

# Aquatic Herbicides and Invasive Plant Control in Midwestern Lakes

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# Summary of Talk

- Common herbicides in the upper Midwest
  - Rates, selectivity
- Discussion of Concentration and Exposure Time (CET) Principles
- Herbicide Residue Sampling
  - Linking residues to CET
- Odds and Ends
  - New herbicides, New invasives, Hybrids,



**Eurasian watermilfoil-  
Dicotyledon**



**Curlyleaf pondweed-  
Monocotyledon**



# Systemic Herbicides that Target Milfoil

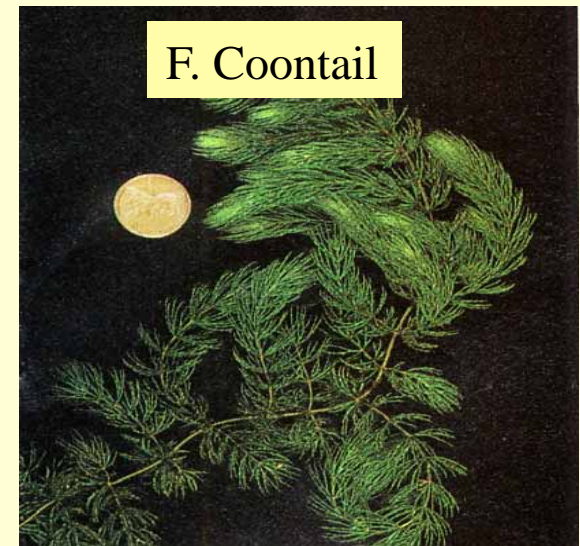
<b>Product</b>	<b>Use Rates (ppm)</b>	<b>Notes</b>
2,4-D Control (1950, 76)	0.5 to 4.0	Selective Milfoil  No impact on CLP
Triclopyr Control	0.5 to 2.5	Selective Milfoil

- Both products have much stronger activity on dicotyledons**
- Some monocots can be sensitive - rate and timing**
- Emergents: bulrush, waterlily, nuphar**



# Quiz: What do we mean by the term selectivity ?

A typical 1.5 ppm application of 2,4-D or Triclopyr will control :



# Contact Herbicides for CLP & EWM

<u>Product</u>	<u>Use Rates (ppm)</u>	<u>Notes</u>
Diquat (1958)	0.15 to 0.37  (placement)	Short exposure requirement <u>Turbidity impacts efficacy</u>  Generally non-selective
Endothall (1960)	1.0 to 3.0	Controls both EWM and CLP No Translocation (root crown ?)

**Fluridone (1986) - Will discuss in more detail**

# What Do we Mean by ppm ?

- 1 ppm Aquathol in 10 acres with 6 foot avg. depth  
Applied using GPS and calibrated pumps

38 gallons Aquathol into 19.6 million gallons of water  
3.8 gallons per acre  
GPS tracks – can insure even application

# Environmental Fate

**Photolysis** – fluridone (10- 45 d), triclopyr (2-7 d)

- timing, water depth

**Microbial** – 2,4-D (4-10 d), endothall (2-7 d)

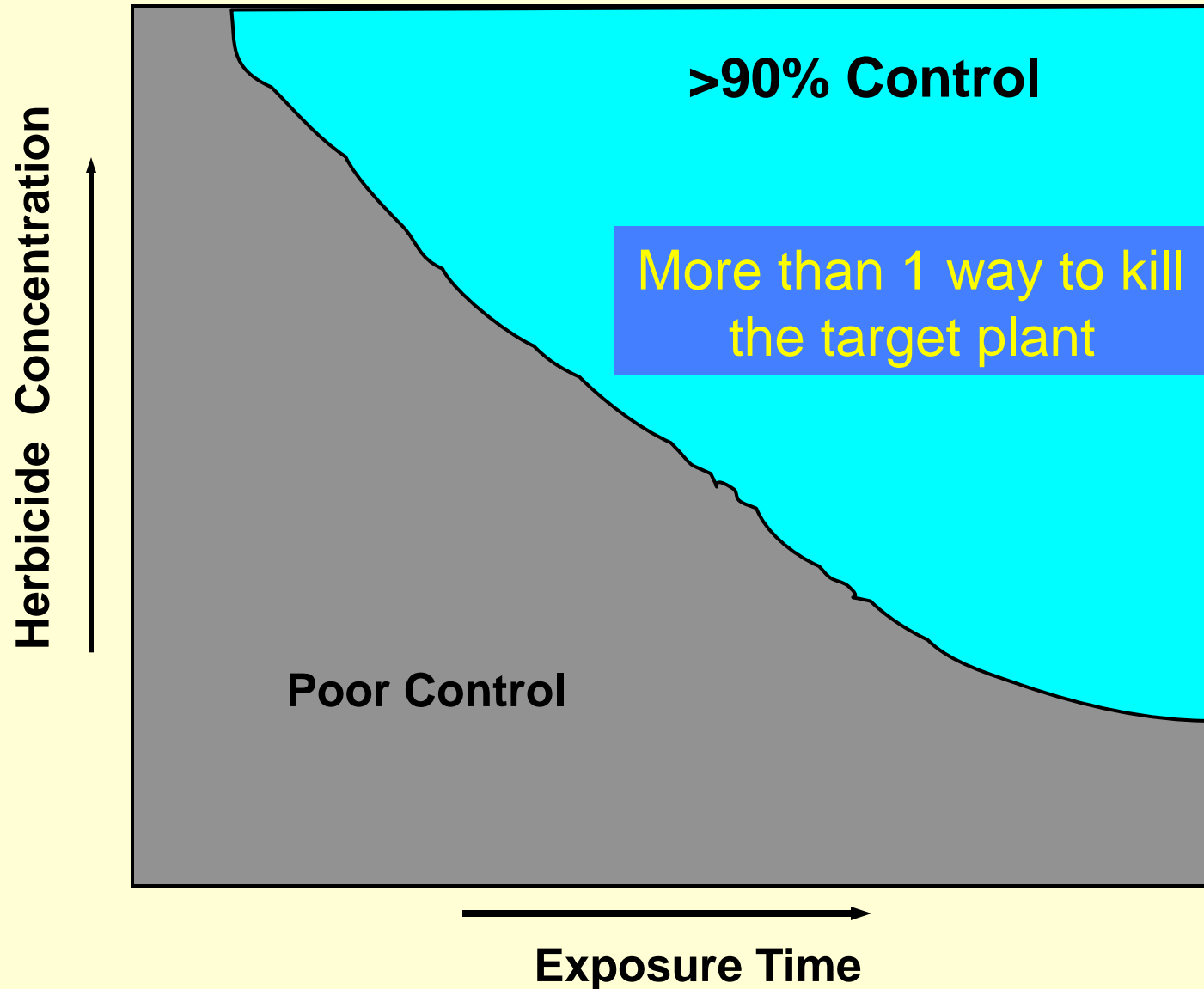
- large variations in half-lives (timing, water body)

**Deactivation** – diquat (minutes to days) – negatively charged particles (sediments) in water column

- Low Turbidity (NTU < 2) = high level of activity



# Concentration-Exposure Time Studies



# Herbicide CET Testing

(Vicksburg MS, Gainesville, FL)



# Growth and Herbicide Testing

(LAERF – Lewisville, TX)





# Why Monitor Residues ?

- Herbicide Residue Monitoring - Perceived as a Regulatory Necessity (NPDES Permits ?)
  - Required for Product Registration
  - Monitoring focused on relief from water use restrictions
  - Limited field efforts to link efficacy/selectivity to residue
    - COST! COST! COST!
- Development of ELISA (immunoassay) = cost-effective ability to monitor
  - Fluridone, triclopyr, 2,4-D, endothall, penoxsulam







# Background

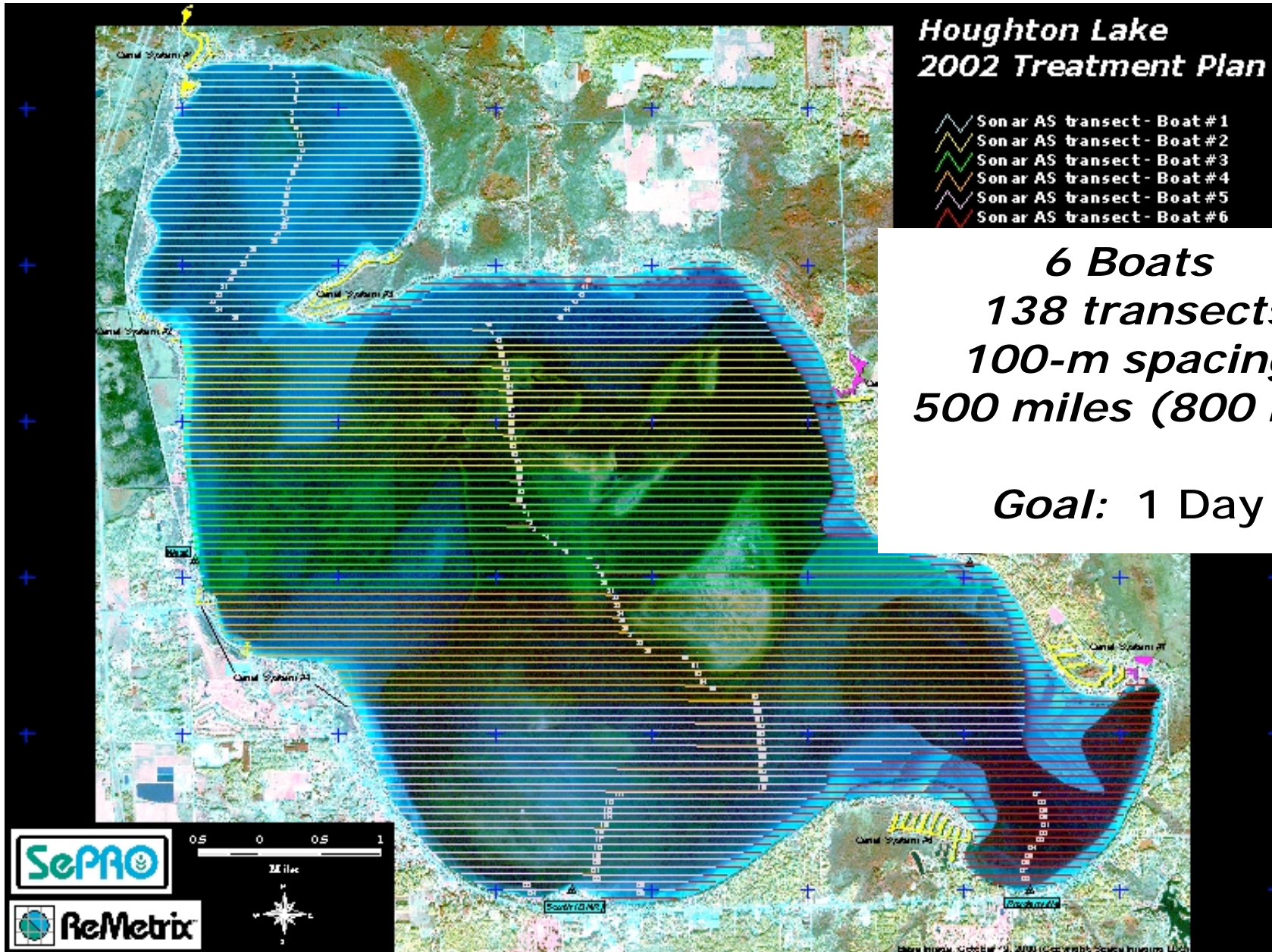
- SePRO Corp. developed an ELISA for fluridone
- Fluridone = low use rates and long-lived product
  - Whole-lake applications = significant investment
  - Concerns regarding non-target selectivity
  - Testing was made commercially available
- Monitoring emphasized efficacy & selectivity - regulators insured of application rates
  - Used since the early 1990's





# 1850

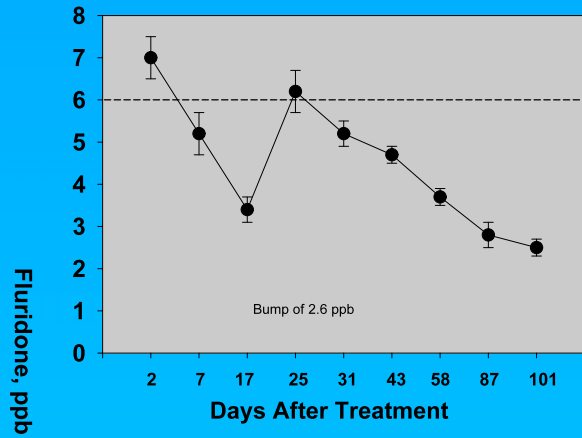
# Houghton Lake 2002 Sonar A.S. Treatment Map





### Houghton Lake Fluridone Residues

Average of 36 sample points



# Is Fluridone the Only Compound Amenable to Operational Sampling ?

Yes – Fluridone is unique as an aquatic herbicide

- whole-lake treatments
- need for bump applications
- strict ppb requirement

No – Sampling can provide valuable information

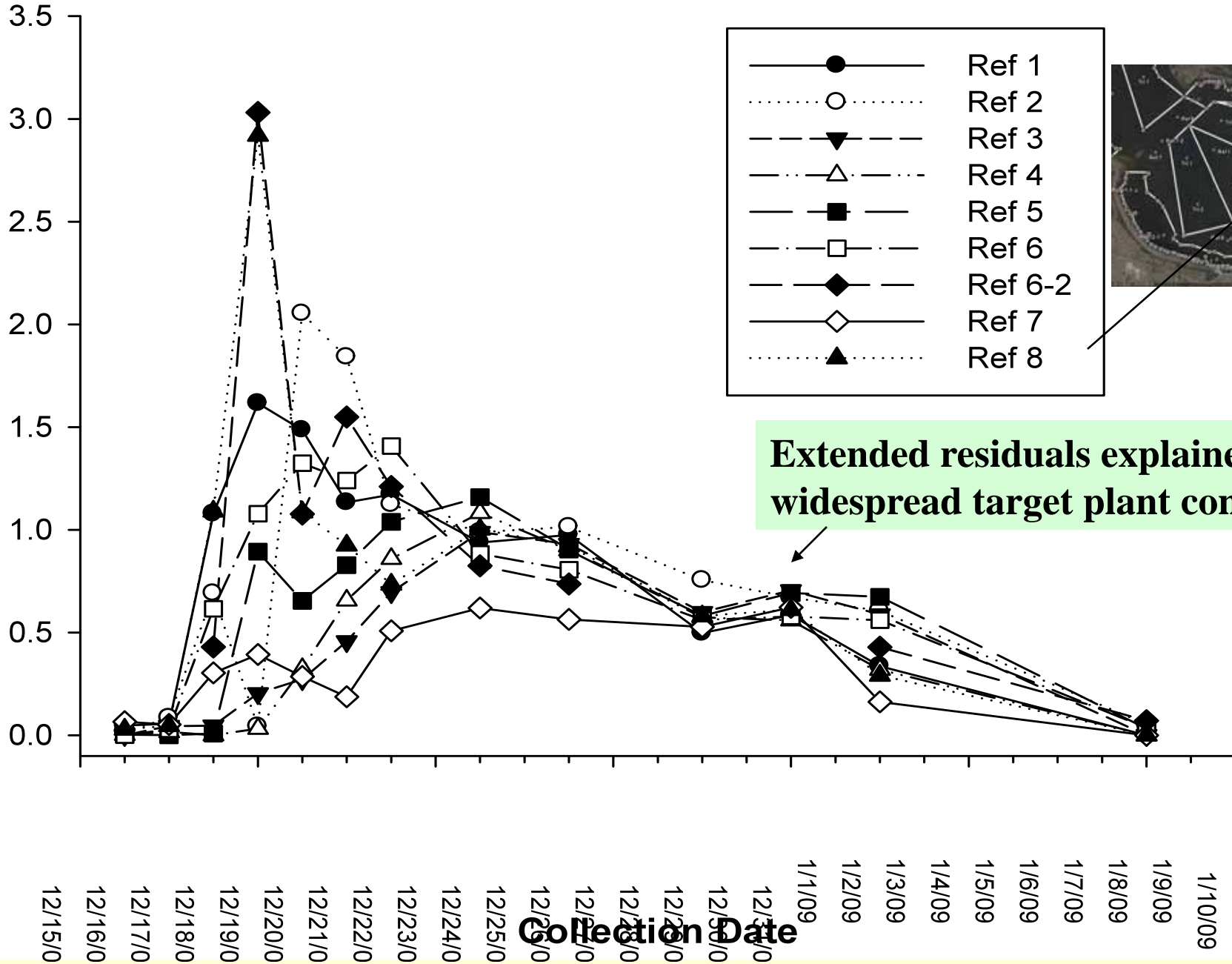
- Determine residue behavior following application
- Environmental factors that influence degradation
- Comparison of application techniques or strategies

# The Scale or Timing of Treatment can Dictate Operational Sampling





# Endothall Residue in Non-treated Sites



**Extended residuals explained widespread target plant control**

# Residues can help to explain poor treatment results

**Early-season large-scale treatments in Lake Minnetonka**

**Endothall 1 ppm + triclopyr 0.25 ppm – April 13, 08**



**Carman Bay**  
**95 acres**  
**48% of littoral**

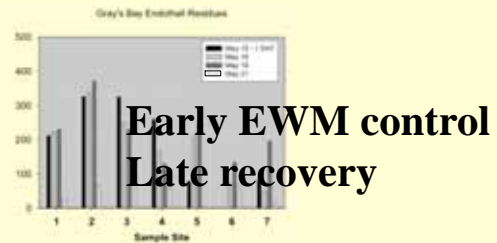
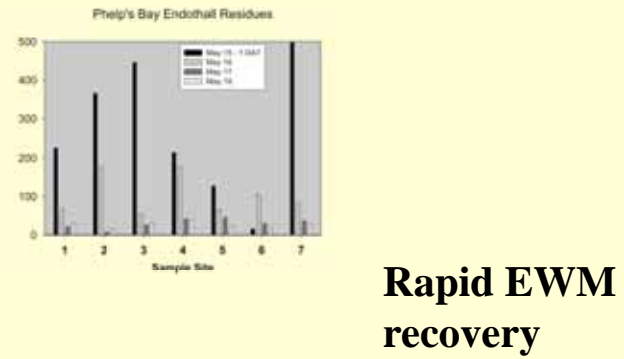
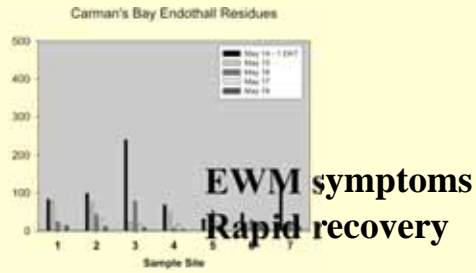


**Phelps Bay**  
**150 acres**  
**55% of littoral**



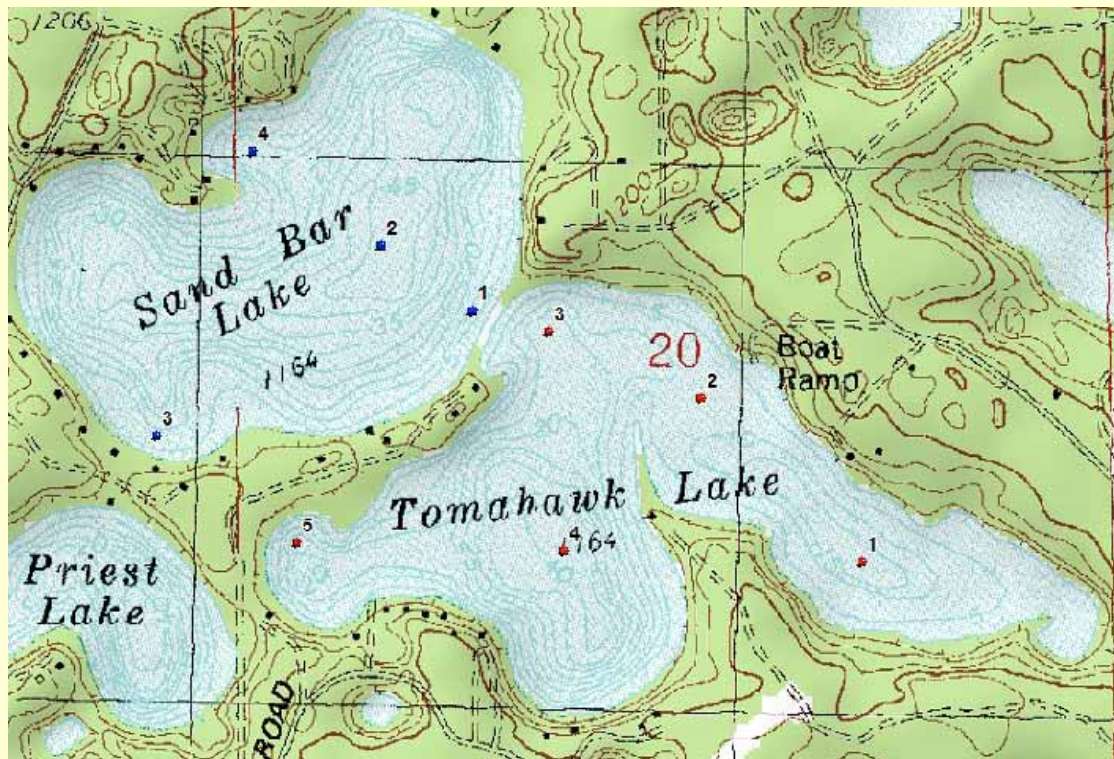
**Gray's Bay**  
**160 acres**  
**91% of Bay**

# Endothall Target rate = 1000 pppb



# Residues & Unexpected Results

- Lake Tomahawk, WI



**Approx 150 acres**

**Treated at 0.5 ppm  
2,4-D**

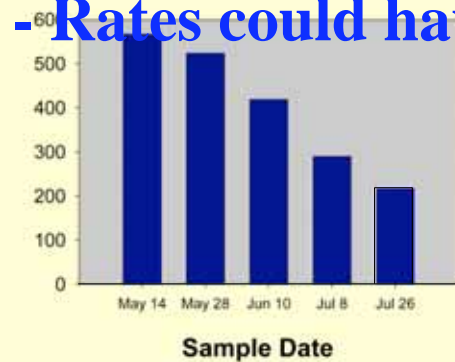
**Sampled through  
summer**



## Residues phytotoxic to EWM remained 2+ months post-treatment

- Impacts to Native plants ?
- Why was 2,4-D degradation so slow in this system ?
  - predicting microbial activity ?

- Rates could have been reduced by 75%



What Else is Going on in Aquatic  
Research – Northern perspective ?

# New Products Registered

Carfentrazone (05) – contact herbicide

Penoxsulam (07) – ALS inhibitor

Imazamox (08) – ALS inhibitor

- New products slow to Midwest

**4 EUP compounds-**

Flumioxazin, bispyribac, quinclorac, topramazone,

**Hybrid or Spicatum ?**



**Hybrid is difficult to distinguish from EWM – Morphology, growth**

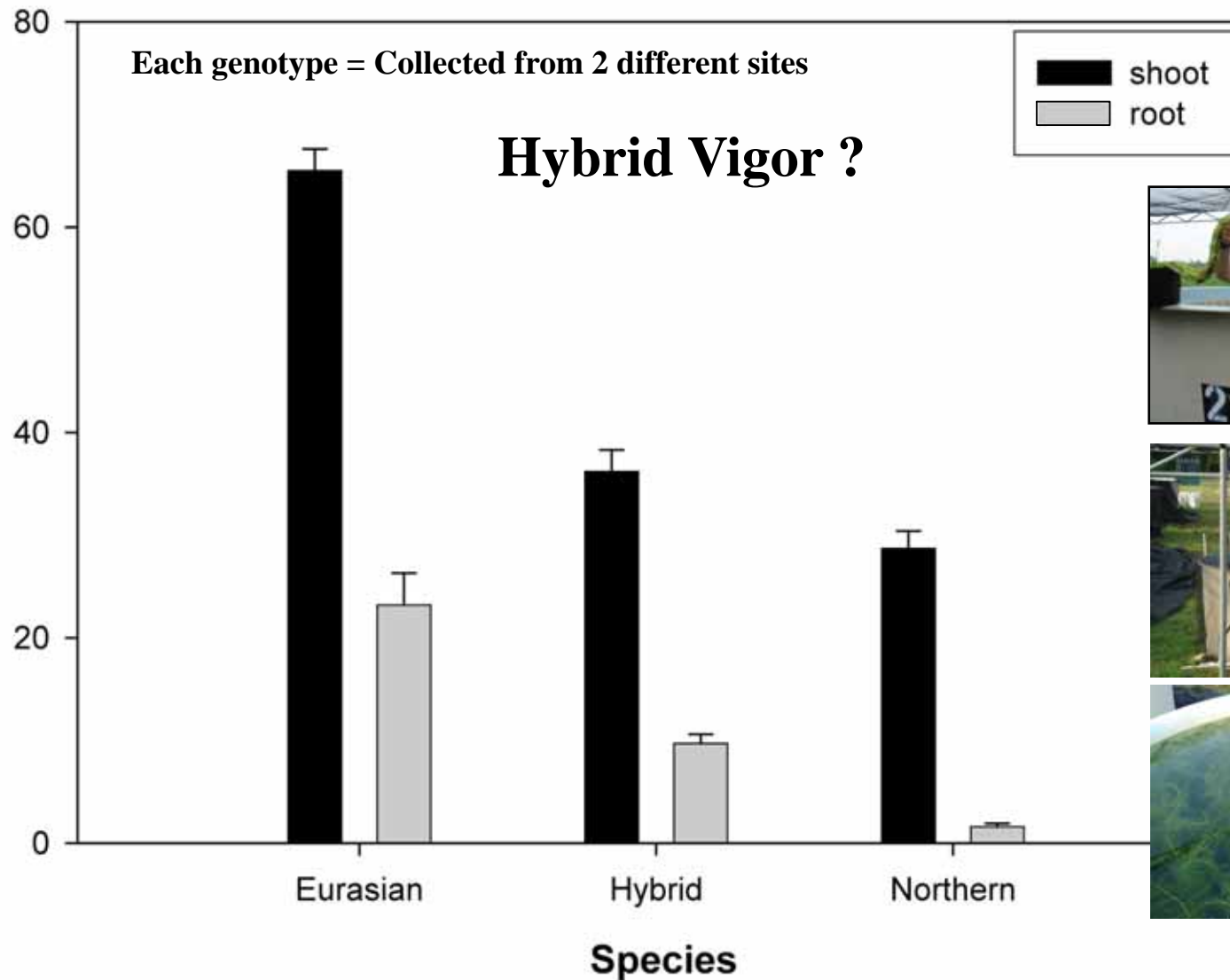


## **7 Decades of Milfoil Management – Is Hybridity a New Phenomenon or Just a Newly Discovered Phenomenon ?**

**Hybrid documented in WA, ID, MN, WI, MI, VT  
widespread geographic distribution = distinct populations**



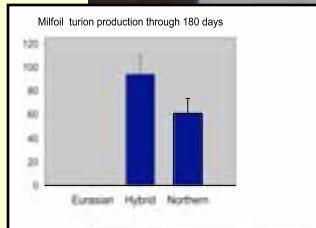
# April 26, 2008 Harvest – Competition between genotypes 8 Months After Planting



# Acquisition of a Parental Trait - Turion Formation by Hybrid Milfoil: Significance to Management ?

Hybrid

Northern



# Cabomba – a worldwide invasive coming on strong



## Cabomba Populations

Red



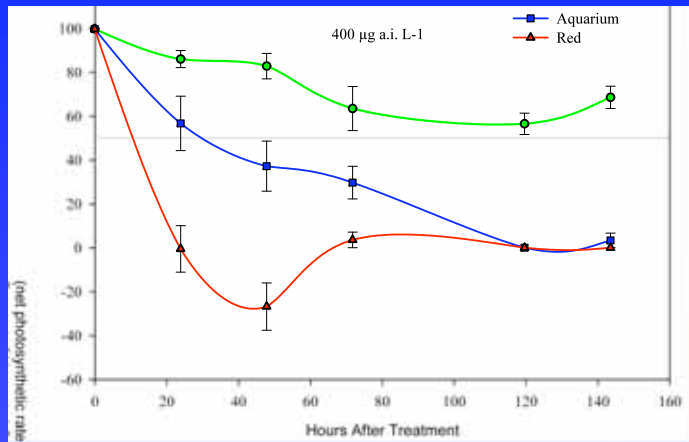
Green



Aquarium



# Response of 3 phenotypes to Carfentrazone



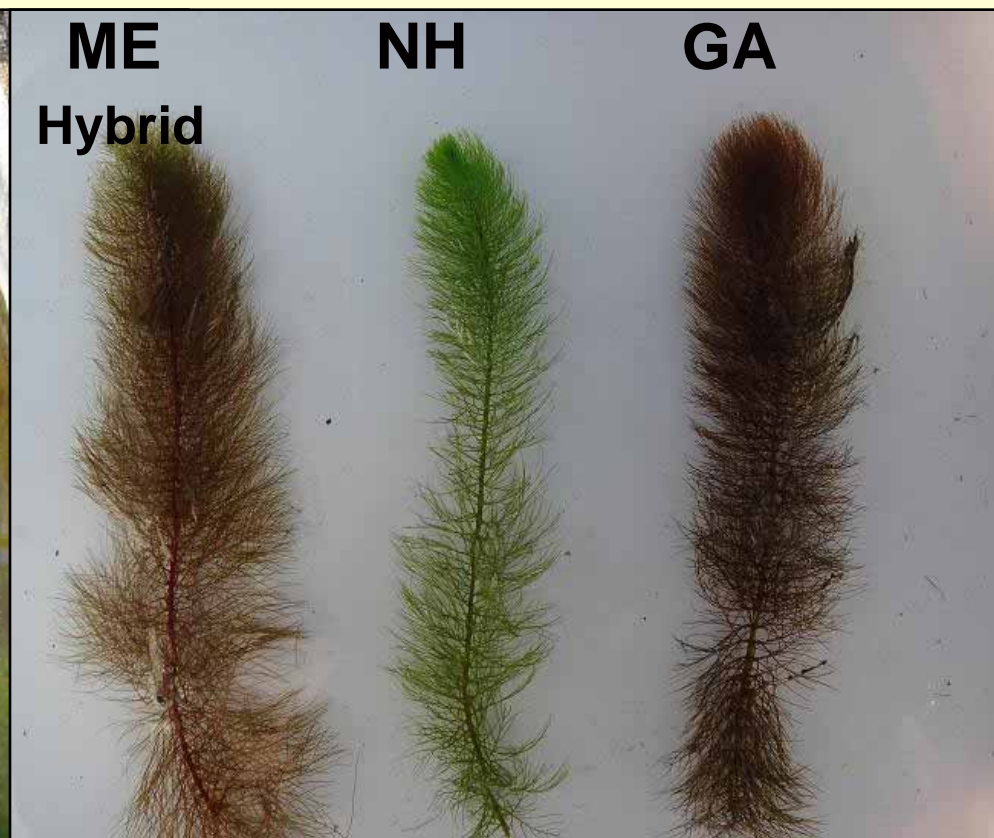
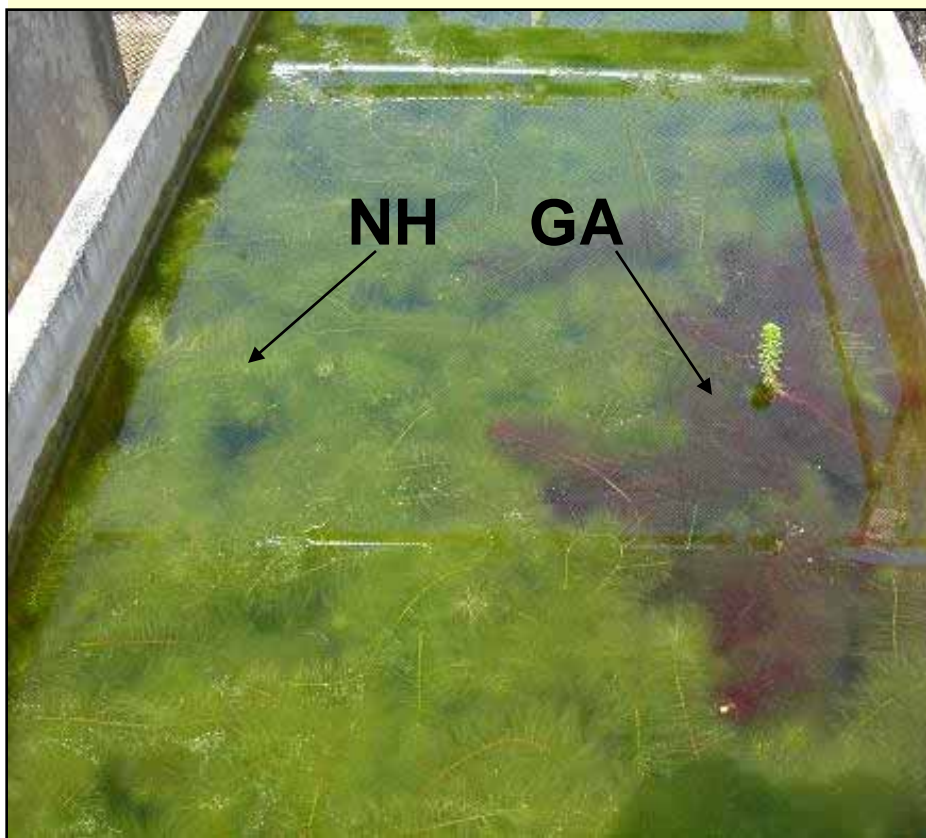


# Variable Milfoil (VM) – When a good native goes bad

## -Easy to Distinguish Phenotypes

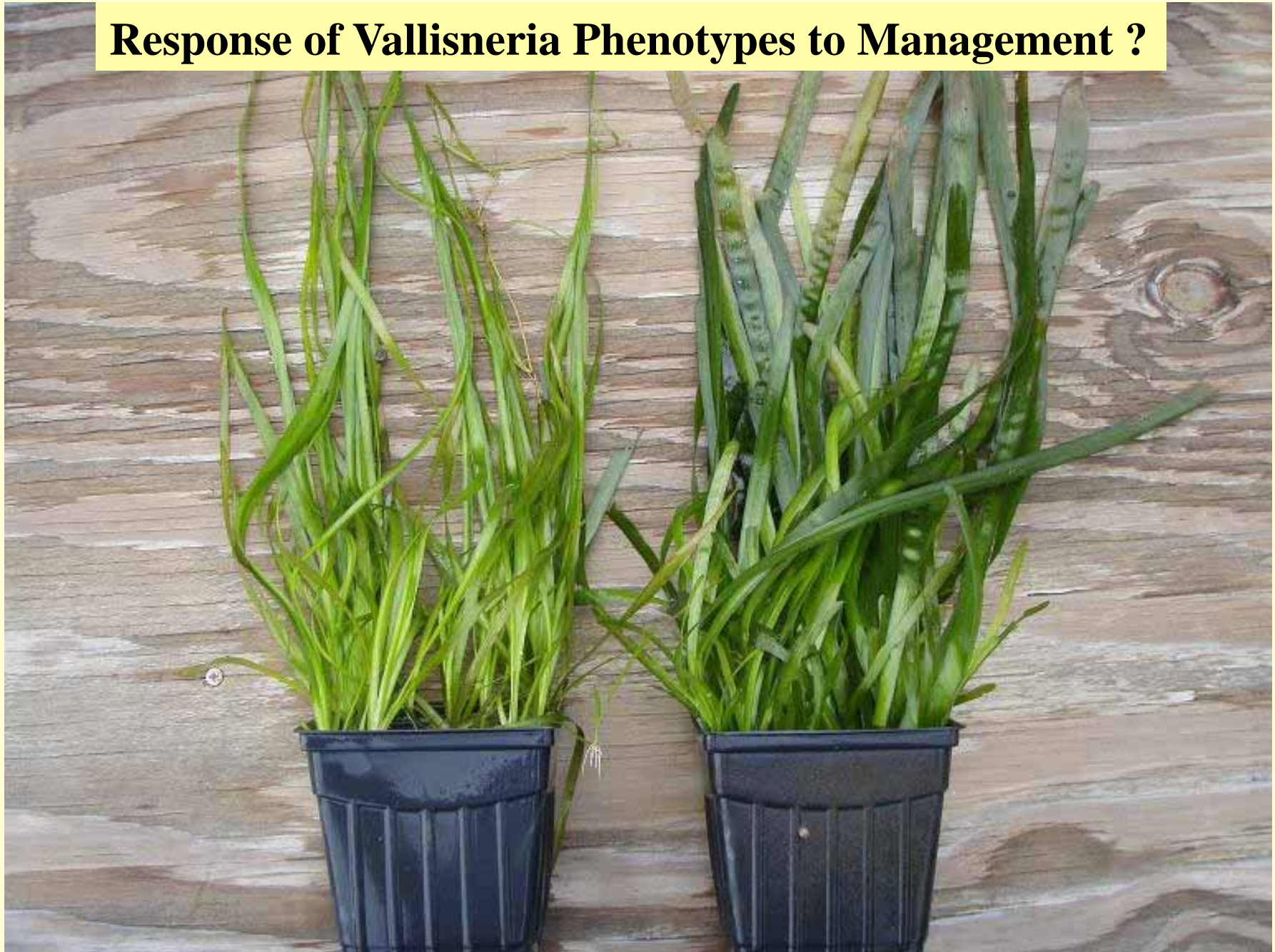
-NH and GA are distinct strains of VM (genetic testing – Thum, and Moody)

-NH strain was most aggressive in culture conditions (FL)





## Response of Vallisneria Phenotypes to Management ?



# ACKNOWLEDGEMENTS

- US Army ERDC – Aquatic Plant Control Research Program
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