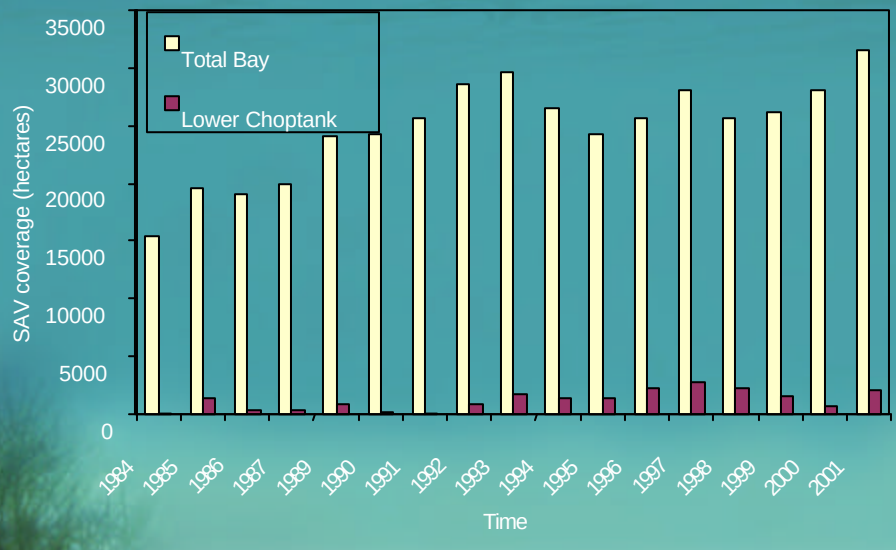
Use of colonizing species of submersed aquatic vegetation as nurse crops in restoration projects

Laura Murray and John Melton

University of Maryland
Center for Environmental Science
Horn Point Laboratory

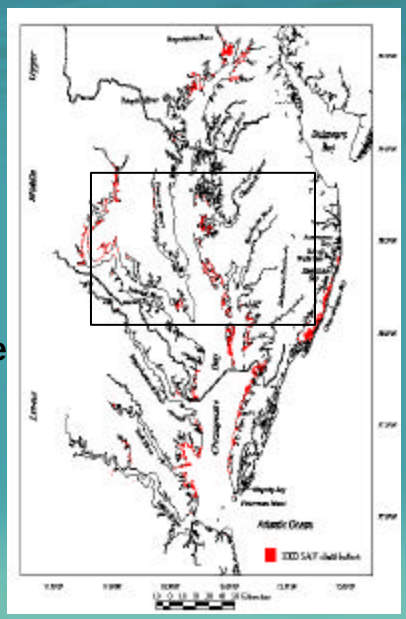
Recent Coverage of SAV in Chesapeake Bay and the Lower Choptank River



Orth et. al 1984-2001

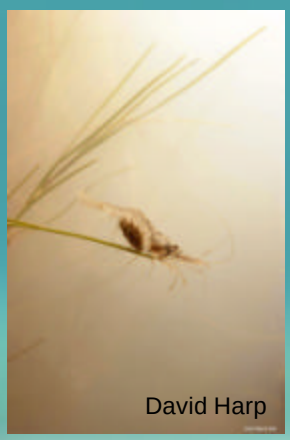
Historically 16 species of SAV were commonly found in the Chesapeake Bay or nearby rivers.

In the mesohaline regions, there is low species diversity when compared to pre-decline years.
(Stevenson and Confer, 1978)



www.vims.edu

Approximately 90% of the SAV coverage in the Choptank River is one species, *Ruppia maritima* (Orth et. al, 1984-2001).



David Harp

R. maritima has been characterized as a colonizing species, reproducing mainly by seeds

Other, more stable species of SAV, are have not re-established

Potamogeton pectinatus

Potamogeton perfoliatus

SAV beds can modify their environment

Trap suspended materials
Clean water
Increase sediment nutrients and reduce water column nutrients

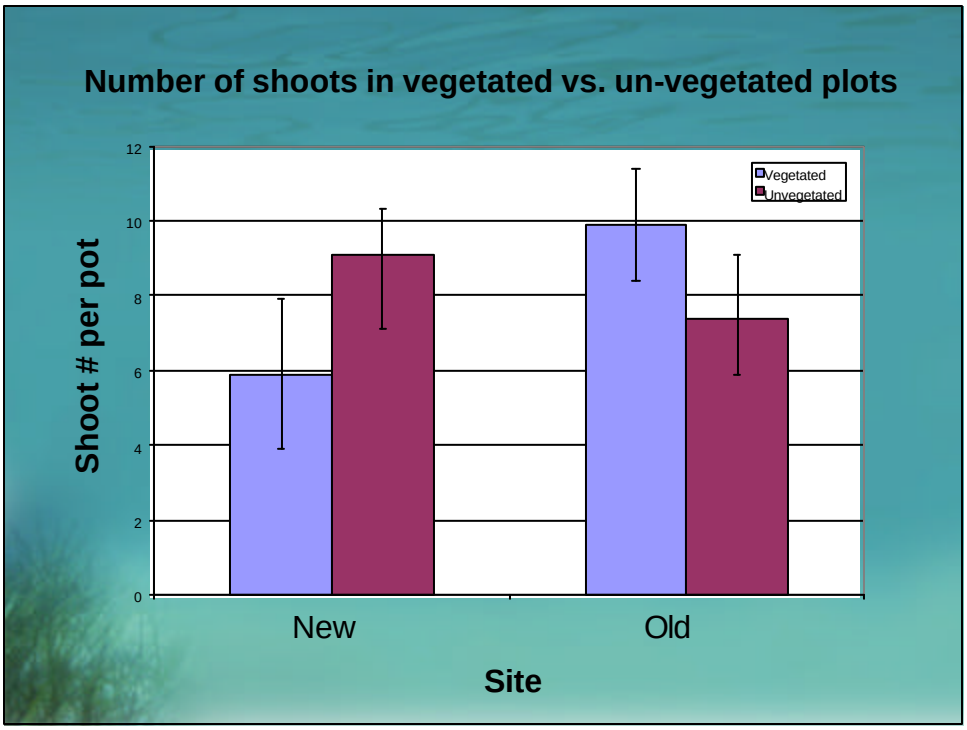
Planting other SAV species in *R. maritima* beds can:

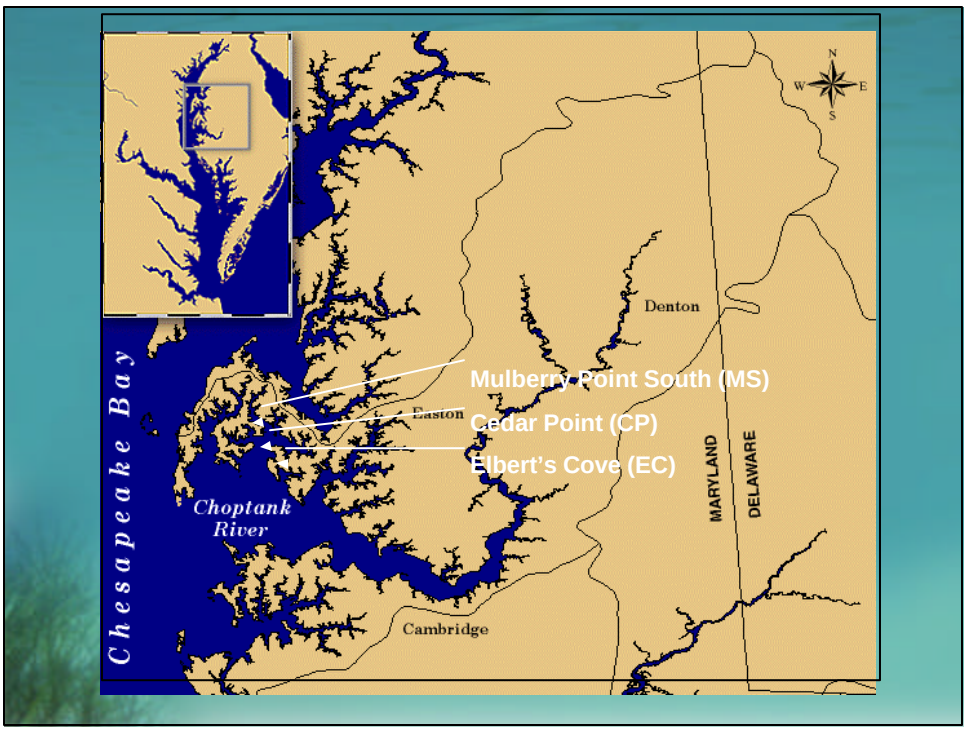
- **Increase species diversity**
- **Provide more stable SAV beds**

Existing *R. maritima* beds can serve as nurse crops for other species of SAV

Recent experiment supports hypothesis:

***Potamogeton perfoliatus* planted in sediments collected from "old" and "new" *R. maritima* beds and from adjacent un-vegetated areas.**


Number of shoots in vegetated vs. un-vegetated plots
Shoot # per pot
12
10
8
6
4
2
0
Vegetated
Unvegetated
New
Old
Site

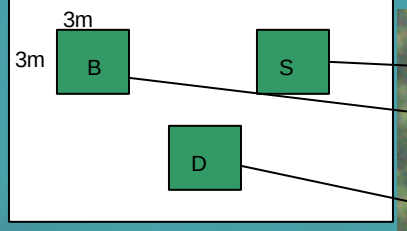

Chesapeake Bay
Choptank River
Denton
Easton
Cambridge
MARYLAND
DELAWARE
Mulberry Point South (MS)
Cedar Point (CP)
Elbert's Cove (EC)
N
W
E
S

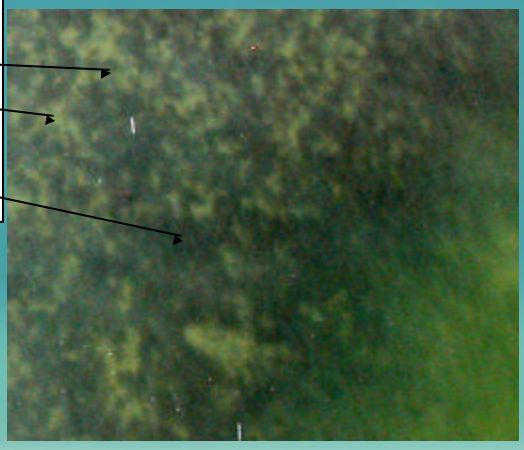
Planting Design

B = Bare = 0 g/m^2 *R. maritima*

S = Sparse = 20-27 g/m^2 *R. maritima*

D = Dense = 47-57 g/m^2 *R. maritima*





Quadrat Design

3m Fencing

3m

.5m

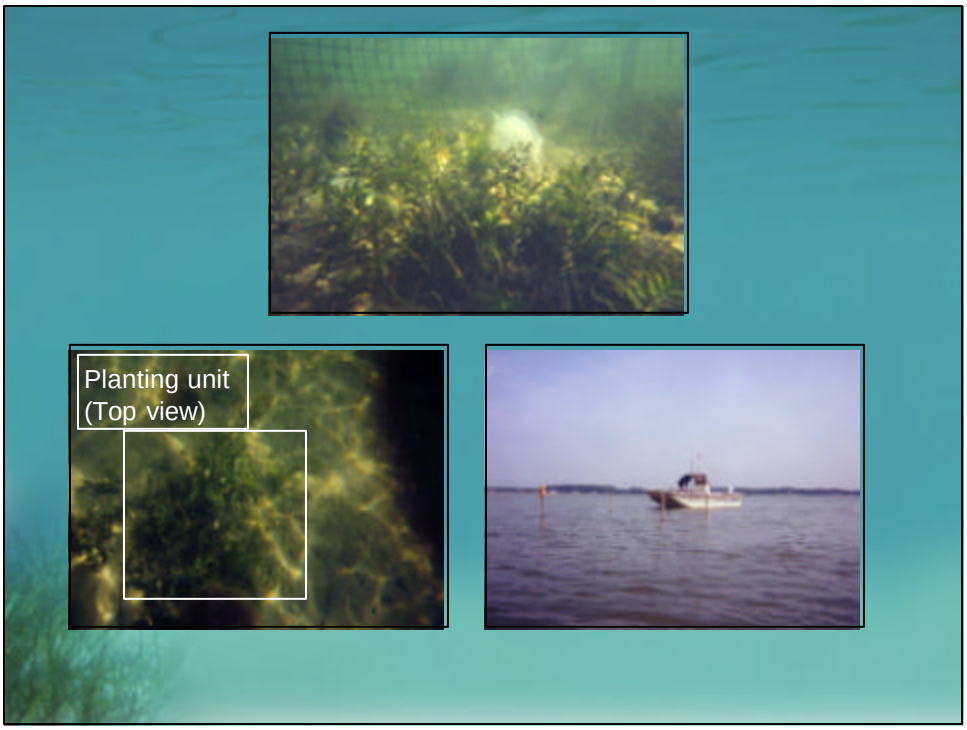
.5m

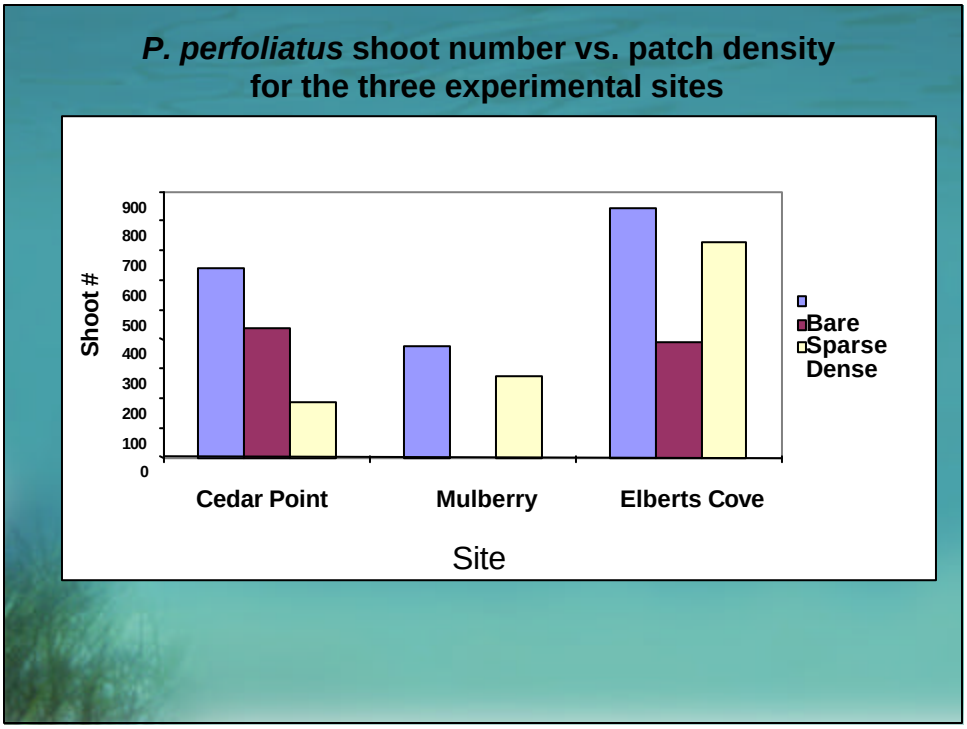
P

Planting Units: **10 Lab propagated *Potamogeton perfoliatus* (Redhead Grass)**

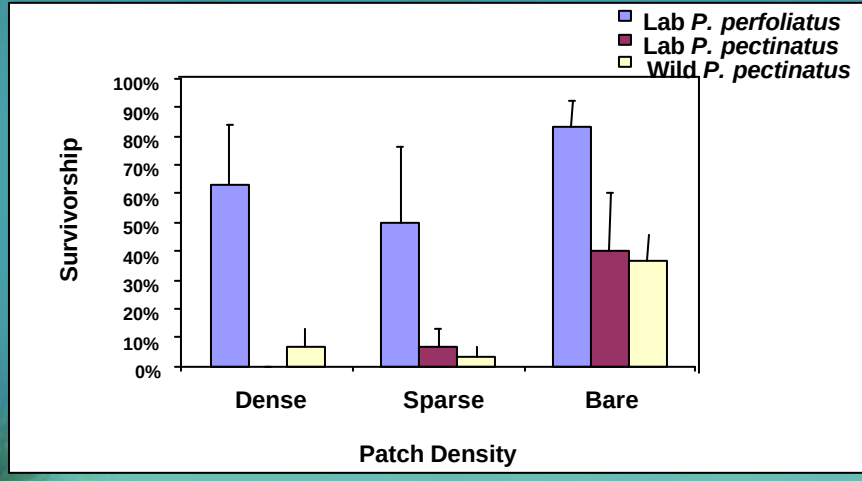
5 Lab propagated *Potamogeton pectinatus* (Sago Pondweed)

10 Wild *Potamogeton pectinatus*

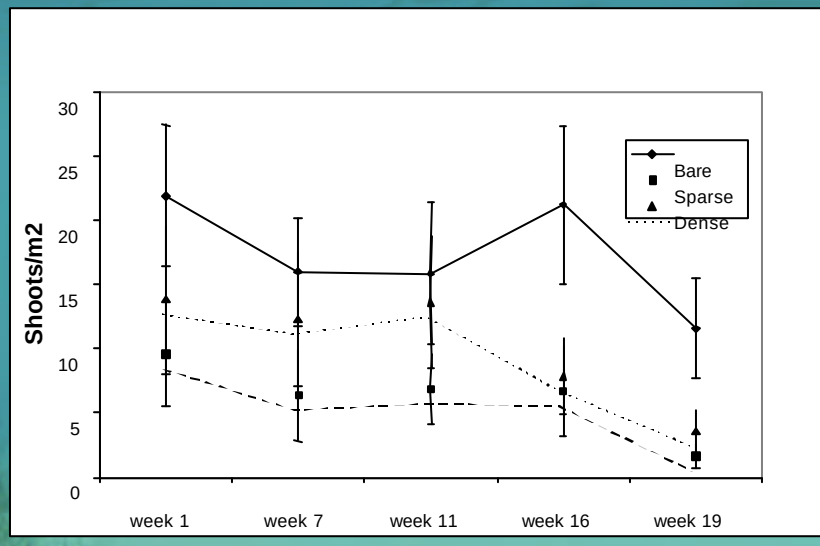

Planting unit
(Top view)


P. perfoliatus shoot number vs. patch density for the three experimental sites
Shoot #
900
800
700
600
500
400
300
200
100
0
Cedar Point
Mulberry
Elberts Cove
Site
Bare
Sparse
Dense

% Survivorship of 2 SAV species in patches



Results (2002 growing season)



Conclusions:

R. maritima **beds can serve as "nurse crops" for restoration of other SAV species, especially older beds**

Restoration of SAV in bare patches within existing beds may have higher rates of success

Survival of ***P. perfoliatus*** **was higher than for** ***P. pectinatus***

Founder Colonies for Restoration of Aquatic Plant Communities in Unvegetated Freshwater Ecosystems

Obstacles to natural establishment (and impediments to restoration)

The fact is, a lot more has changed than just water quality!

"Rogues Gallery"

Our SAV did not co-evolve with these guys!

This is what I see in freshwater systems: Herbivory is the overriding factor

Herbivory is the overriding factor in freshwater systems

Herbivory is the overriding factor in freshwater systems

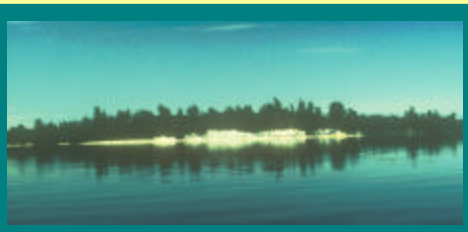
Beaver “trails”

It's not just about the water quality

- In many freshwater ecosystems we have made substantial improvements in water quality, yet these improvements are not always accompanied by an increase in SAV.
- Many of these systems remain in what we would call an "*unvegetated state*".
- Is it that we are lacking the necessary plant propagules, or is it something else?

Onondaga Lake, NY (the "most polluted lake in the US")

Even in Onondaga Lake, "America's dirtiest lake", we have made substantial progress in cleaning up the water. Of course SAV recovery has been minimal.



Have we just not improved the water quality enough? Or is there something else?

Even here, it's not just the water quality

In a multiagency effort aimed at restoring Onondaga Lake, we found that we could, in fact, restore SAV -- provided that we protected the transplants from both waves and herbivores.

In some cases, we even had recovery of species that we had not planted! These must have come from the seedbank.

Had we not installed the wave breaks and exclosures we wouldn't have known.

Seedbank Assessment

The lesson here is that we do *not* always know *why* the plants are not there.

Before we go about "restoring" SAV (or making decisions regarding restoration) we should at least assess the sediment seedbank.

Seedbank assessment:

Lake Okeechobee, FL

Test Plantings

We should also routinely conduct test plantings of a variety of species. (in FW settings)

Test plantings should include robust transplants both inside and outside of exclosures.

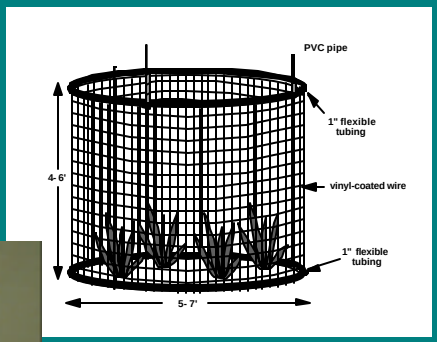
Unplanted exclosures could test the ability of SAV to recover from the seedbank (if any).

***Heteranthera* in Lake Waco, TX**

Test Plantings

Test plantings should utilize exclosures of proven design and constructed of durable materials.

Exclosure integrity should be verified monthly during the growing season

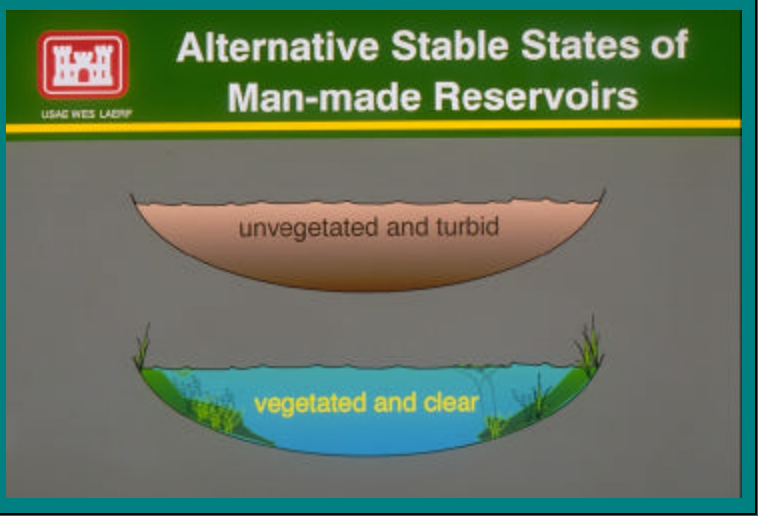


"Hoop" cage design

"Maybe you can't get there from here"

At least not with just water quality improvements.

In Europe they frequently employ drawdown, dredging, and fish eradication to achieve SAV restoration.



The overriding importance of herbivory (in fresh water) …

(in my opinion) precludes the use of extensive planting of *unprotected* seed, seedlings, or bare-root plants.

So, given that you *will* have to provide herbivore protection …

large-scale planting efforts are *not* the answer!

(No matter what the Congressman says.)

What we want are large-scale *results*.

"Founder Colony" Approach

Introduction of *mature transplants*, *protected from herbivory*, into *selected favorable sites to* ensure establishment and sustainability of founder colonies, resulting in:

- modification and improvement of environmental conditions

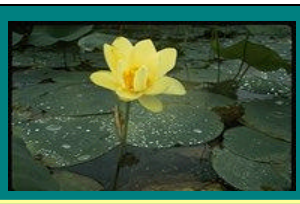
  sediment stabilization, water column filtration, and nutrient uptake, resulting in improved water clarity, improving the light climate

- development of a seedbank/tuberbank for recovery following adverse conditions

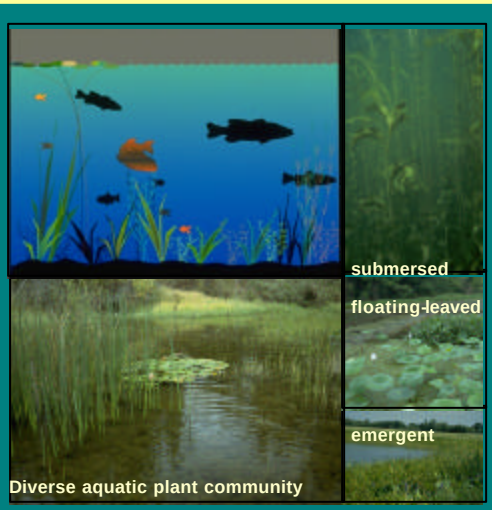
- continual production of propagules to ensure spread when conditions become suitable

Mature transplants
(nursery grown)

Plants - Diversity is good!



Plant a diversity of species and growth forms to maximize habitat diversity and resilience



Establishing aquatic plant communities in Texas lakes

A cooperative effort with Texas Parks and Wildlife to develop, test, and refine aquatic plant establishment methodology in selected reservoirs representing a diversity of environmental conditions

Lakes:

Jacksonville, Conroe, Cooper, Grapevine, Waco, Coleman, Choke Canyon

Exclosures:

none, small, large

Plants:

21 species (emergent, floating-leaved, submersed)

Herbivore exclosures

'Tomato' Cage

Constructed from 2" by 4" mesh galvanized welded wire, this exclosure protects a single plant within a 2 to 3 ft diameter circular cage.

Herbivore exclosures

Fenced Plot

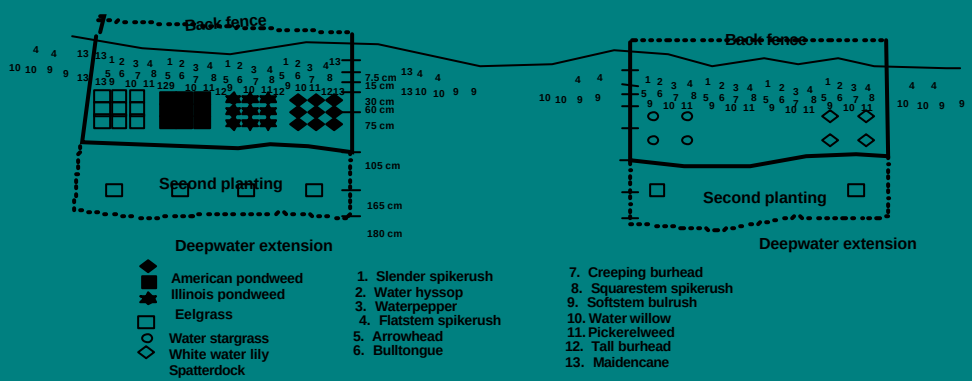
A rectangular pen, constructed from 2" by 4" mesh galvanized welded wire, at a depth of 3.5 ft, this exclosure protects several submersed plants.

Herbivore exclosures

Shoreline Fence

Constructed from 2” by 4” mesh galvanized welded wire placed along the 3 ft depth contour and extending back to the shoreline, this exclosure protects many plants of a variety of growth forms.

1999 Plantings: Shoreline Fences

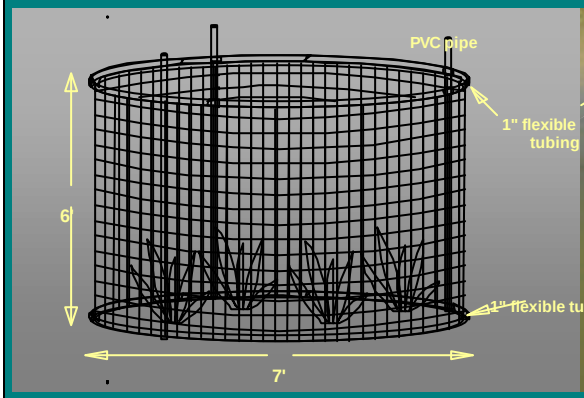


Herbivore exclosures

Fenced Cove

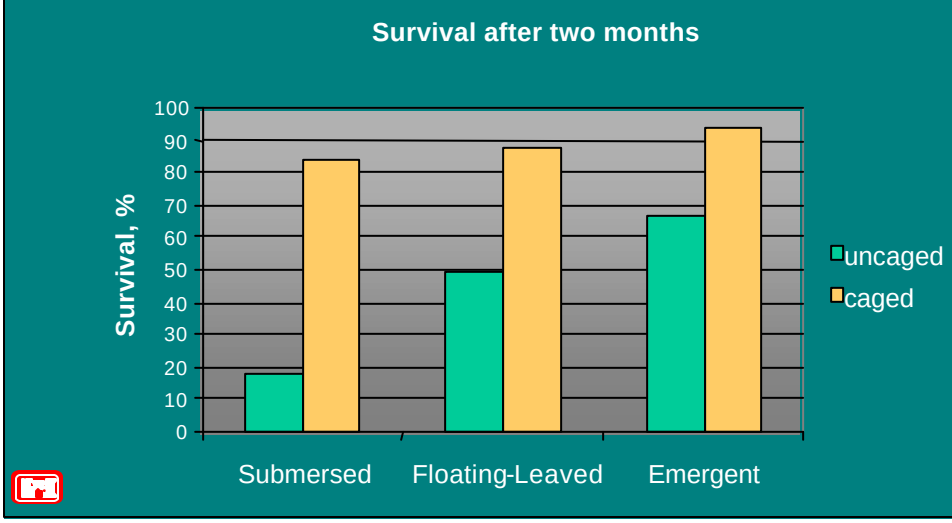
Constructed from 2” by 4” mesh galvanized welded wire placed across the mouth of a shallow cove, this exclosure protects many plants of a variety of growth forms.

Hoop cages for ‘chasing’ water levels

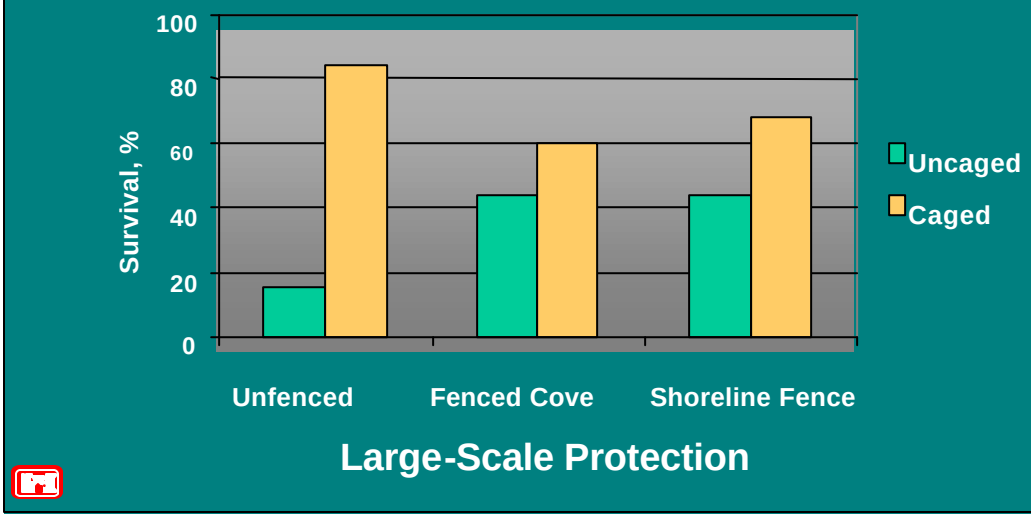


Plant at 2 and 4 ft depths and plant additional cages on 2-ft intervals as water levels drop

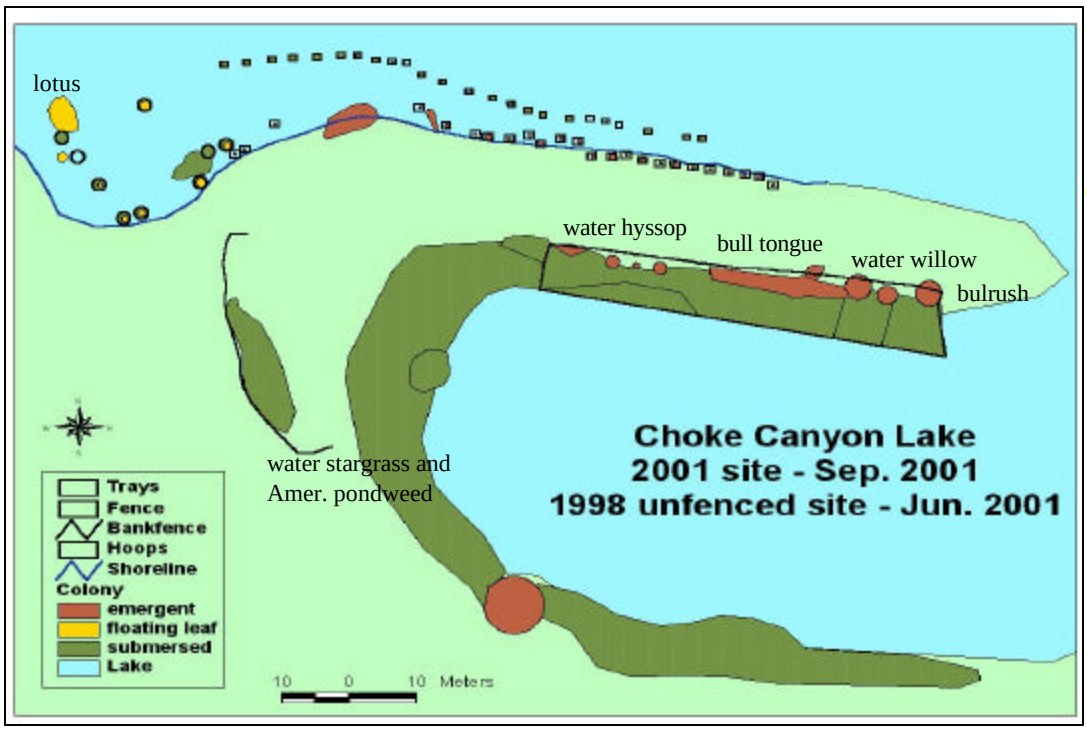
Effects of herbivory/biotic disturbance on survival of different growth forms

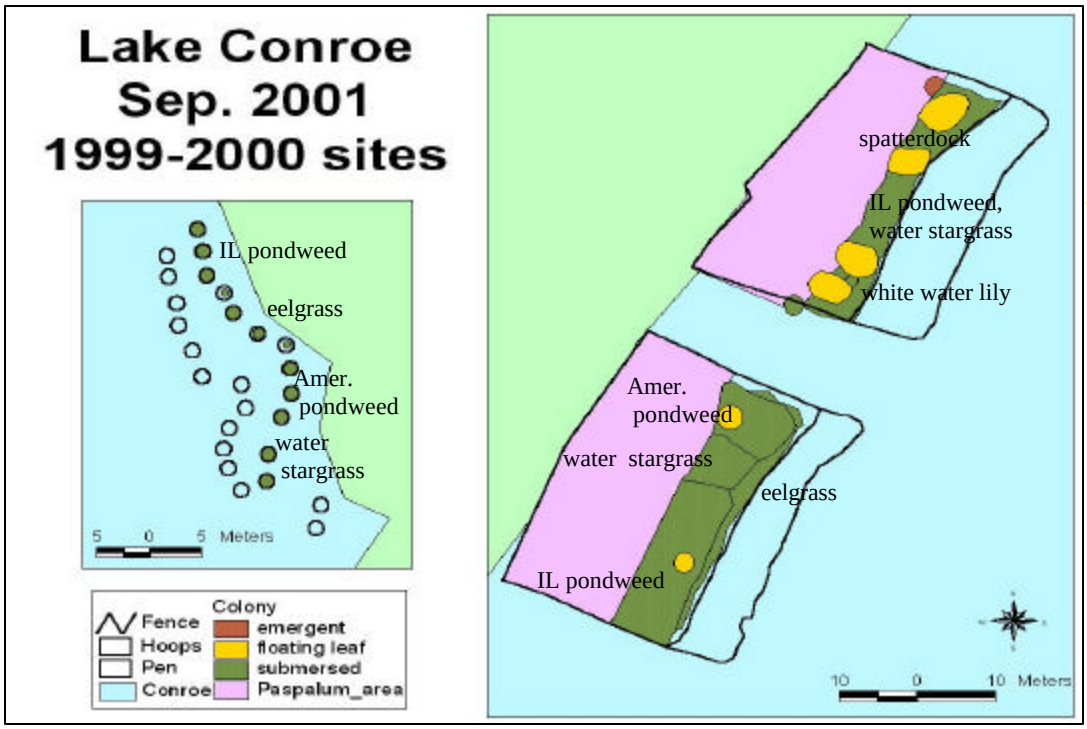


Survival of caged and uncaged SAV, with and without large-scale protection

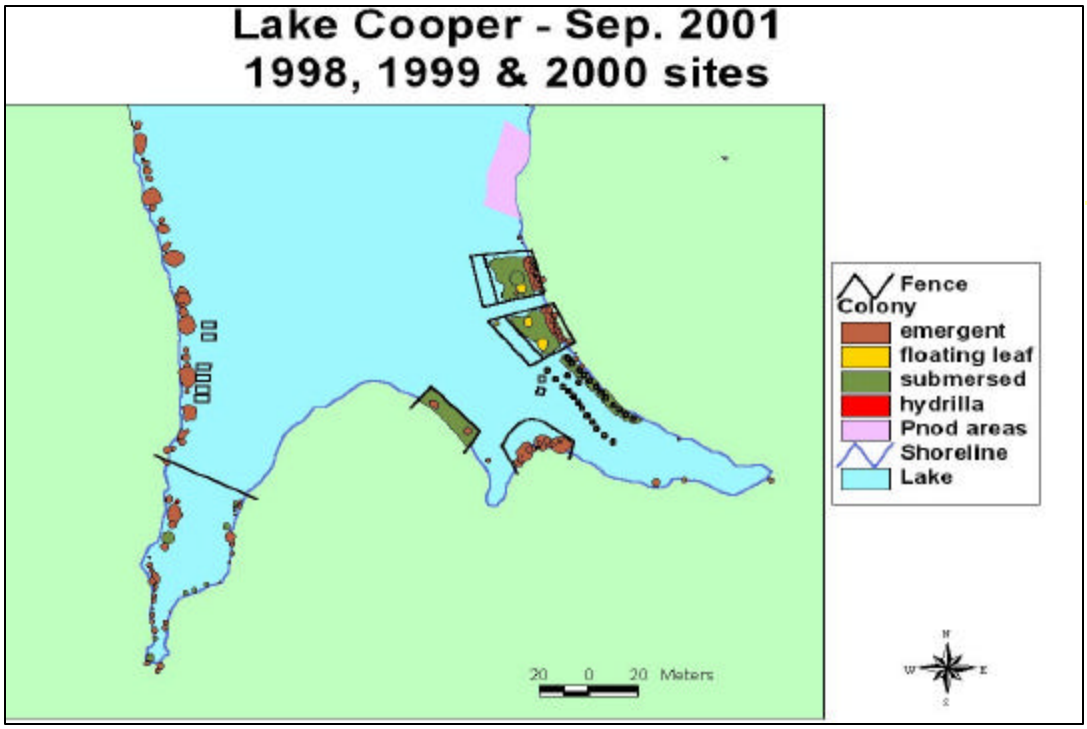


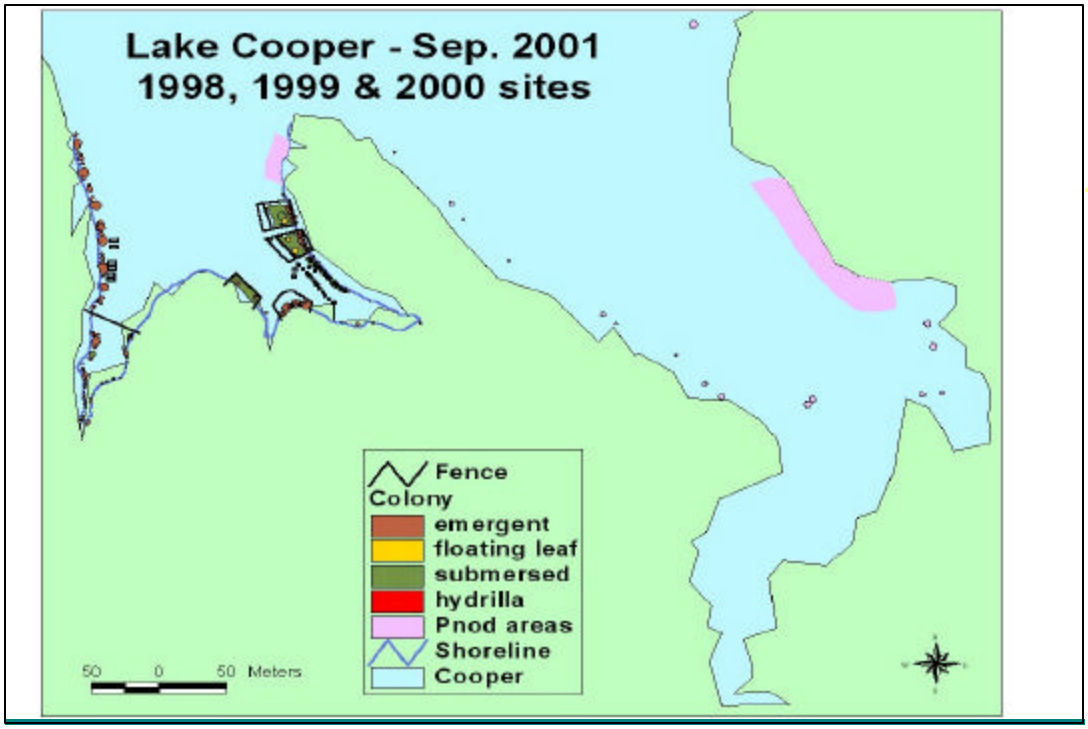
Large-scale, longer-term results: GPS mapping of plant colonies

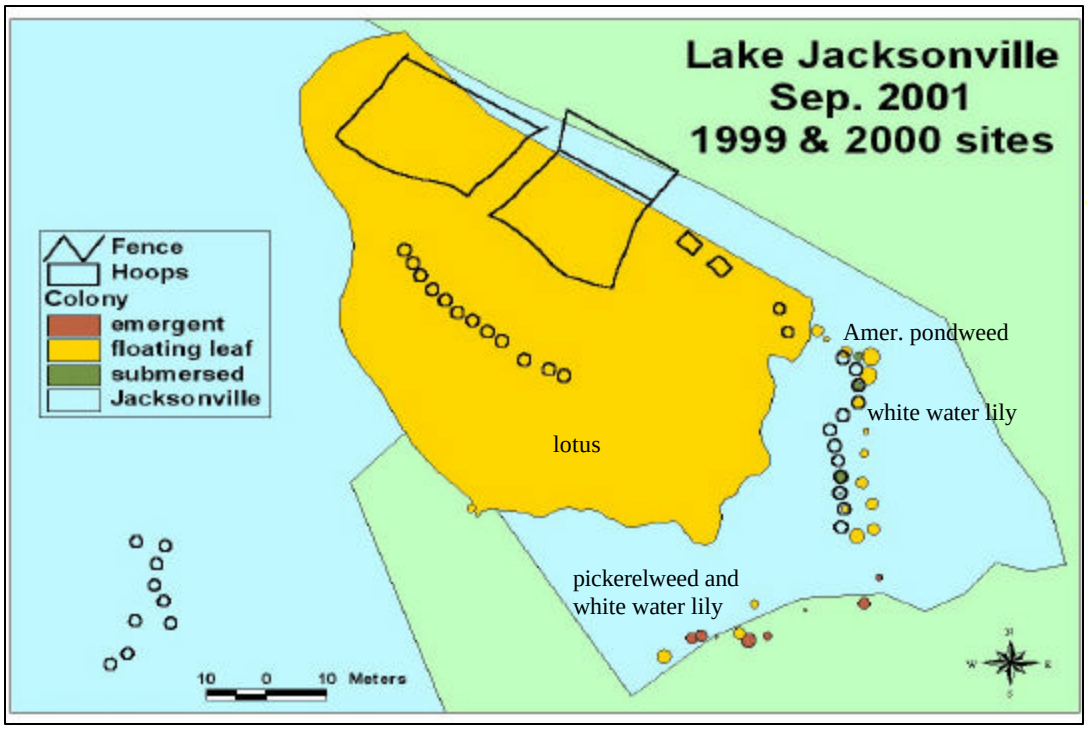


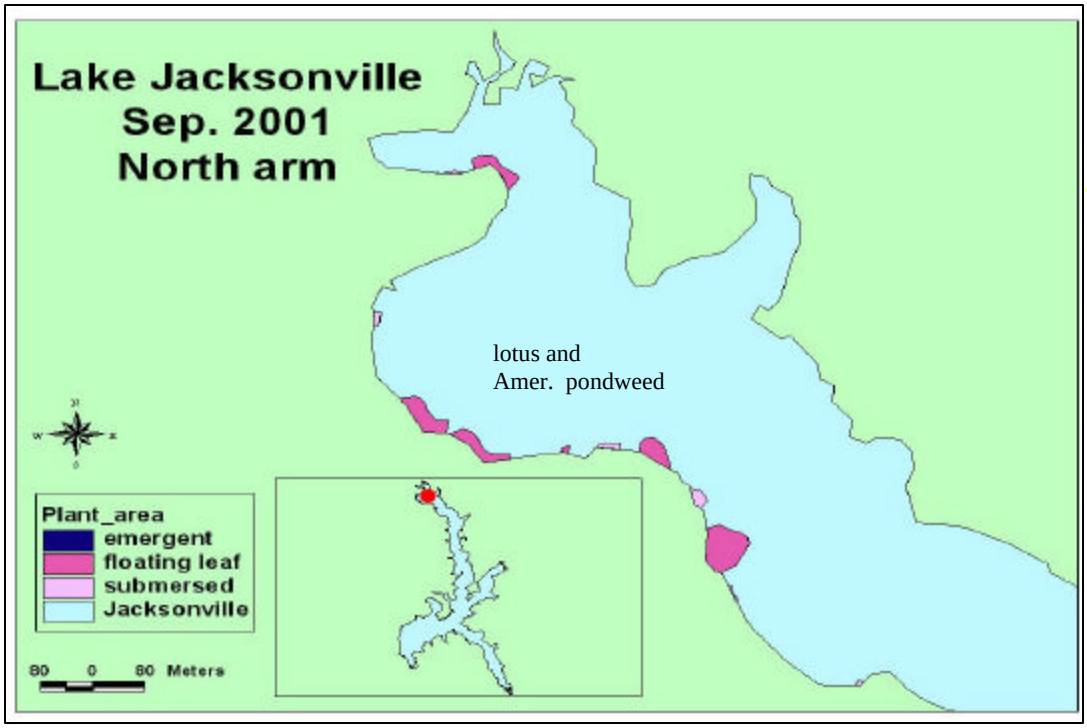

Lake Conroe
Sep. 2001
1999-2000 sites
IL pondweed
eelgrass
Amer. pondweed
water stargrass
5 0 5 Meters
Fence
Hoops
Pen
Conroe
Colony
emergent
floating leaf
submersed
Paspalum_area
spatterdock
IL pondweed, water stargrass
white water lily
Amer. pondweed
water stargrass
eelgrass
IL pondweed
10 0 10 Meters

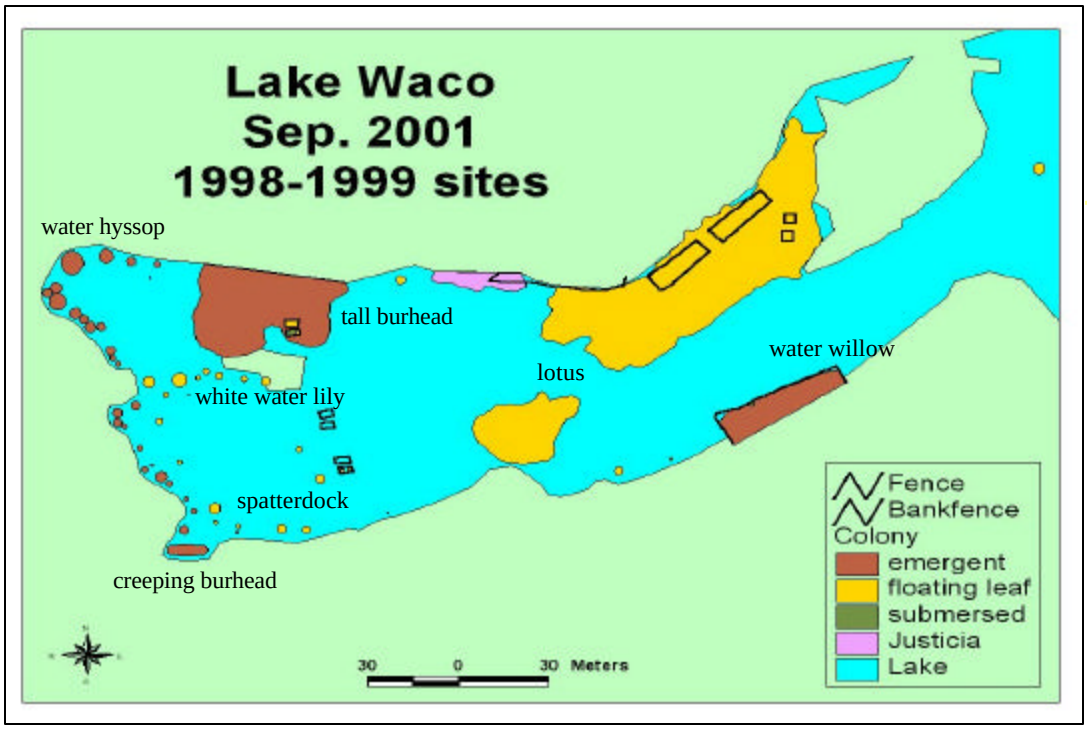

Lake Conroe - 2002


Lake Cooper - Sep. 2001
1998, 1999 & 2000 sites
Fence
Colony
emergent
floating leaf
submersed
hydrilla
Pnod areas
Shoreline
Lake
20 0 20 Meters


Lake Cooper - Sep. 2001
1998, 1999 & 2000 sites
Fence
Colony
emergent
floating leaf
submersed
hydrilla
Pnod areas
Shoreline
Cooper
50 0 50 Meters


Lake Jacksonville
Sep. 2001
1999 & 2000 sites
Fence
Hoops
Colony
emergent
floating leaf
submersed
Jacksonville
Amer. pondweed
white water lily
lotus
pickerelweed and
white water lily
10 0 10 Meters


Lake Jacksonville
Sep. 2001
North arm
lotus and
Amer. pondweed
Plant_area
emergent
floating leaf
submersed
Jacksonville
80 0 80 Meters



Conclusions and Recommendations

- **Protect plantings with herbivore exclosures**
- **Plant a diversity of growth forms and species**
- **Mature, robust transplants can handle adverse water quality conditions**
- **Establish founder colonies in multiple locations to ensure propagule supply**
- **Fonder colonies will help to improve improve water quality**
- **Founder colonies will produce the millions of propagules that will be needed to vegetate the "1000 acres"**

Bob's question: "Can we afford to do transplants?"

Answer: In fresh water, can we afford not to?