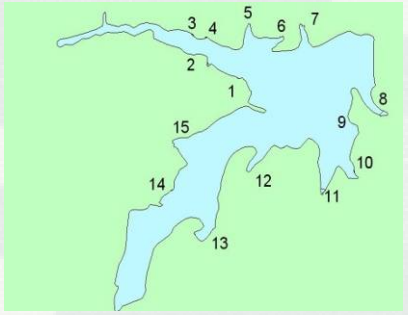
Active Management---Planting where plants are needed

- •Full-scale planting
  - •Suitable for small systems
  - •Logistically and fiscally impractical in larger systems
- •Founder colonies…
  - •The approach of choice for large systems

14 acres: full-scale



1,800 acres: founder colonies

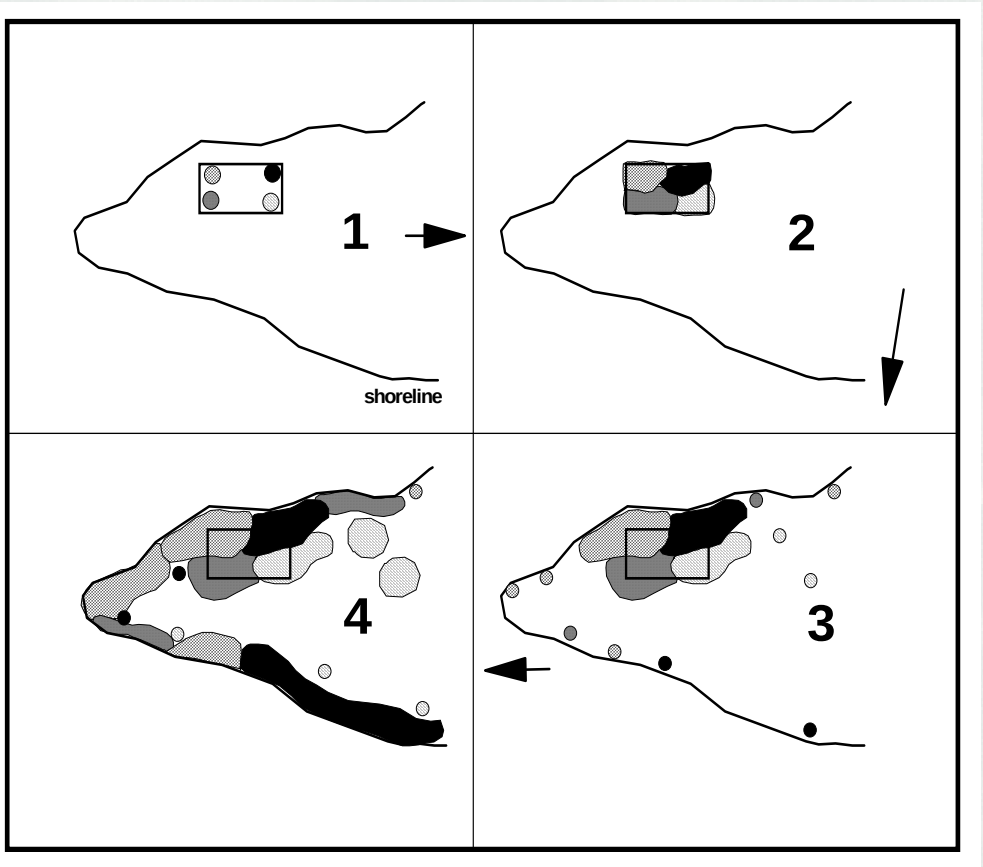


Founder colony approach

- Select sites most suitable for aquatic plant establishment
  - Backs of coves
  - Soft substrates
  - Shallow, gradual slopes
- Conduct intense plantings
- Monitor and maintain sites
- Established founder colonies will produce propagules for natural spread
- Founder colonies provide small-scale but immediate local benefits
- Techniques for establishing founder colonies are applicable to small-scale projects (full-scale planting)

Founder colony approach

In theory…



Lake LBJ, TX

Drakes Creek, TN

Waco Lake, TX

Founder colony approach

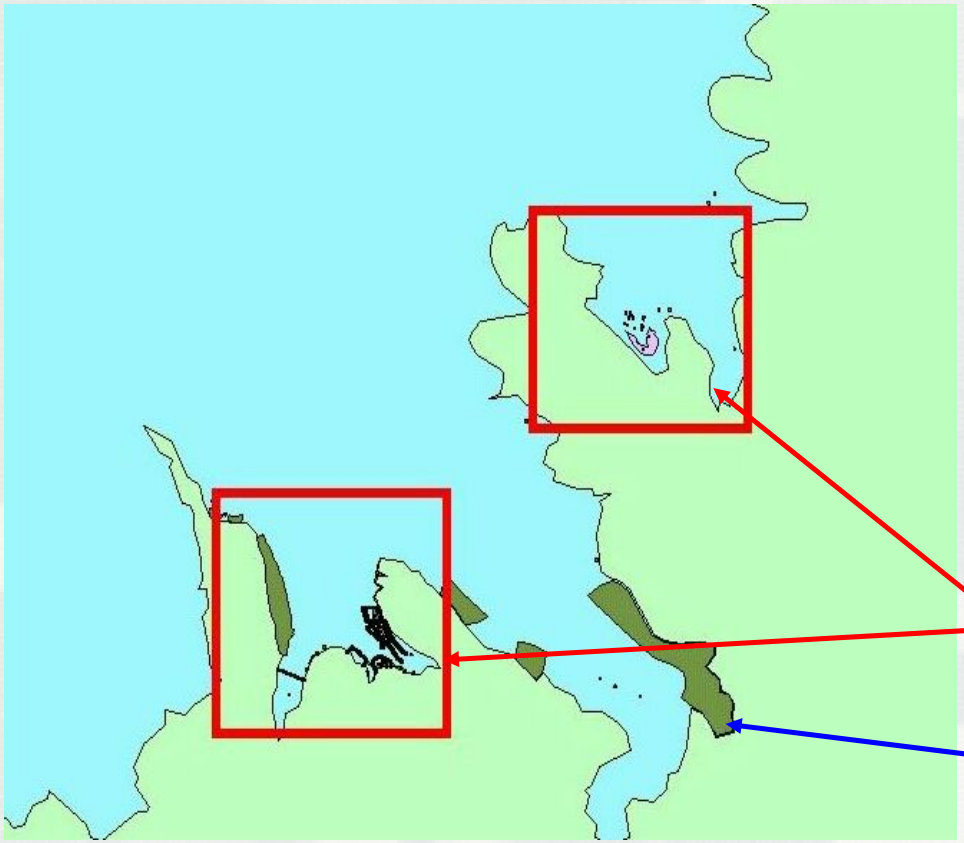
In practice: Cooper Lake, Texas

Planting began in 1998

Water level fluctuation 6 ft

Founder colonies established by end of 1999

Significant spread by 2000



Founder colony approach

In practice: Cooper Lake, Texas

Lake-wide spread

Significant spread: over 150 acres after 3 years

Founder colonies & local spread

What are the major obstacles to establishing founder colonies?

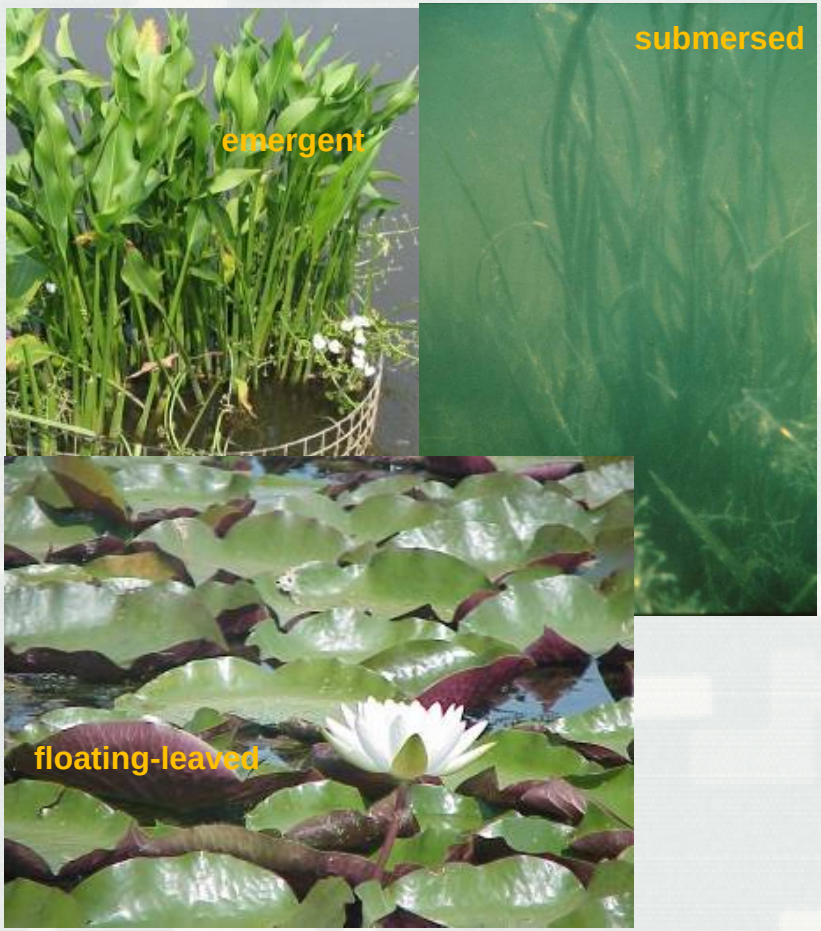
The same obstacles that prevent natural establishment

- **Plant selection and acquisition (propagule source)**
- **Fluctuating water levels**
- **Herbivory**

Lake Conroe, TX

Obstacles: Plant selection and acquisition

- **Use only native species**
  - **Not likely to become problematic**
  - **Local sources are best**
- **High diversity--- more is better**
  - **Use multiple morphological growth forms & species**
  - **Provides greater benefits than monocultures**
  - **More likely to survive harsh conditions**
  - **Adaptive management: test plantings help identify the most suitable species for larger-scale efforts**
- **Sources are limited**
  - **Few commercial suppliers---many have tainted stock**
  - **Harvests from wild populations have risks**
  - **We grow our own…**



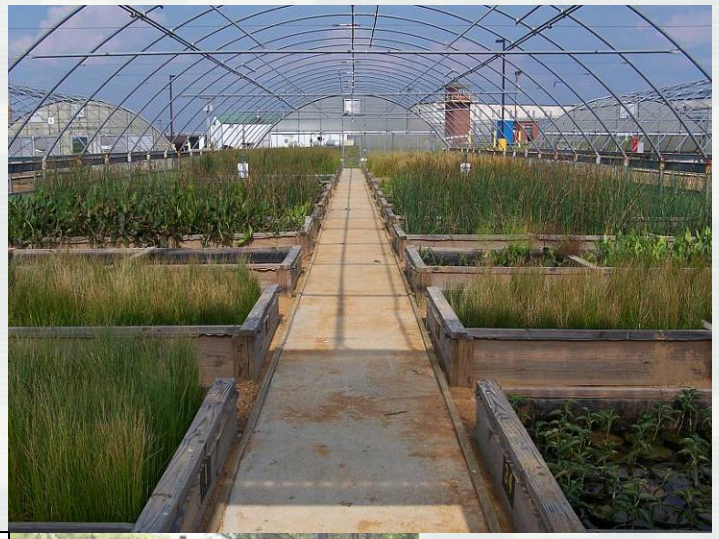
Obstacles: Plant selection and acquisition

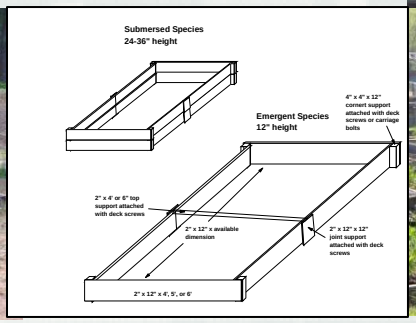
- **Containerized plants**
  - **Establish more successfully than seeds, tubers, etc**
  - **Can be available year-round**
- **Nurseries**
  - **Fairly inexpensive to construct and maintain**
  - **Stock plants can be collected locally with little impact**
  - **Quarantine!!!**
  - **Finding suitable substrates may be problematic**
- **Options**
  - **Labor intensive, but…**
  - **Volunteers (Master Naturalists, etc)**
  - **School Districts (class projects, etc)**
  - **Cooperative efforts with project sponsors**

Obstacles: Plant selection and acquisition

In addition to growing plants at LAERF for use in projects in which we are involved, we have assisted others in setting up functional aquatic plant nurseries

- Corps SAJ
- Arkansas Game & Fish Commission
- Franklin County Water District (TX)
- Caledonia Prison Farm (NC)
- Oklahoma Water Resources Board
- Oklahoma Department of Wildlife Conservation
- Texas Parks and Wildlife Department





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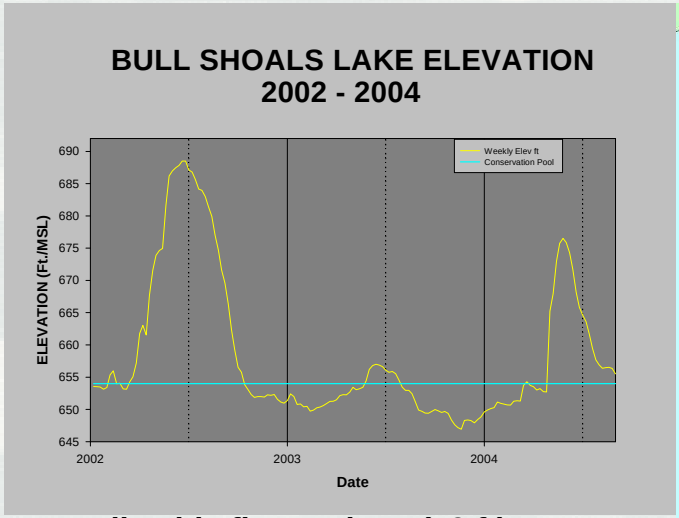
Obstacles: Water level fluctuation

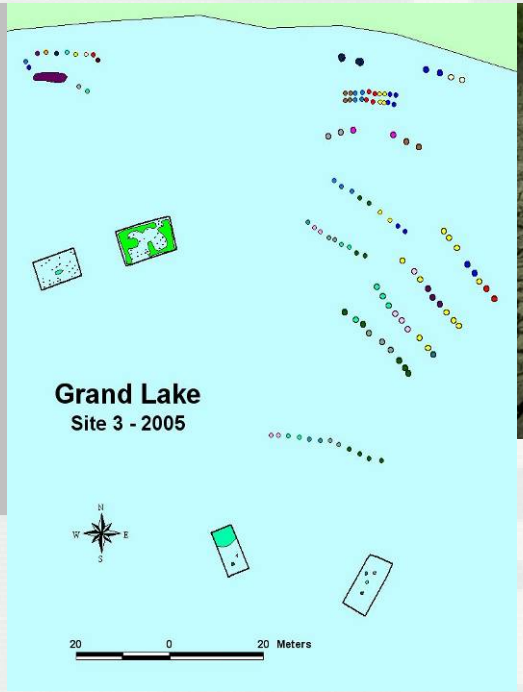
- Most plants establish best at specific depths
  - Emergent---0 to1 ft
  - Floating-leaved---1 to 3 ft
  - Submersed---2 to 4 ft
- But once established can survive a broader range
  - Emergent---periodically dry to 3 ft
  - Floating-leaved---periodically dry to 6 ft
  - Submersed---moist to 6 ft+
- Fluctuating water levels can…
  - Leave plants high and dry
  - Starve or drown plants
- Chase water levels
  - Multiple plantings at multiple depths

Obstacles: Water level fluctuation

- Timing and range of fluctuations are hard to predict
- Failure to address fluctuation may lead to project failure
- Adaptive management: be prepared to chase water levels



Unpredictable fluctuations (40 ft)



Chasing water levels

Low water struggle

Obstacles: Herbivory

- **Plant-eaters abound in aquatic systems**
  - **Most are not strict herbivores**
  - **Many are in place, waiting**

- **Some plants are moderately resistant to herbivory**
  - **Water willow, spikerushes**
  - **Unreliable methodology**

Guntersville Reservoir, AL
Grass carp and turtles

Obstacles: Herbivory

What's out there?

Obstacles: Herbivory

What can we do about it?

- **Protective exclosures**
  - Very effective
  - Diversity of designs
- **Herbivore control?**
  - Usually not practical

Hoop cages

Cove & shoreline fences

Pens

Tray cages

Ring cages

Test plantings and the beginnings of adaptive management

Even though we know what obstacles to expect, we won't know how plants will perform until planted. So…

We recommend test plantings

- **Small-scale founder colonies at selected sites**
- **Identify plant species most suitable for the project based upon field performance**
- **Identify specific obstacles to overcome**
- **Identify best protective devices and mesh sizes**

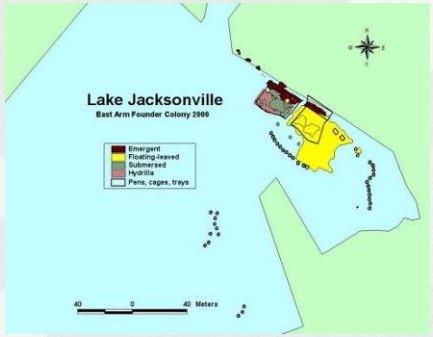
Information gleaned from test plantings can then be used when scaling-up efforts

Monitoring and additional adaptive management

It would be nice if we could walk away after planting, but…

Monitoring

- **Evaluate plantings**
  - **Survival?**
  - **Spread?**
- **May require supplemental or replacement plantings**
  - **Replace unsuitable species with those that have survived and spread**
- **Identify problems that need to be corrected in order to meet project goals**



Maintenance

- **Repair or replacement of damaged and lost exclosures**
- **Long-term assurances---exclosures are refugia for plants during and after significant ecological disturbance**

Conclusions

- Native aquatic plants are good for the ecosystem
- Many aquatic systems lack sufficient vegetation to realize their benefits
- We can help Mother Nature speed up the process of aquatic plant establishment
- It takes time, effort, and money
- Benefits are invaluable

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