An Ecological Approach to Submersed Aquatic Plant Management

Biological Control for Nature

Oct 3 – 7, 2010
Northampton, Massachusetts

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Why do non-native, invasive aquatic plants cause problems in the US?

Held in check in their native waters by:

- Biological controls (predators, pathogens)
- Environmental conditions
  - Nutrient limitation
  - Seasonality
  - Hydrological cycles/events (floods and droughts)
- Competition with other aquatic plant species

When non-native, invasive aquatic plants arrive in the USA they find …

Engineered systems

- Altered hydrology
- Dampened water level fluctuations
- High nutrient loads

The Corps of Engineers

versus

invasive aquatic plants

The Corps is the largest provider of water resources in the US

In many cases these water resources projects are adversely impacted by excessive growth of nonindigenous aquatic plants.

Hydrilla growing in 3 m water in Guntersville Reservoir, Alabama

Why do we (Corps of Engineers) have so many aquatic weed problems?

- We are not dealing with pristine natural lakes formed by glacial retreat
- The diverse aquatic plant communities of natural lakes have developed over hundreds or even thousands of years

Man-made systems do not come equipped with diverse native plant communities

Many of our reservoirs are only decades old

Even natural lakes have sometimes been so disturbed that they have lost their SAV

Unlike terrestrial systems, these empty niches can be persistent

Colonizing species *(disturbance specialists)*

Characteristics

- **Rapid growth rates**
- **Broad tolerance ranges**
- **Early maturation and reproduction (fragmentation)**
- **Adapted for dispersal (fragmentation)**

Although we have many native pioneer (colonizing) species, in many parts of the US, nonindigenous aquatic weeds greatly outnumber native species. These invasive weeds are the first to colonize, fill the niche, and preempt available resources – preventing later arrivals from establishing.

The species that cause widespread problems are simply the *best adapted weeds in the world* for colonizing empty niches! *And they have escaped their co-evolved natural controls!*

In the past, management actions often contributed to the problem

- A lack of monitoring precluded early detection-rapid response
- Little thought was given to ecosystem health, integrity or long-term sustainability
- The goal of management was often eradication of all vegetation
  - whole lake herbicide applications
  - massive grass carp stocking
  - large-scale dewatering (drawdown)

Did this type of management achieve a desirable outcome?

Choked with weeds

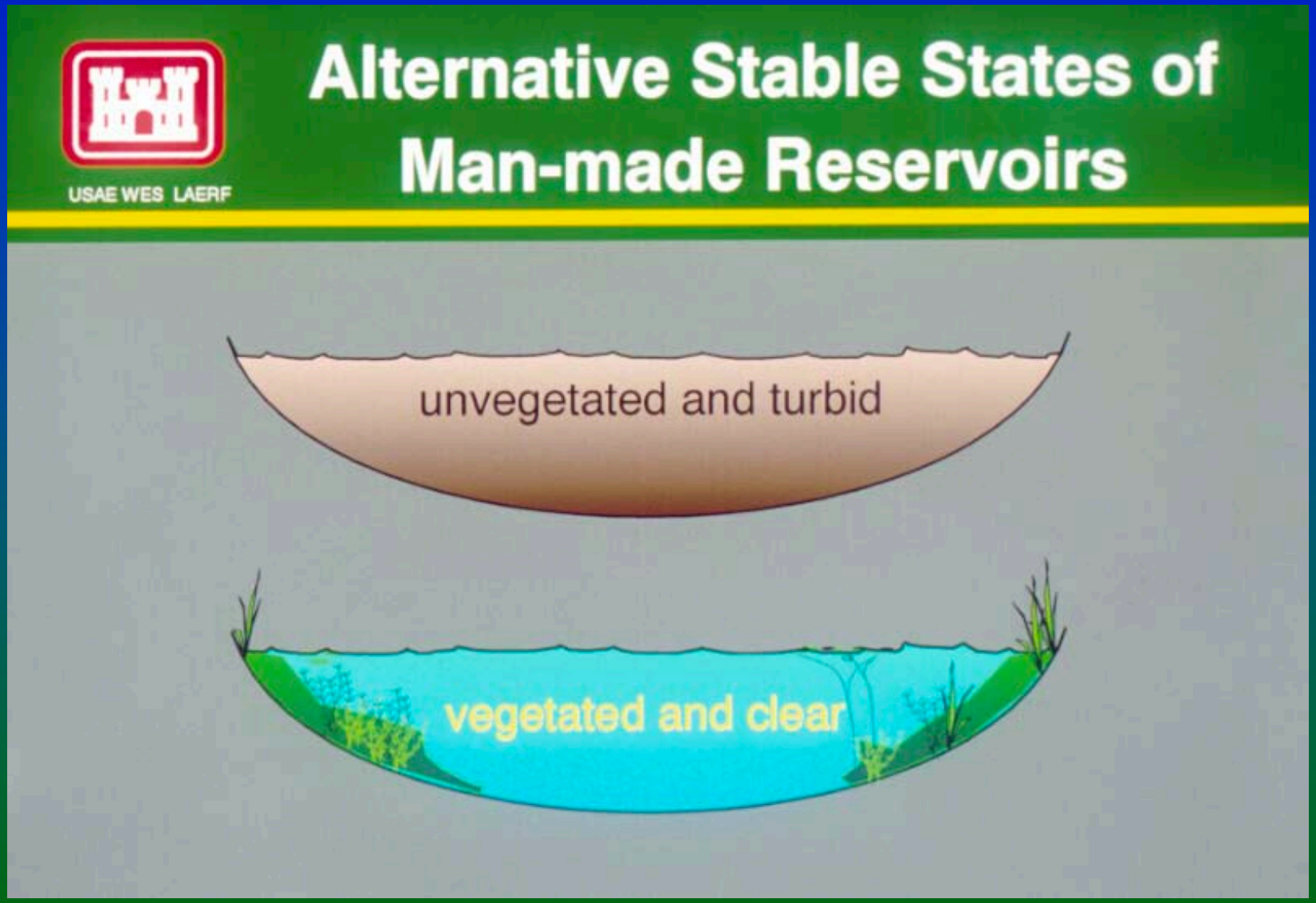
Weed free, but …

Poor water quality

(turbidity, algal blooms)

Poor fish and wildlife habitat

Alternative stable states?



A desirable outcome?

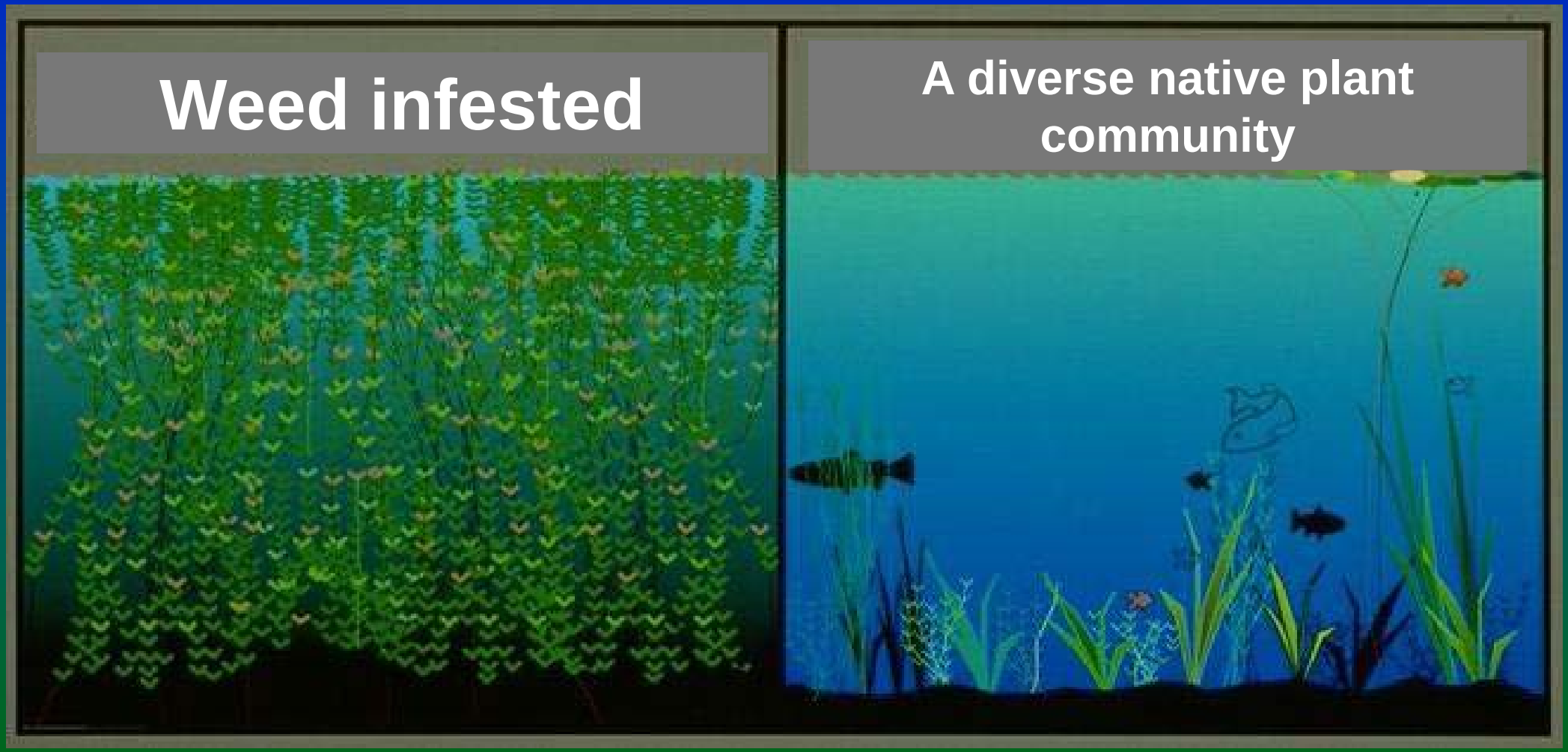
No!

Unvegetated (empty niche)

(turbid, algal blooms, poor habitat)

Choked with weeds

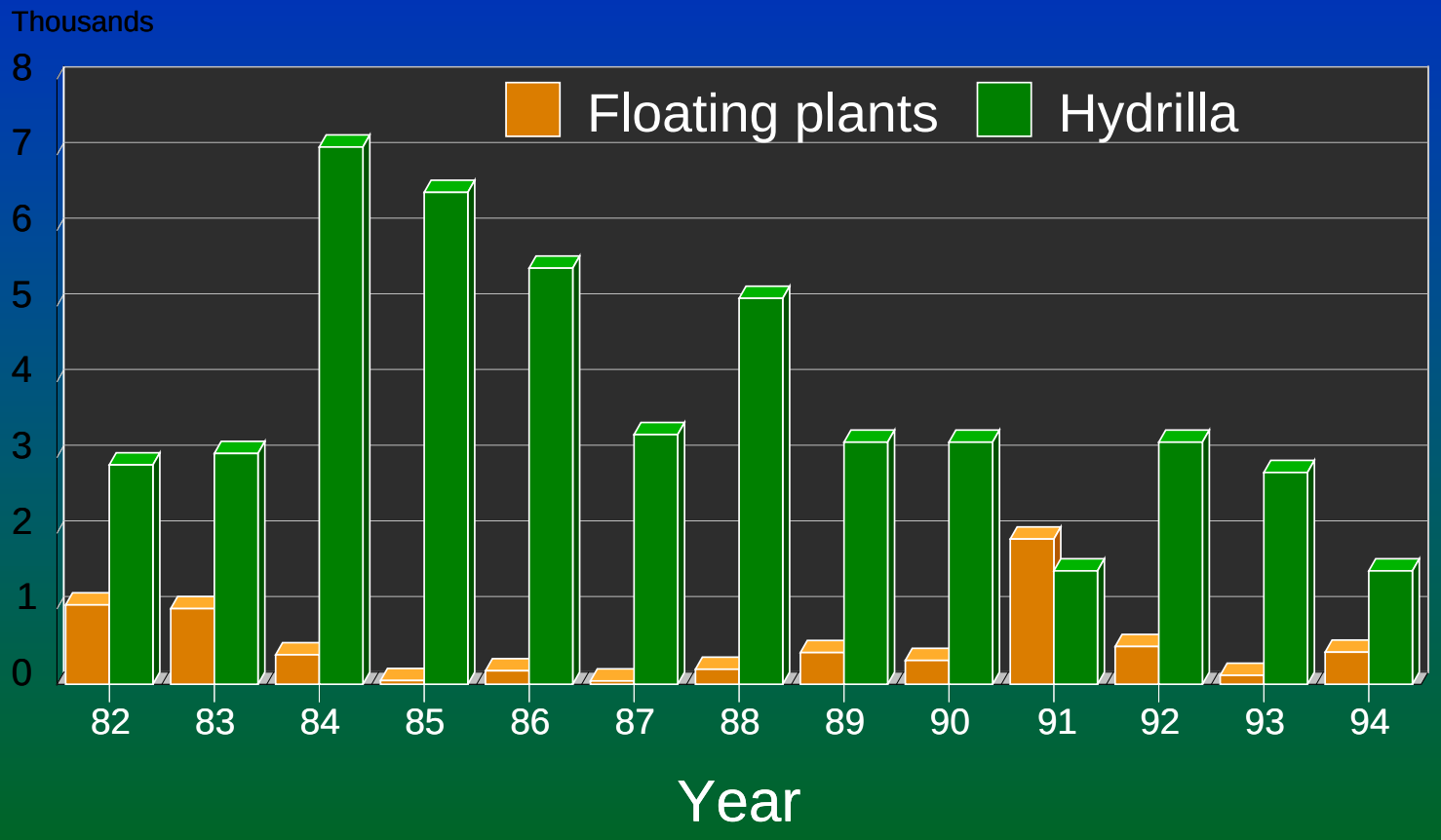
We never ***managed*** to get from “weed infested” to a diverse native plant community!



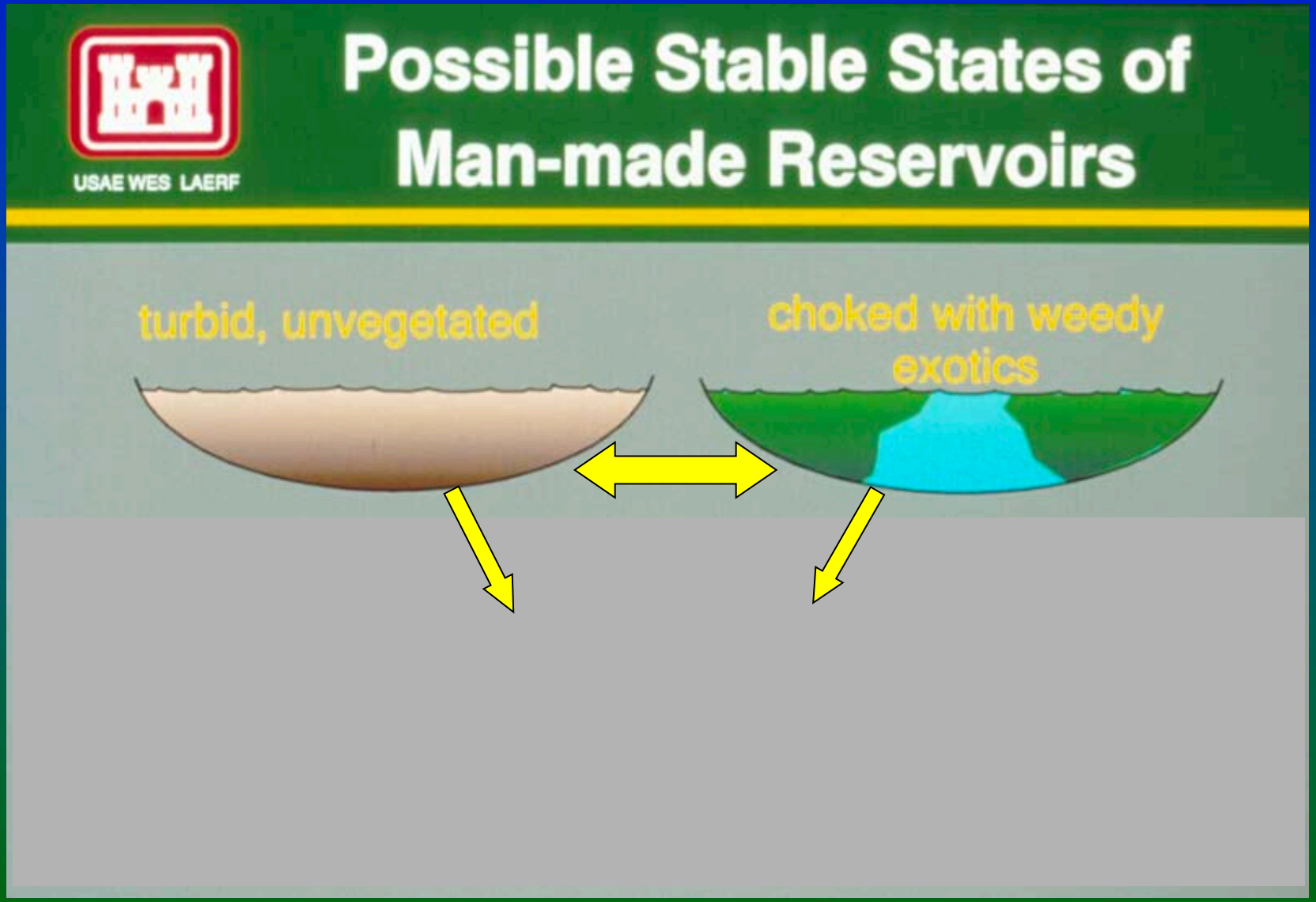
It can always get worse!

“Successful” elimination of waterhyacinth?

Areal coverage of nonindigenous invasive plants in Rodman Reservoir, Florida



We need a better way, an *ecological* approach.



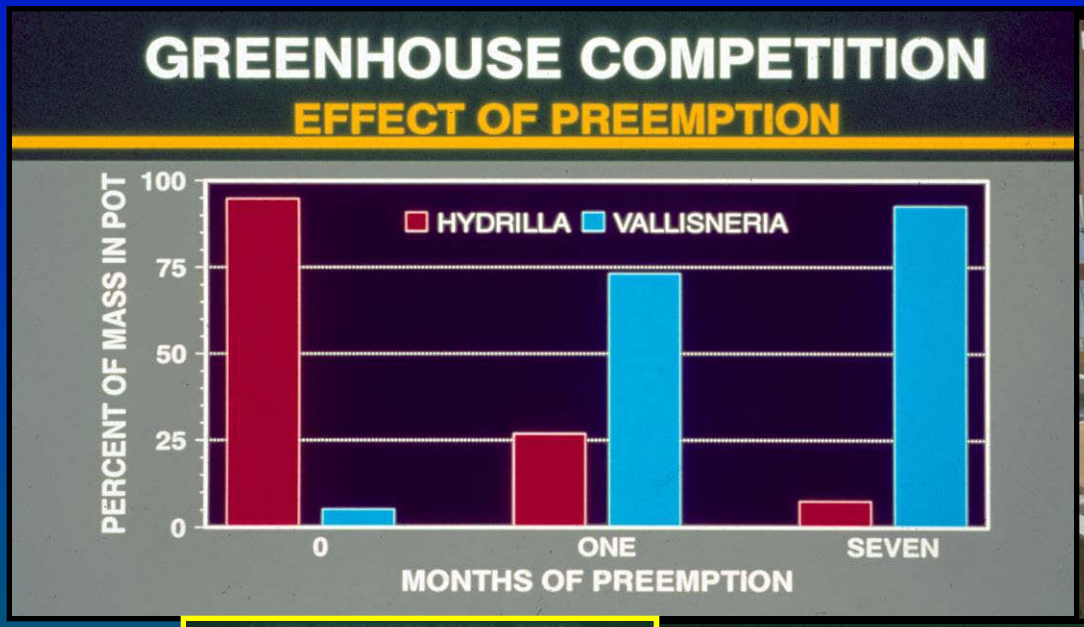
Causative factors

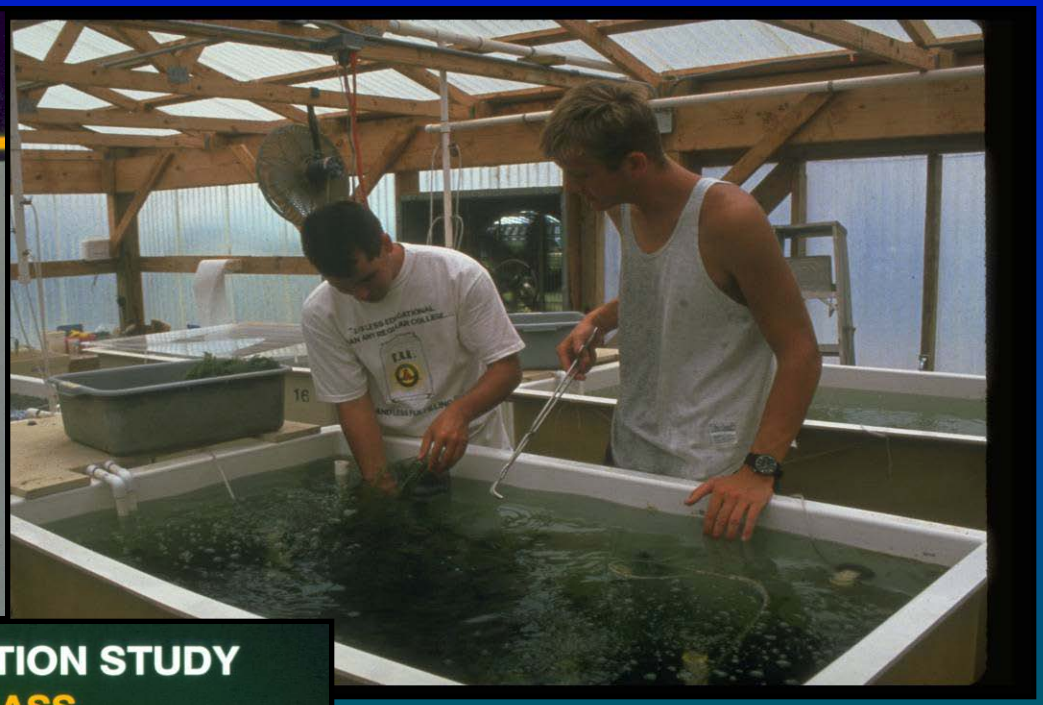
- Stable water levels
  (regulated rivers)
- Abundant shallow water
  (light limits depth distribution)
- High nutrient loads and a lack of filtering wetlands
  (watershed activities, STPs, septic fields, excess lawn fertilization)
- Lack of biological controls
  (predators, pathogens)
- Lack of competing aquatic plant species
  (empty niche)

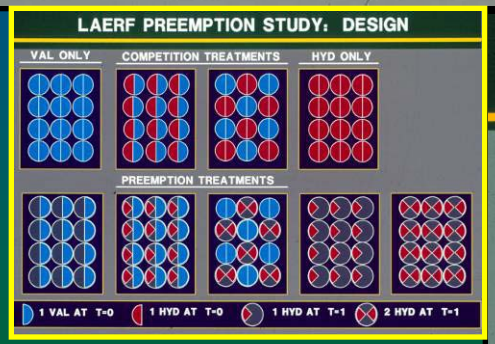
= plants!

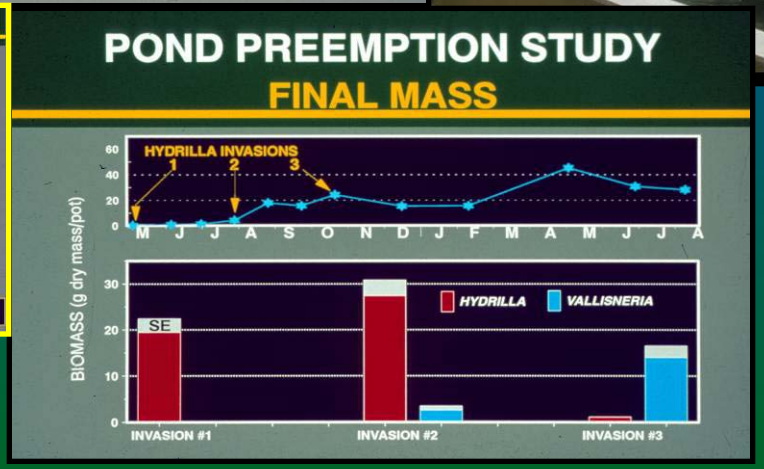
= weedy plants!

Native plants can resist invasion





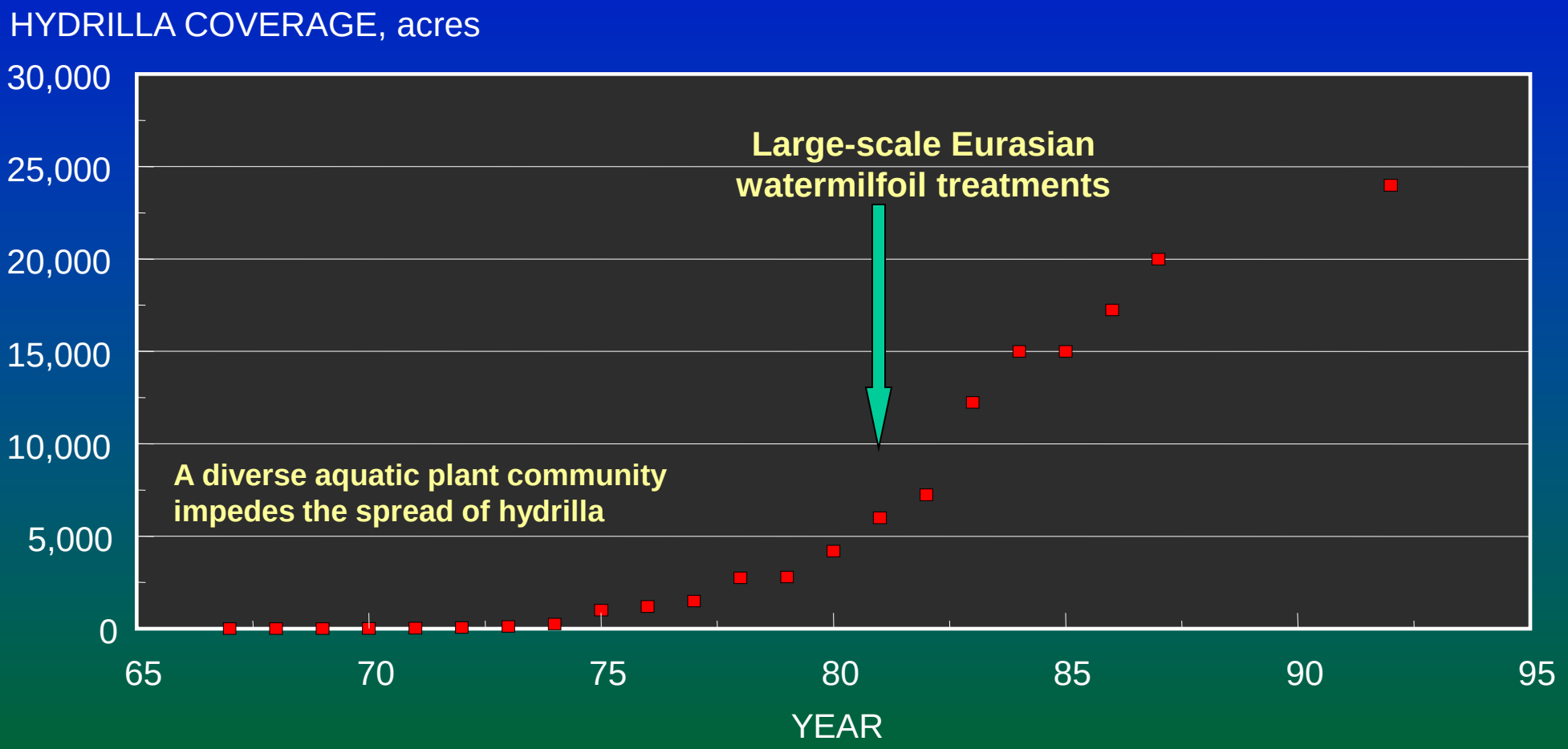




Preemption is the key to resistance!

Lake Seminole, Florida

Hydrilla first observed 1967



The best defense (against nonindigenous invasive aquatic plants and algae) is a good offense!

So, how do you manage water bodies to promote the development of beneficial, native aquatic plant communities?

There’s got to be a better way!

Under the Corps of Engineers’ Aquatic Plant Control Research Program we have been developing *holistic, ecological approaches to aquatic weed problems*

An Ecological Approach to invasive aquatic plant problems

- Control invasive species
- Reduce disturbances and excess nutrient loading
- Introduce host-specific biological controls
- Introduce a variety of native plant species
- Monitor plant community
- Take prompt remedial action

Hydrilla verticillata

Interfere with:

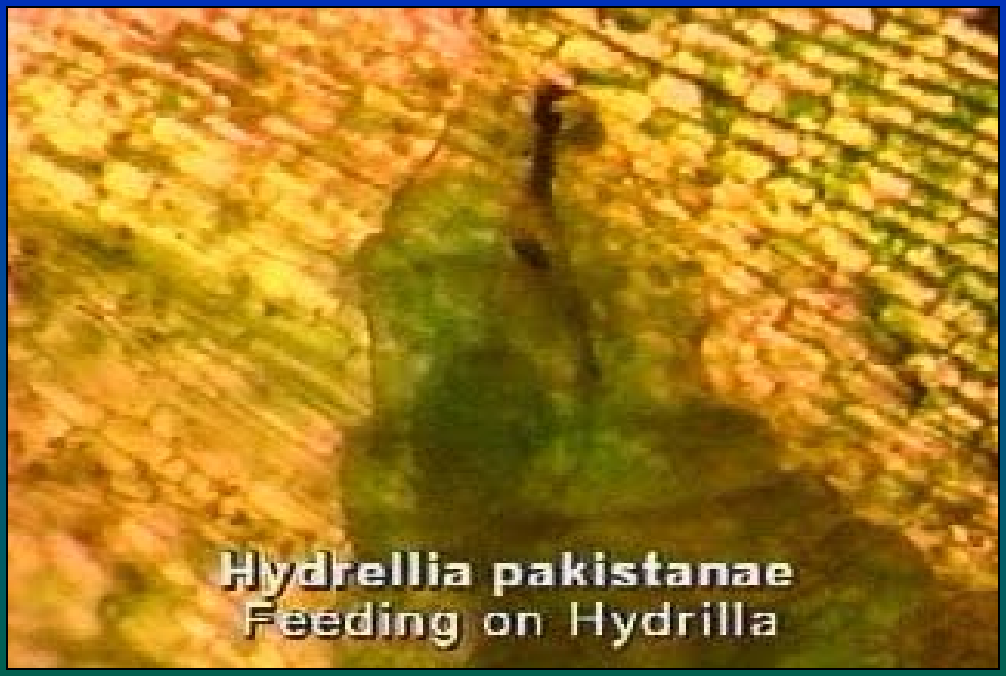
- Navigation
- Flood protection
- Recreation
- Water supply
- Hydropower production
- Fish and wildlife habitat

3 M water depth

“tubers”

Biological Control Options
Hydrilla leaf-mining flies

Adult

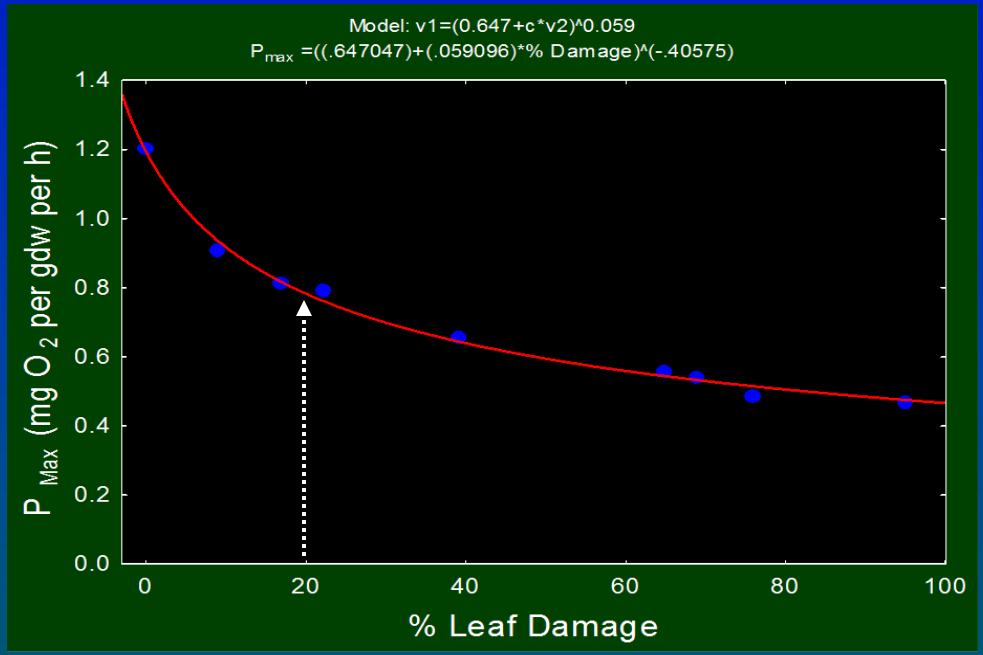


Larva feeding

Impacts of *Hydrellia* feeding

Decreased photosynthetic rates

As little as 20% damaged leaves can send the plant into negative carbon balance (24 hrs)

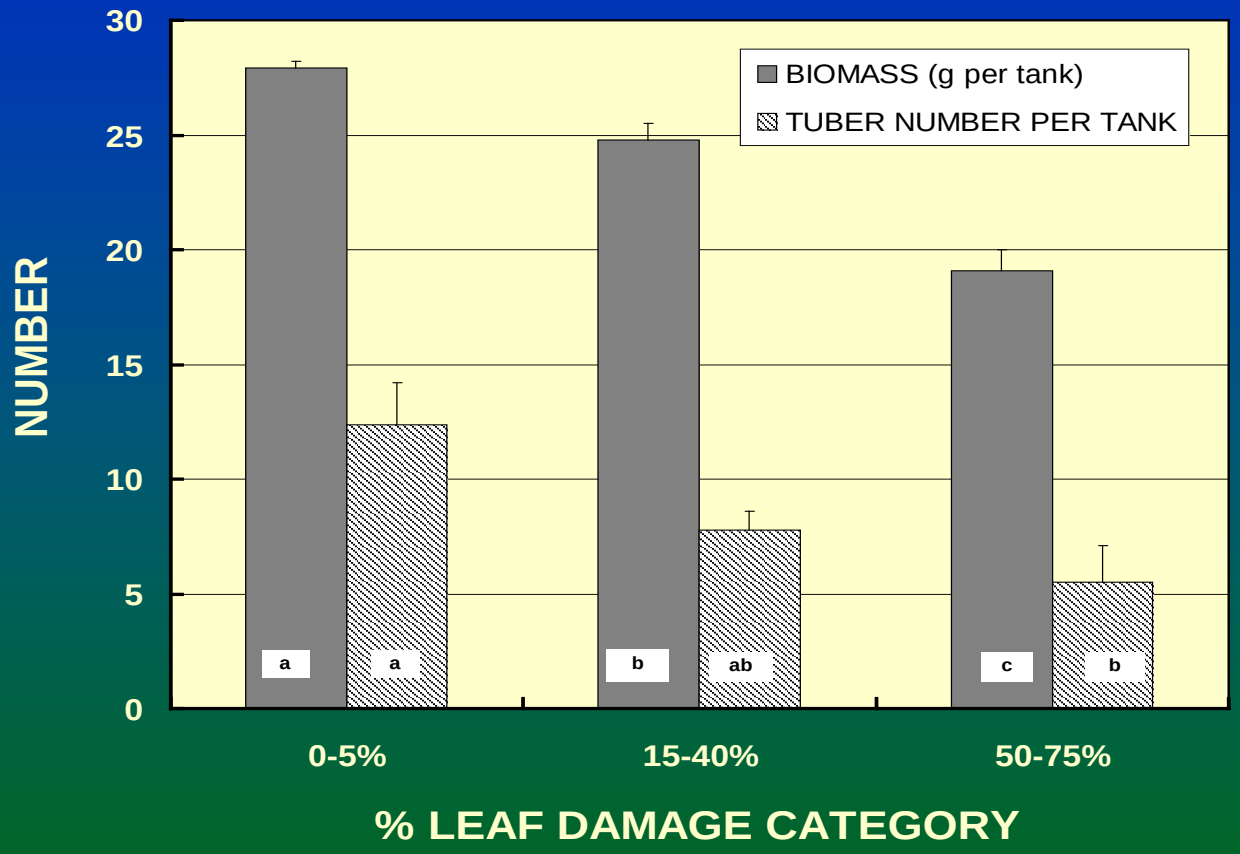


Impacts of *Hydrellia* feeding

Decreased photosynthetic rates

Decreased shoot biomass

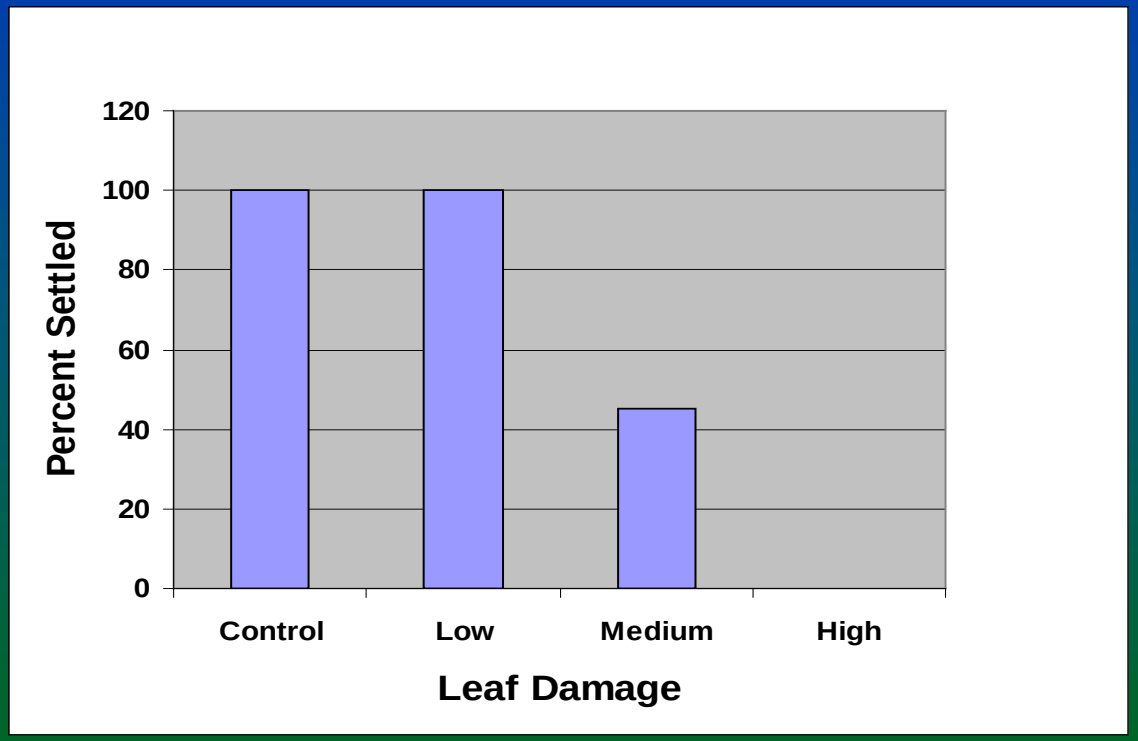
Decreased tuber production



Impacts of *Hydrellia* feeding

- Decreased photosynthetic rates
- Decreased shoot biomass
- Decreased tuber production
- **Decreased fragment viability**

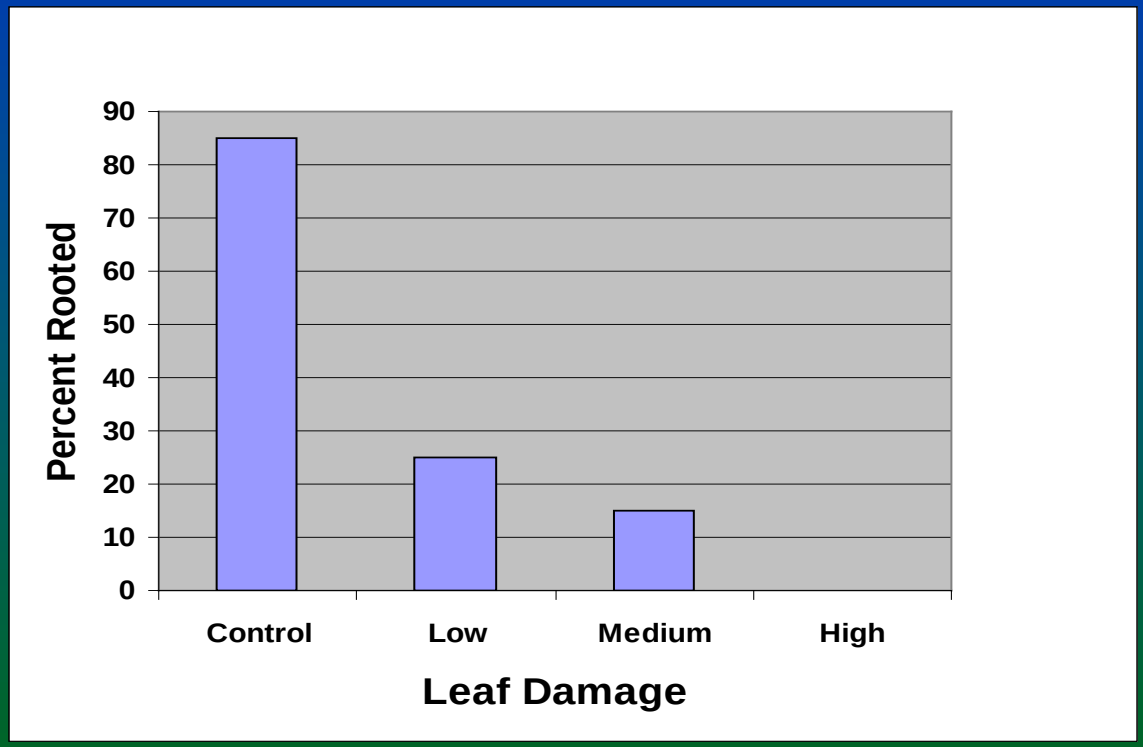
Fragment *Settling*



Impacts of *Hydrellia* feeding

- Decreased photosynthetic rates
- Decreased shoot biomass
- Decreased tuber production
- **Decreased fragment viability**

Fragment *Rooting*

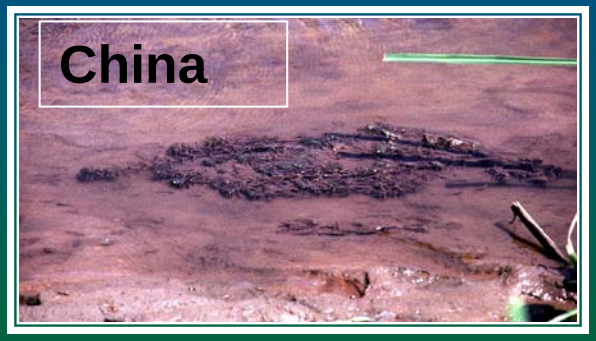


Impacts of *Hydrellia*

Rarely complete elimination

but …

- **Less competitive**
- **Slower spread**
- **Allow native species time to establish**



A “research-scale” example

Lake Jacksonville, Texas

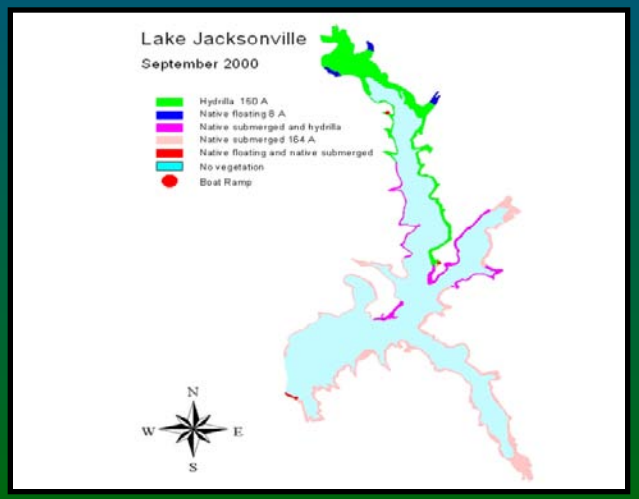
- **600 hectare impoundment**
- **Hydrilla invasion early 1990’s**
- **Selected for “test plantings” in 1997**
- **Cooperative agreement for small-scale “demo project” in 1998**

Lake Jacksonville – hydrilla management

- *Hydrellia* flies (single releases in 2002, 2005)
- Low-dose Aquathol ("spot" treatments annually)
- Low density grass carp (3-5 per vegetated acre)
- "Test plantings" of native aquatics (1997, 1998, 1999, 2000)

- Good establishment of native vegetation and flies
- Native plants spread into traditional hydrilla beds, resisted hydrilla spread


Fly damage to hydrilla




Spreading natives

Where do we go from here?

We have "proof of concept"

Laboratory, greenhouse, outdoor mesocosm, pond, and field studies have all produced positive results.

We need to conduct a large-scale demonstration project (*with adequate funding for long-term monitoring*) to demonstrate the *reality* of this approach.

Unfortunately …

Questions?