Herbicide Selectivity/Aquatic Plant Management

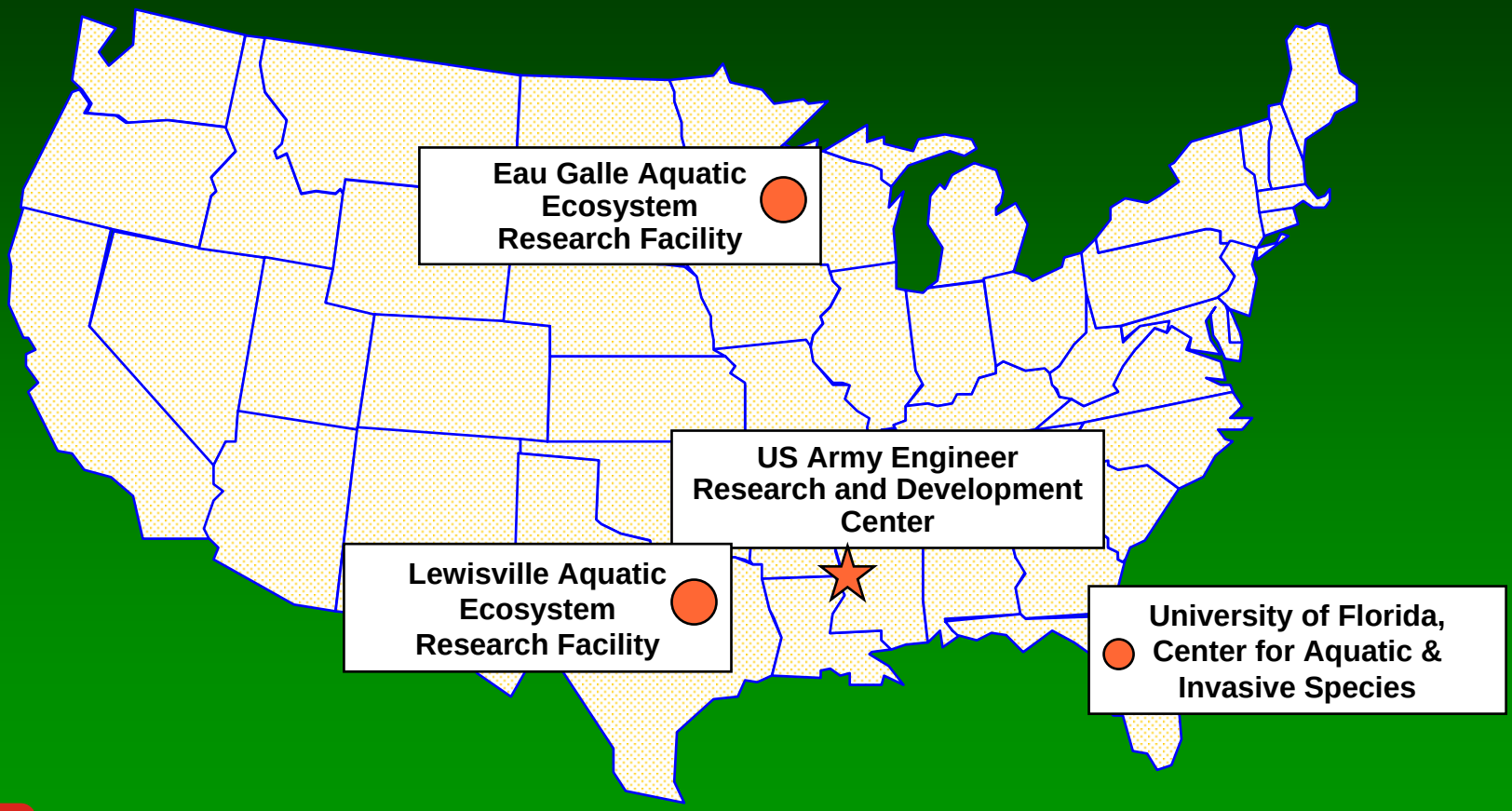
US Army Engineer Research and Development Center (ERDC)

Chemical Control Technology Team

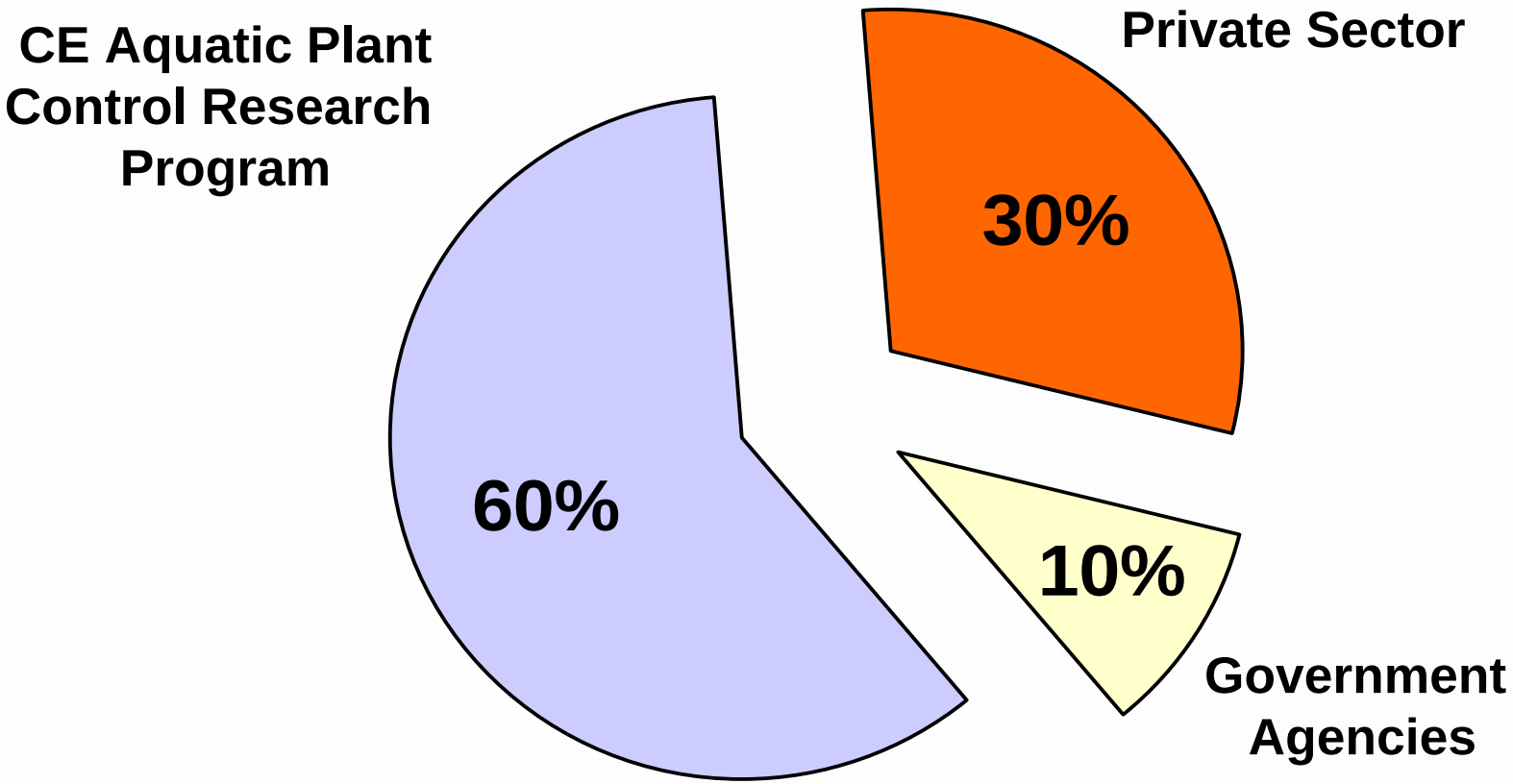
- Develop effective and environmentally compatible chemical control techniques

- Provide guidance for their use to manage nuisance vegetation in the Nation's waterways

Research Facilities



Research Sponsors



Technology Transfer

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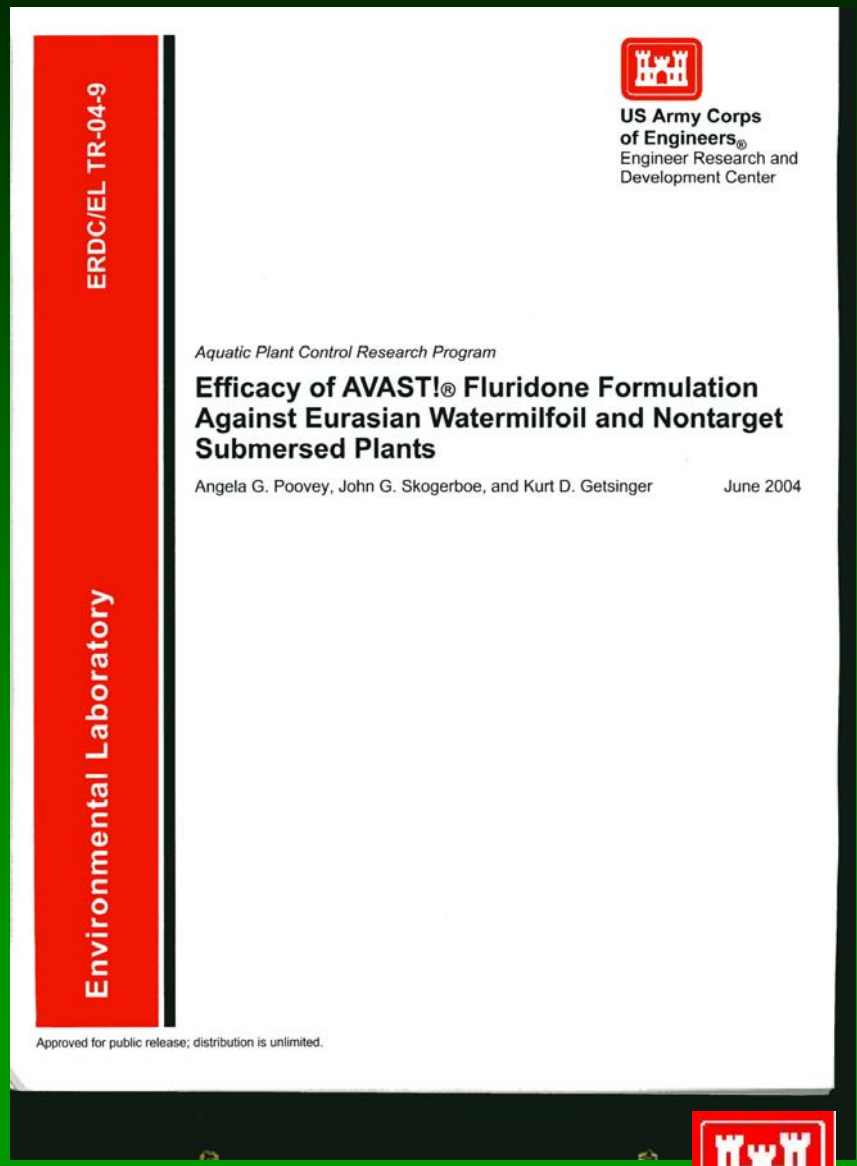


ERDC/EL TR-04-9

Environmental Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Aquatic Plant Control Research Program

Efficacy of AVAST!® Fluridone Formulation Against Eurasian Watermilfoil and Nontarget Submersed Plants

Angela G. Poovey, John G. Skogerboe, and Kurt D. Getsinger June 2004

Herbicide Selectivity/Aquatic Plant Management

- Cost effective control of target species
- No adverse impacts to non target species

Eurasian watermilfoil

Curlyleaf pondweed

Concentration Exposure Time Experiments

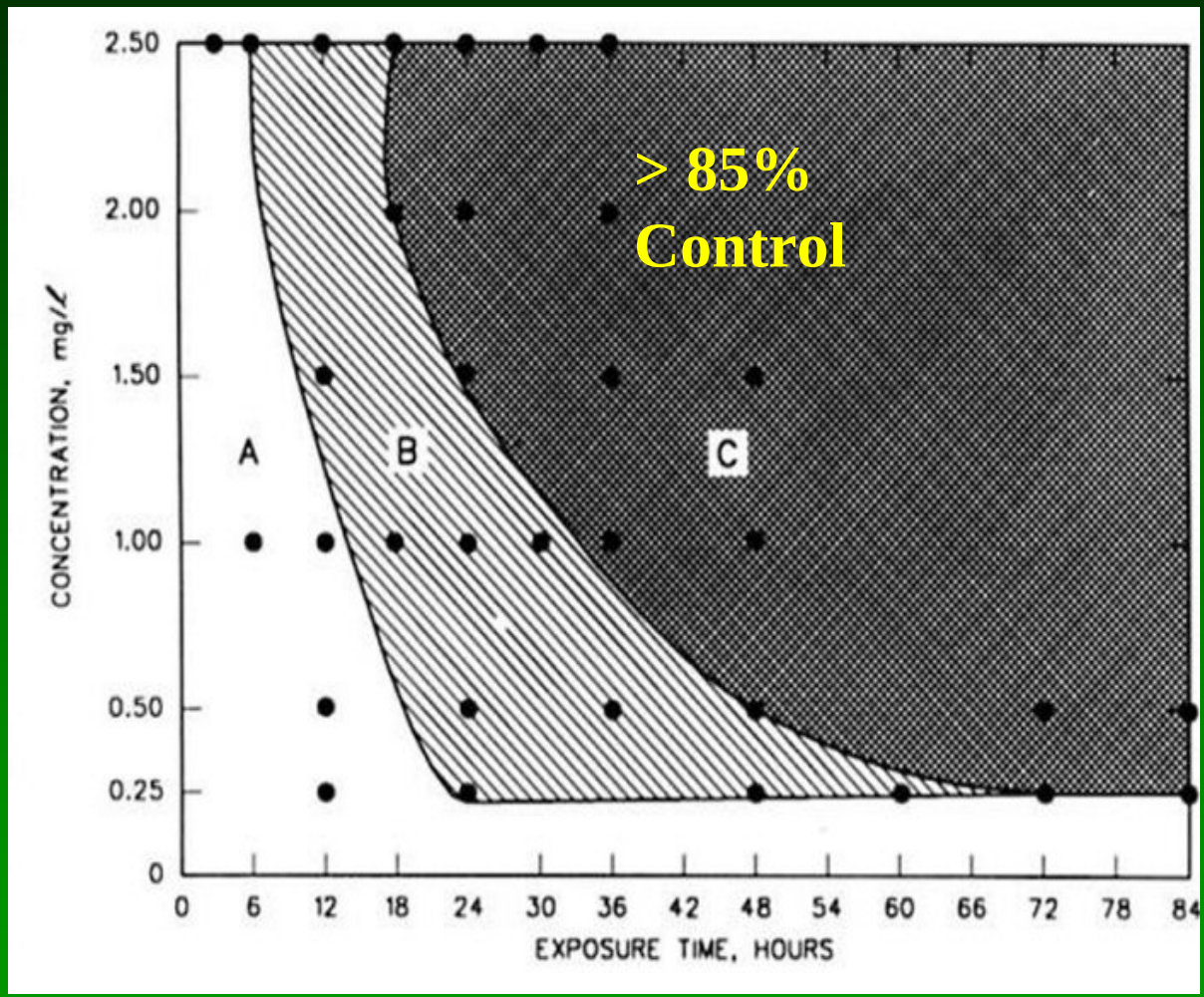
Indoor Growth Chambers and Greenhouse

Environmentally Controlled

- Temperature
- Light intensity and duration
- Water Quality

- Wide Range of herbicide conc. and exposure times
- Replicated Studies

Triclopyr Concentration/Exposure Time Relationship



J. Aquat. Plant Manage 30: 1-5

Concentrations Exposure Times Required for Effective Plant Control

Herbicide	Concentrations	Exposure Times
Copper	0.75-1 mg/L	2-4 hours
Diquat	0.09-0.37 mg/L	2-4 hours
2,4-D	1 – 2 mg/L	24-72 hours
Triclopyr	.5 – 2.5 mg/L	24-72 hours
Endothall	1.5-5 mg/L	24-72 hours
Fluridone	5 – 150 ug/L	45-60 days

Spatial Selectivity

Small area/spot treatments

- Short contact times, diquat and copper
- Slower release granular and gel formulations
- Herbicide combinations

Species Selectivity

1. Dicot specific herbicides
2. Differential sensitivity to herbicides between aquatic plant species
3. Phenology/application timing
4. Herbicide combinations

Herbicide Selectivity Experiments
Outdoor Mesocosms

- 30, 7000 L tanks
- Flow rate controls

24, 1100 L shallow tanks

Dicot Specific Herbicides

2,4-D, triclopyr

Triclopyr mesocosm evaluation

Untreated reference

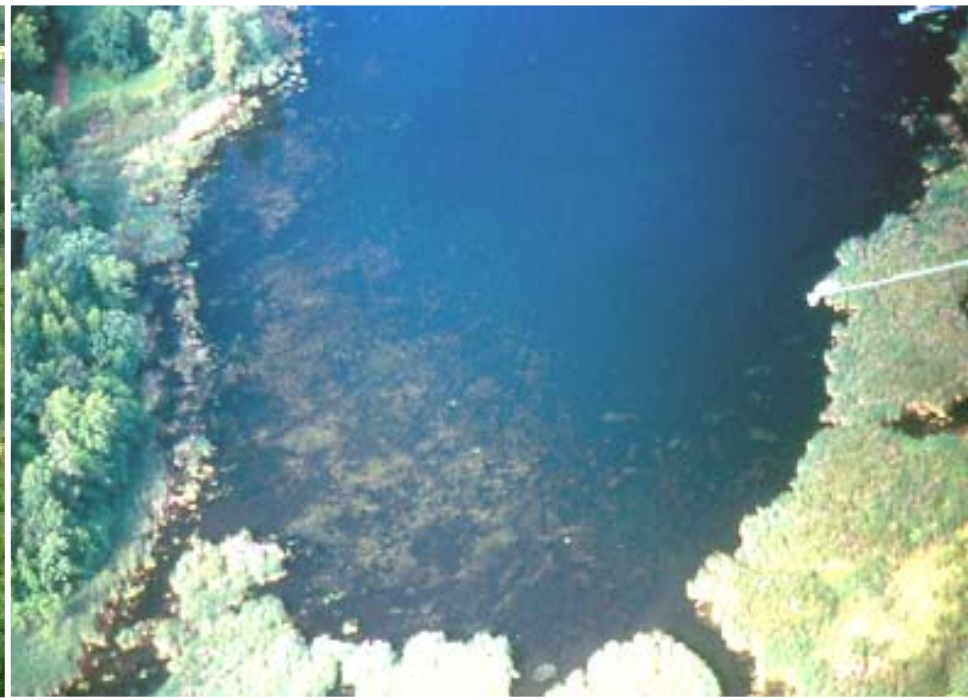
2.5 mg/L, static

Selective Herbicides

Triclopyr

Carson's Bay, Lake Minnetonka

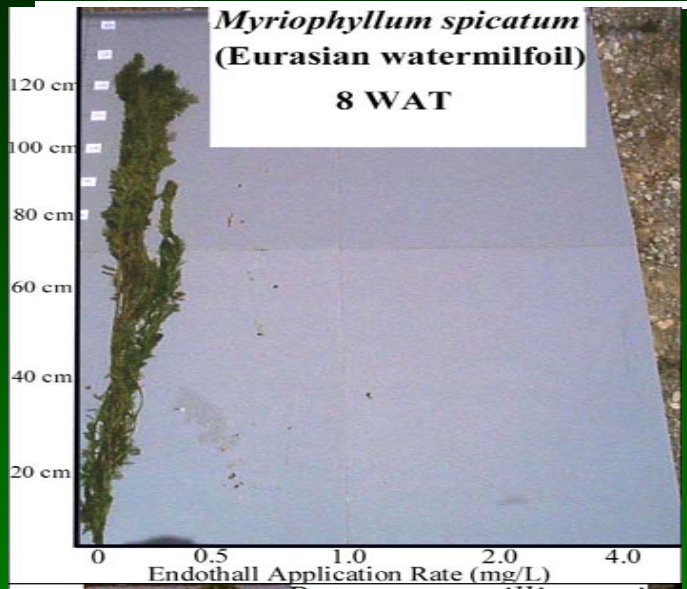
1994 post treatment

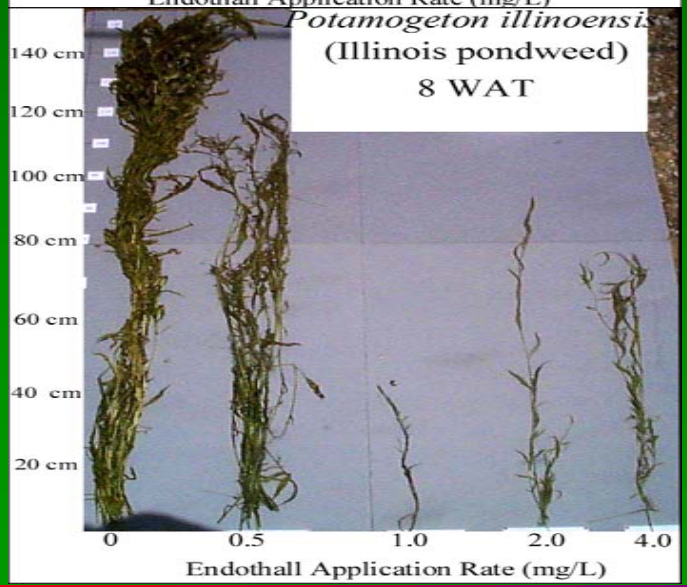


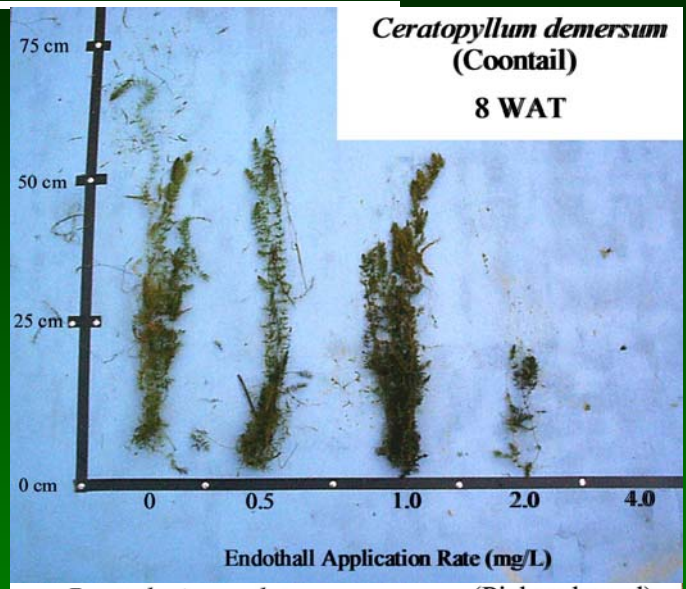
1994 pre treatment

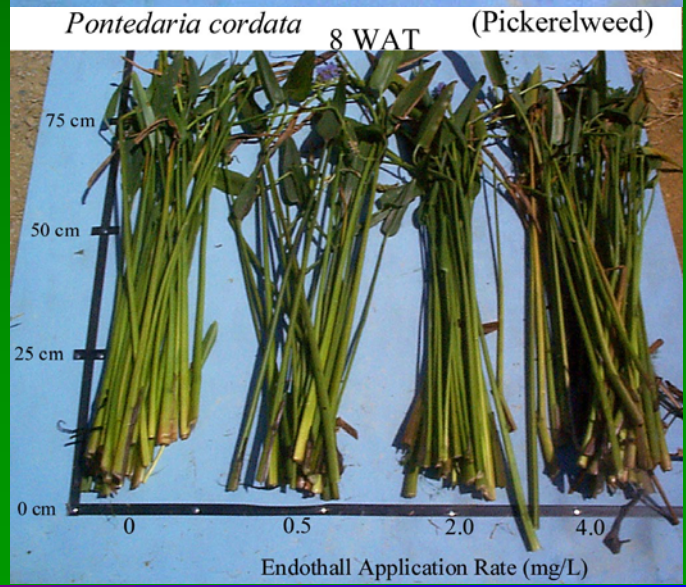
Differential Sensitivity

Endothall Mesocosm Evaluation



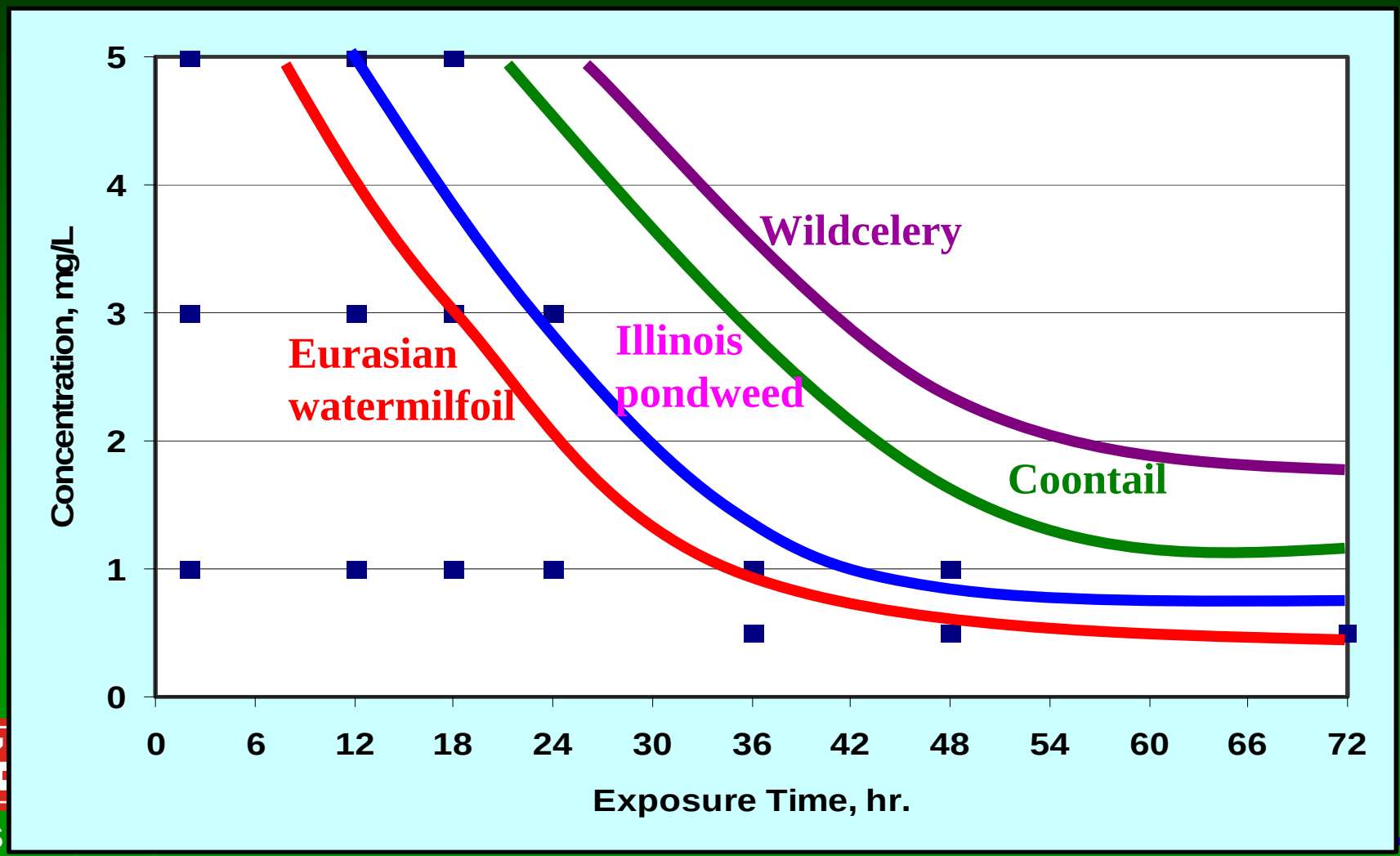






Differential Sensitivity to Herbicides

Endothall



Species Selective Aquatic Herbicides

1. 2,4-D
   - Eurasian watermilfoil
   - monocot dominated lakes
2. Triclopyr,
   - Eurasian watermilfoil
   - monocot dominated lakes
3. Fluridone
   - Curlyleaf pondweed & Eurasian watermilfoil
   - Mesotrophic lakes dominated by pondweeds
4. Endothall
   - Curlyleaf pondweed & Eurasian watermilfoil
   - Eutrophic lakes dominated by coontail and elodea

Application Timing/Phenology

Early Spring Herbicide Applications

Objective
Early Spring Herbicide Applications

- **Control curlyleaf pondweed before new turions are formed**
- **Control exotic plants before many native plants actively grow**
- **Apply herbicides when exotics are weakest (low carbohydrates)**

Multi Phase/Multi Year Research Project

- **Small Scale Greenhouse Studies (1998-1999)**
- **Mesocosm Scale Studies (1997-1999)**
- **Field Demonstration (1999-2004)**

Study Lakes

Lake	Area (acres)	Depth (feet)	
Cleary Lake	120	4	Untreated Reference
Hurley Lake	4	3	Untreated Reference
Blackhawk Lake	37	4	Whole Lake Treatment
Schwanz Lake	12	6	Whole Lake Treatment

Study Lakes

Lake	2000 Application Rate	2001-2003 Application Rate
Cleary Lake	0 mg/L	0 mg/L
Hurley Lake	0 mg/L	0 mg/L
Blackhawk Lake	1.5 mg/L	1.0 mg/L
Schwanz Lake	2.0 mg/L	1.0 mg/L

Plant Evaluations

- **Relative abundance (biomass)**
- **Percent Occurrence**

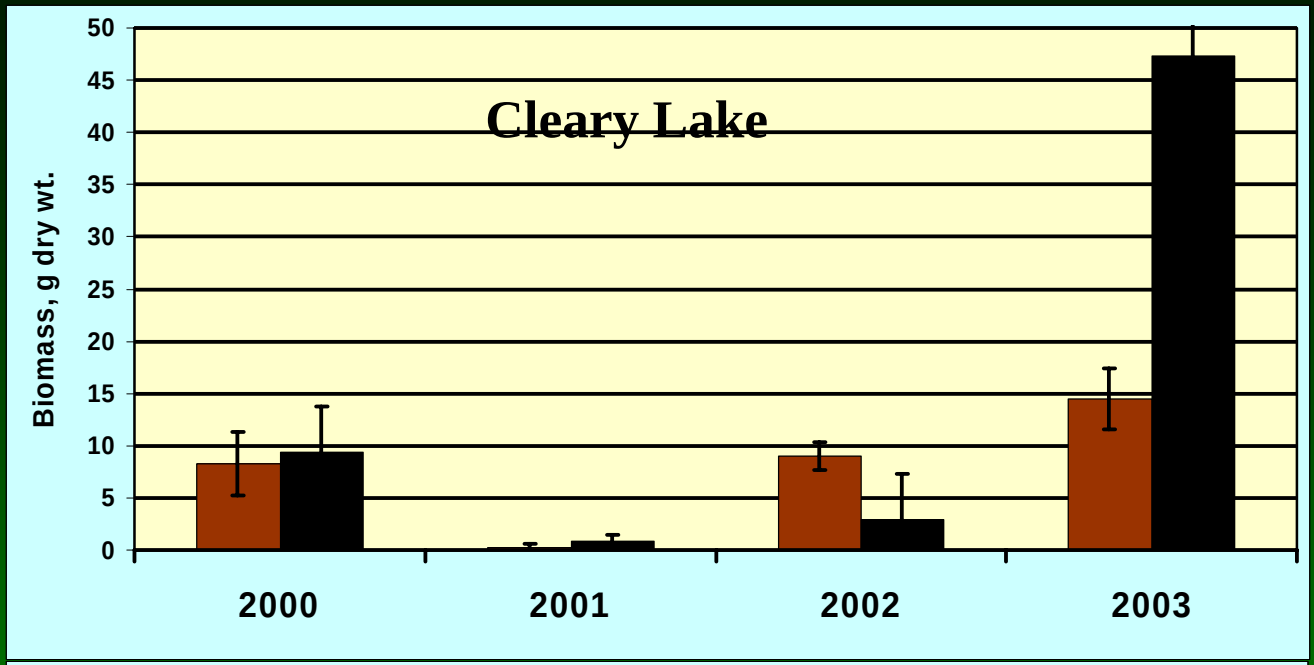
– **April, pre treat**

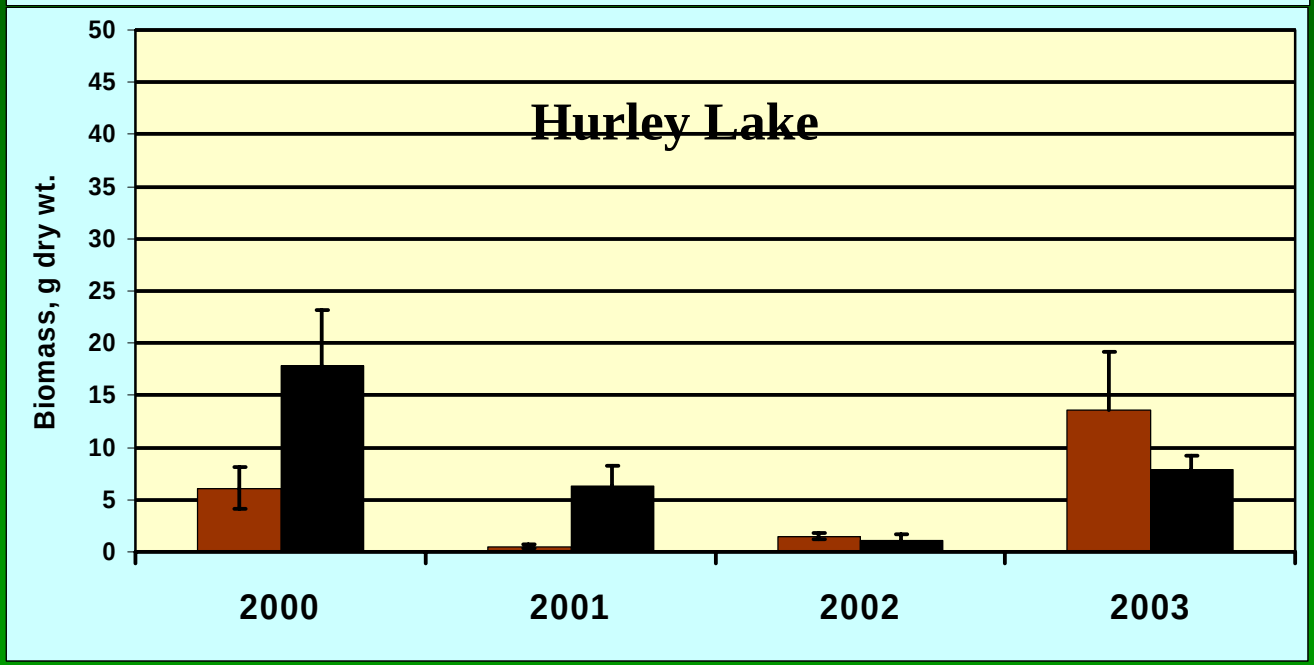
–**June, 8 WAT**

–**August**

Curlyleaf pondweed Abundance

Untreated Reference Lakes



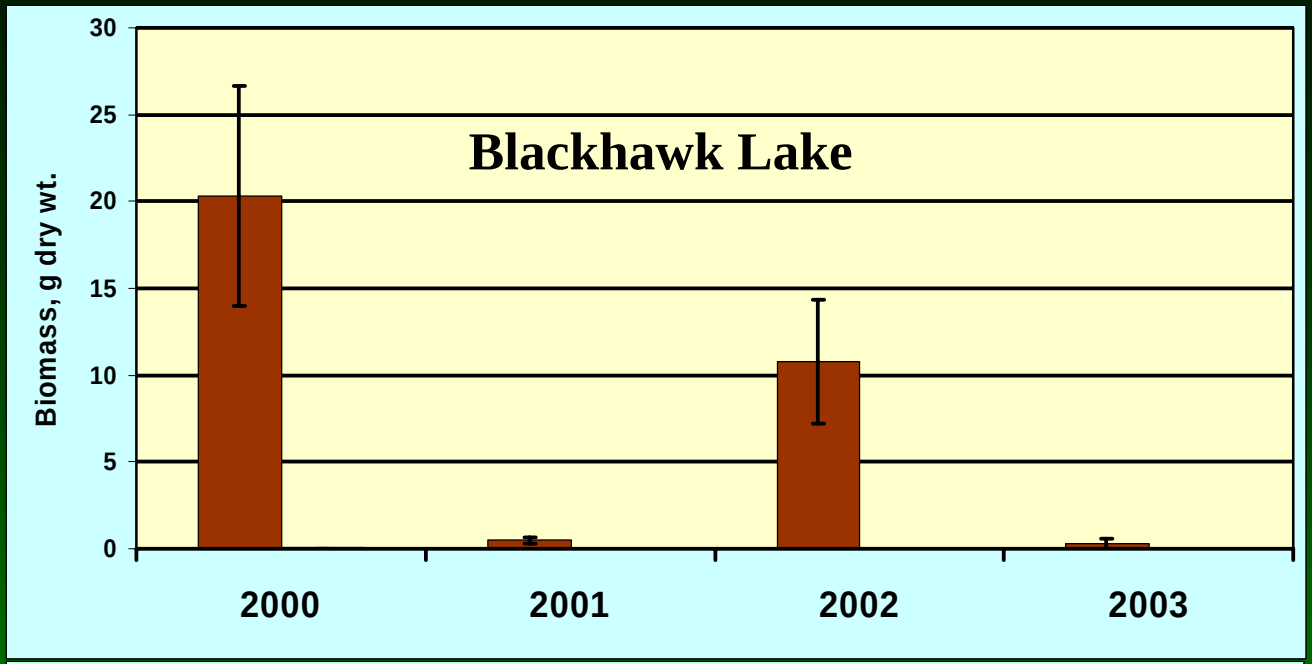


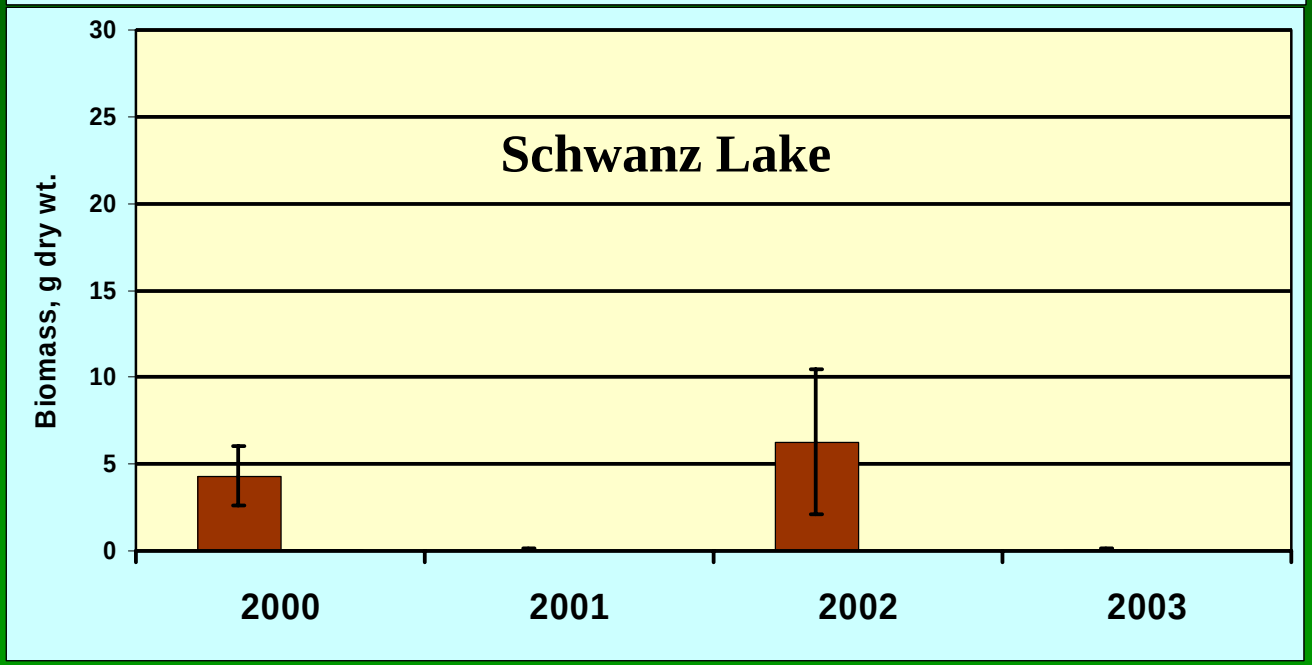
April

June

Curlyleaf pondweed Abundance

Lakes Treated with Aquathol® K



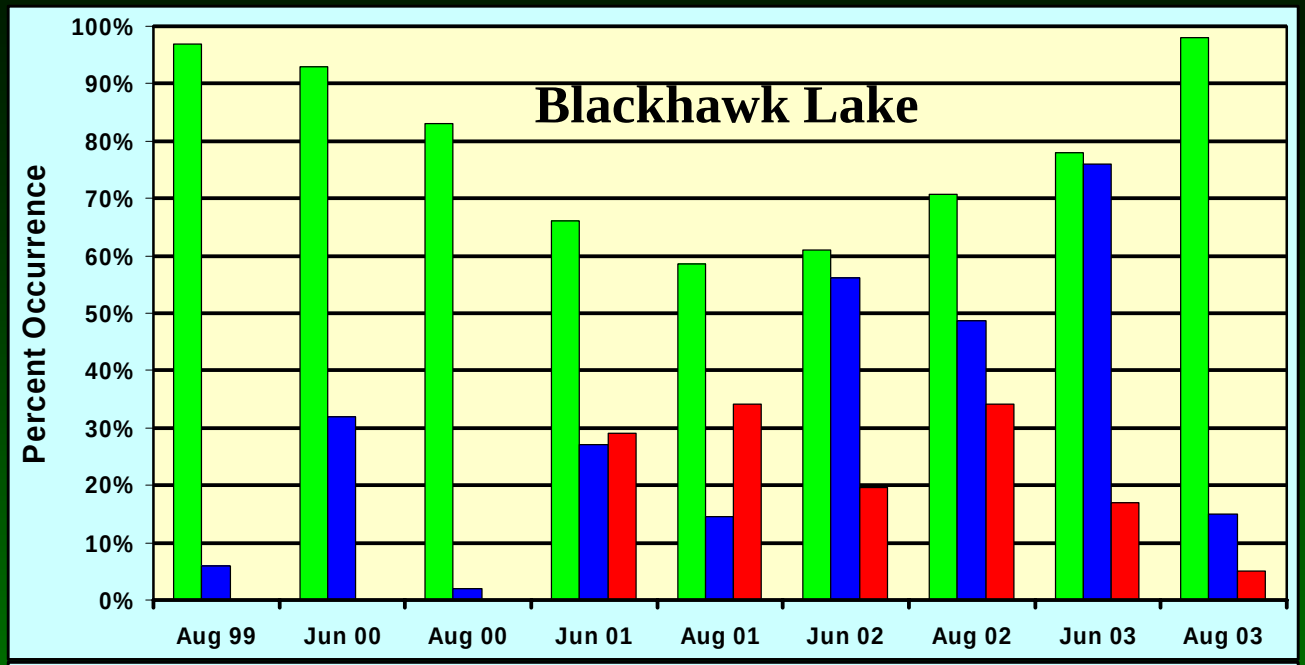


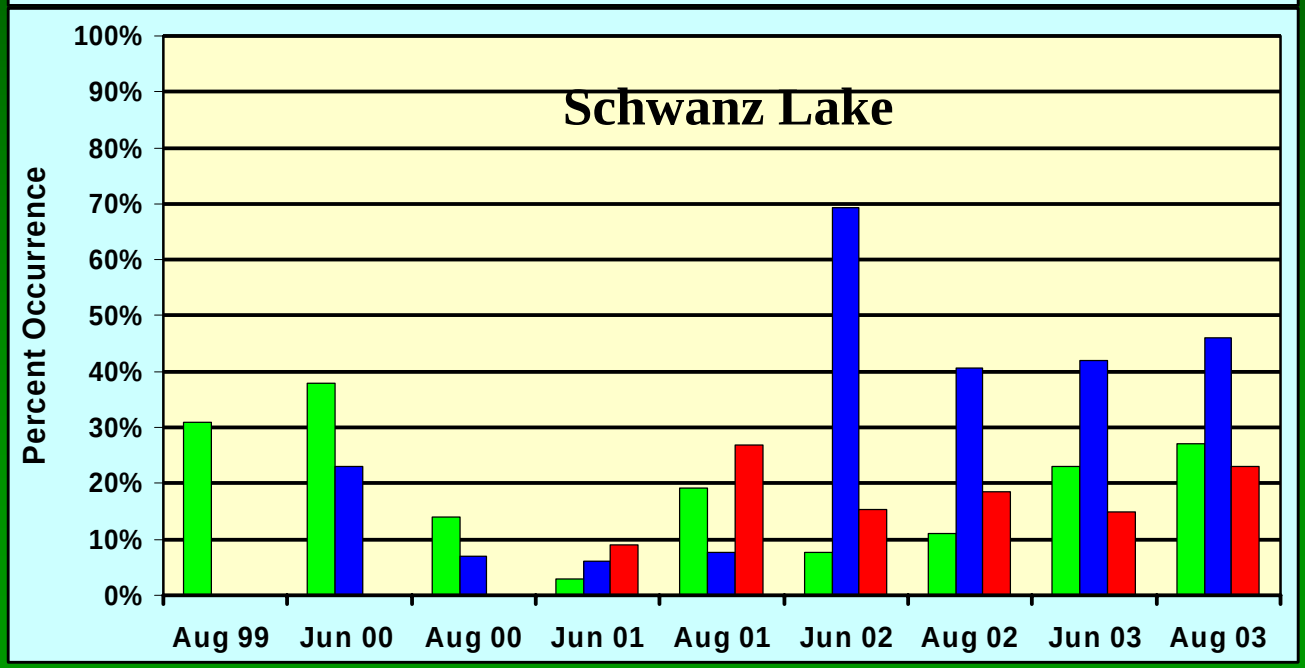
April

June

Submersed Native Plant % Occurrence

Lakes Treated with Aquathol® K





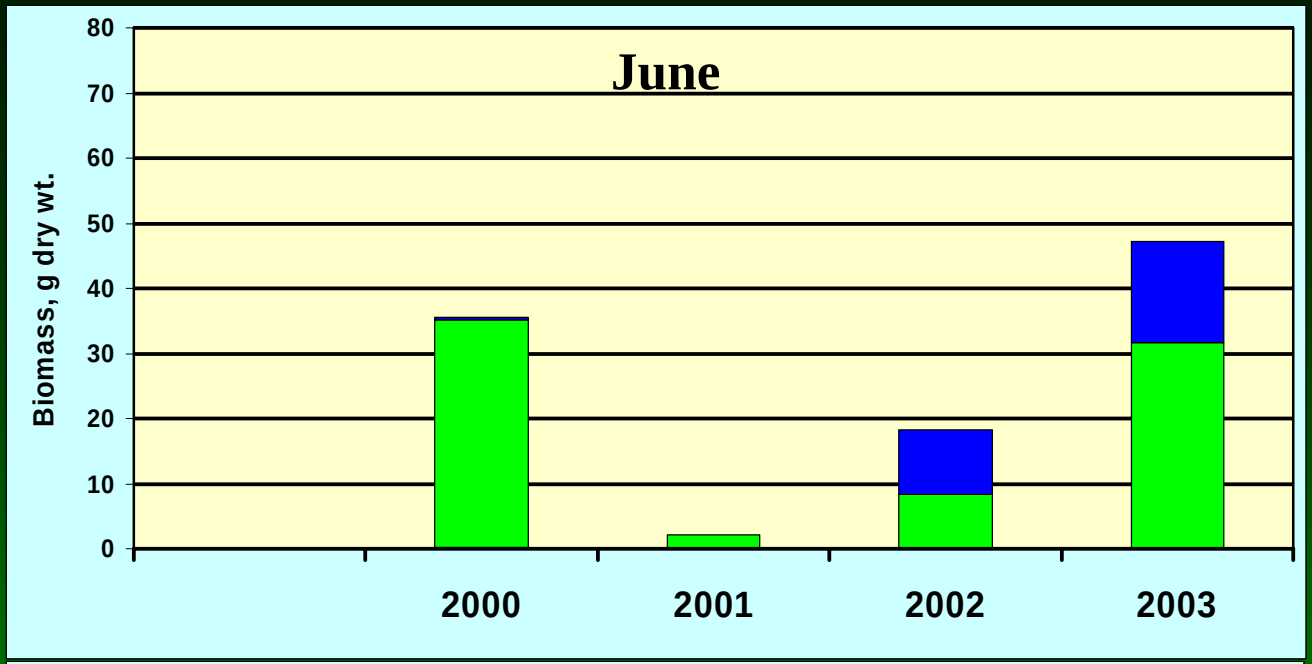
Coontail

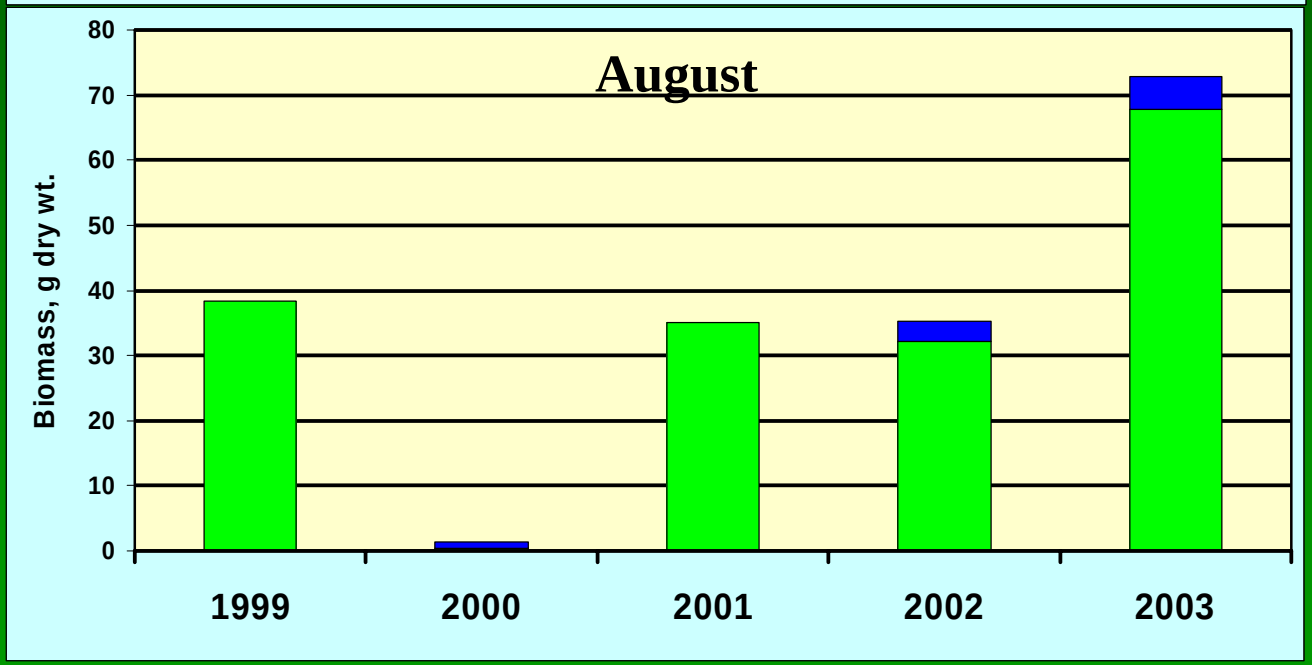
Elodea

Other Native Species

Plant Abundance

Blackhawk Lake Aquathol® K Treated





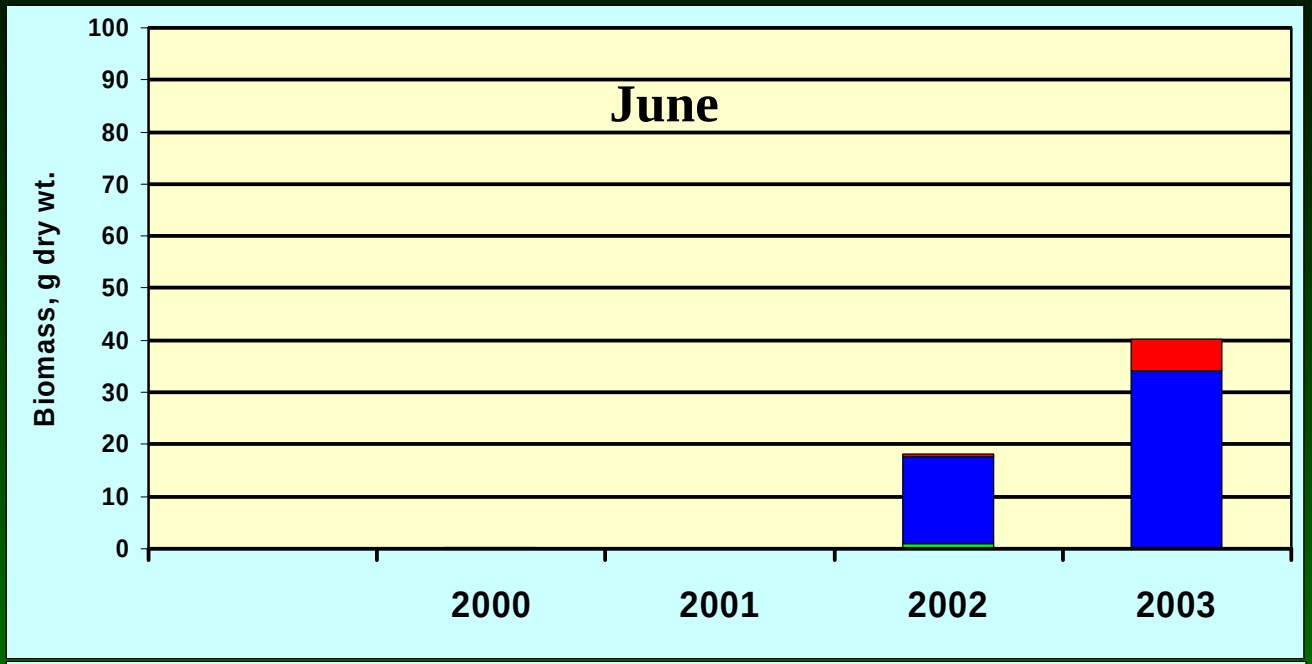
Coontail

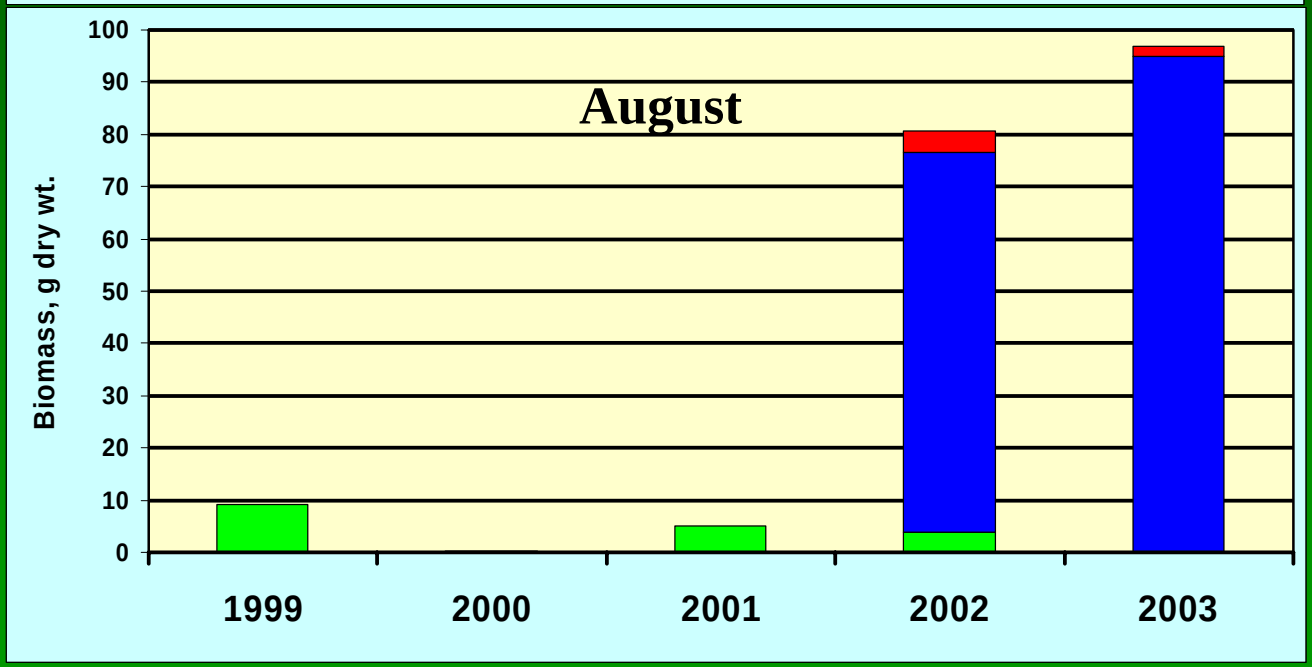
Elodea

Other Native Species

Plant Abundance

Schwanz Lake Aquathol® K Treated





Coontail

Elodea

Other Native Species

Herbicide Combinations

- Improved control of target species
- Improved selectivity

Selective Control of Eurasian Watermilfoil and Curlyleaf Pondweed Using Herbicide Combinations

US Army Corps of Engineers

Engineer Research and Development Center

Objective

- Control two exotic plants Eurasian watermilfoil (dicot) and Curlyleaf pondweed (monocot)
- No adverse impacts to the native aquatic plant community
- Evaluate the effects of changes in the plant community on water quality
- Evaluate the effects of changes in the plant community on fisheries

Approach

- Whole lake management of the plant community
- Apply low dose concentrations of endothall (1 mg/L) combined with 2,4-D (0.5 mg/L)
- Apply in early spring as water temperatures approach 15^{o}C
- Evaluate plant and fish communities in June and August

Study Lakes

	Lake	Littoral	Percent
Lake	Area (acres)	Zone (acres)	Littoral Zone
Auburn	261	158	61%
Bush	172	114	66%
Pierson	235	118	50%
Zumbra	162	92	57%

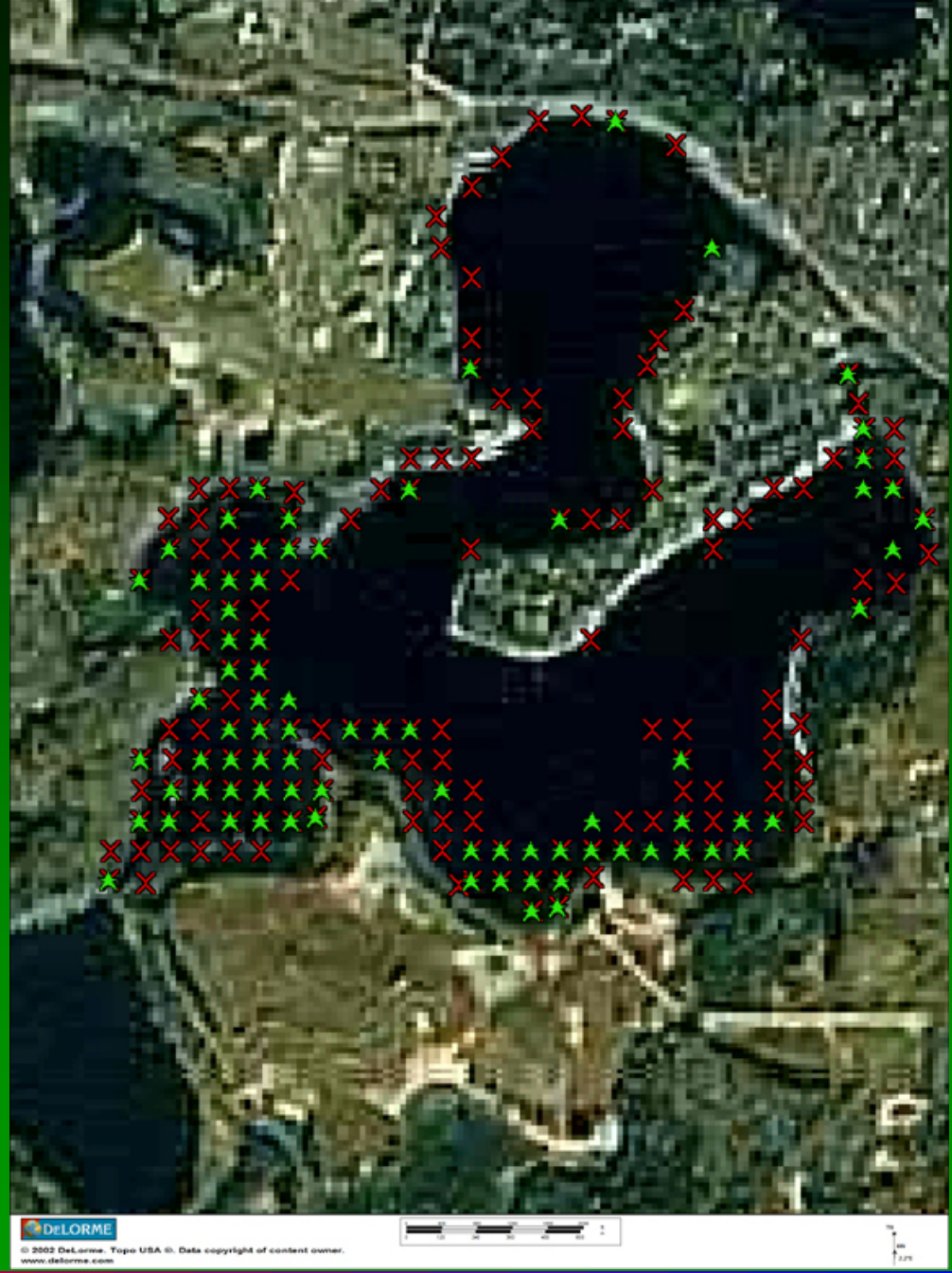
Zumbra Lake
50 meter
Sample Grid

Zumbra Lake

162 acres

X – Eurasian watermilfoil

*** -- Curlyleaf pondweed**



Zumbra Lake Treatment Areas

162 acres

Endothall + 2,4-D

Aquathol Super K

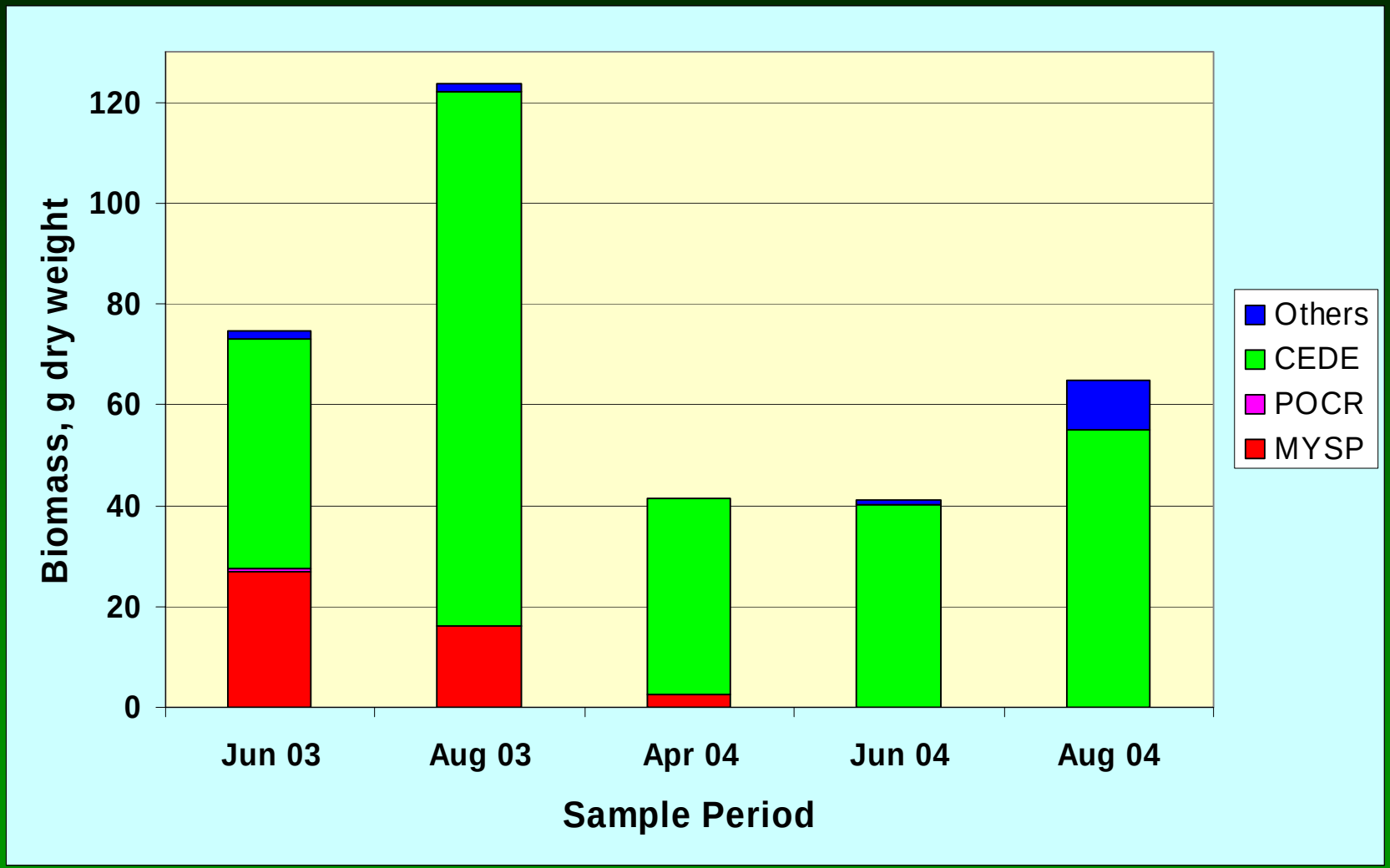
Zumbra Lake Exotic Plant Distribution Post Treatment, June 04

162 acres

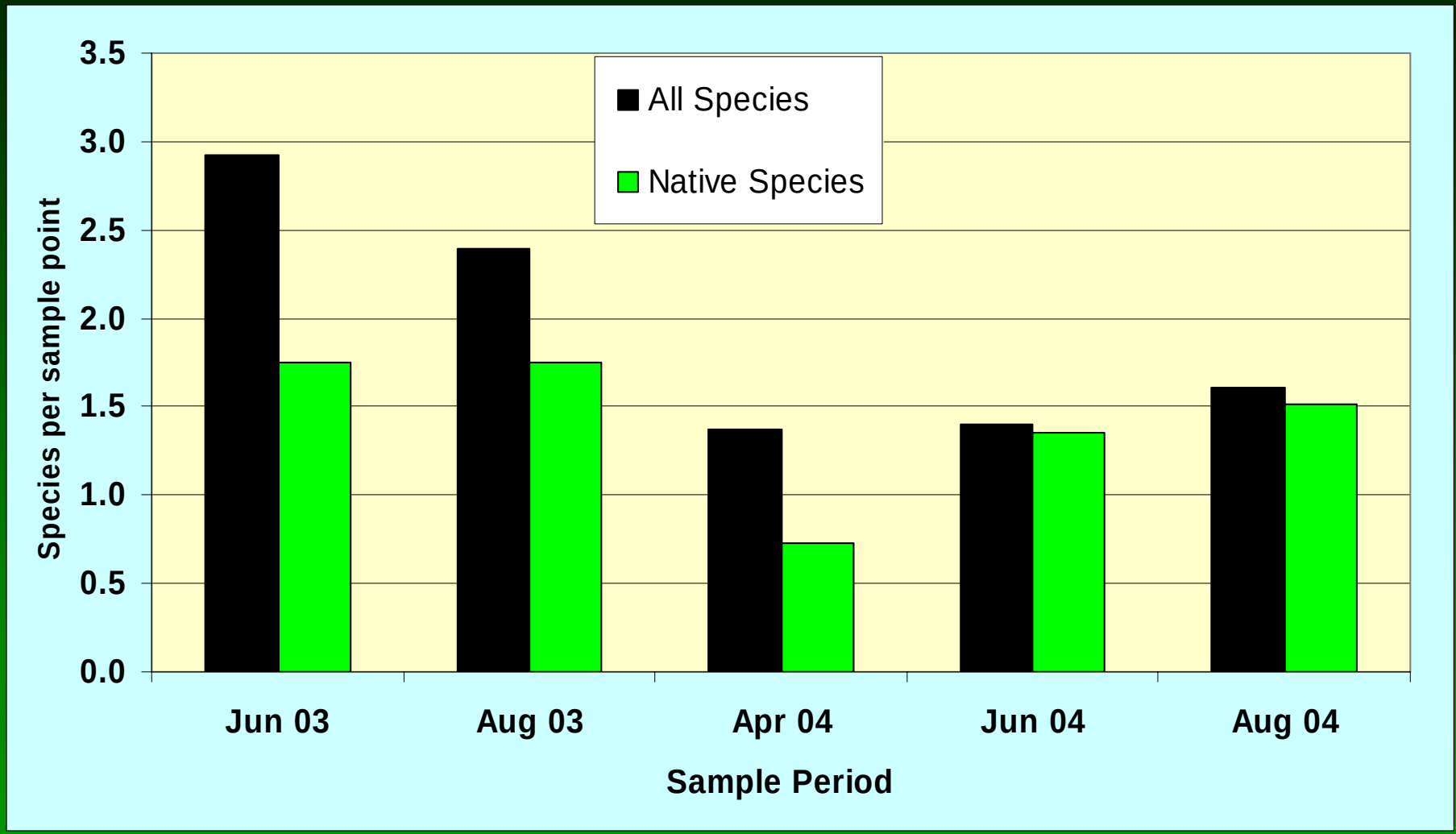
X – Eurasian watermilfoil

* -- Curlyleaf pondweed

Zumbra Lake Plant Abundance

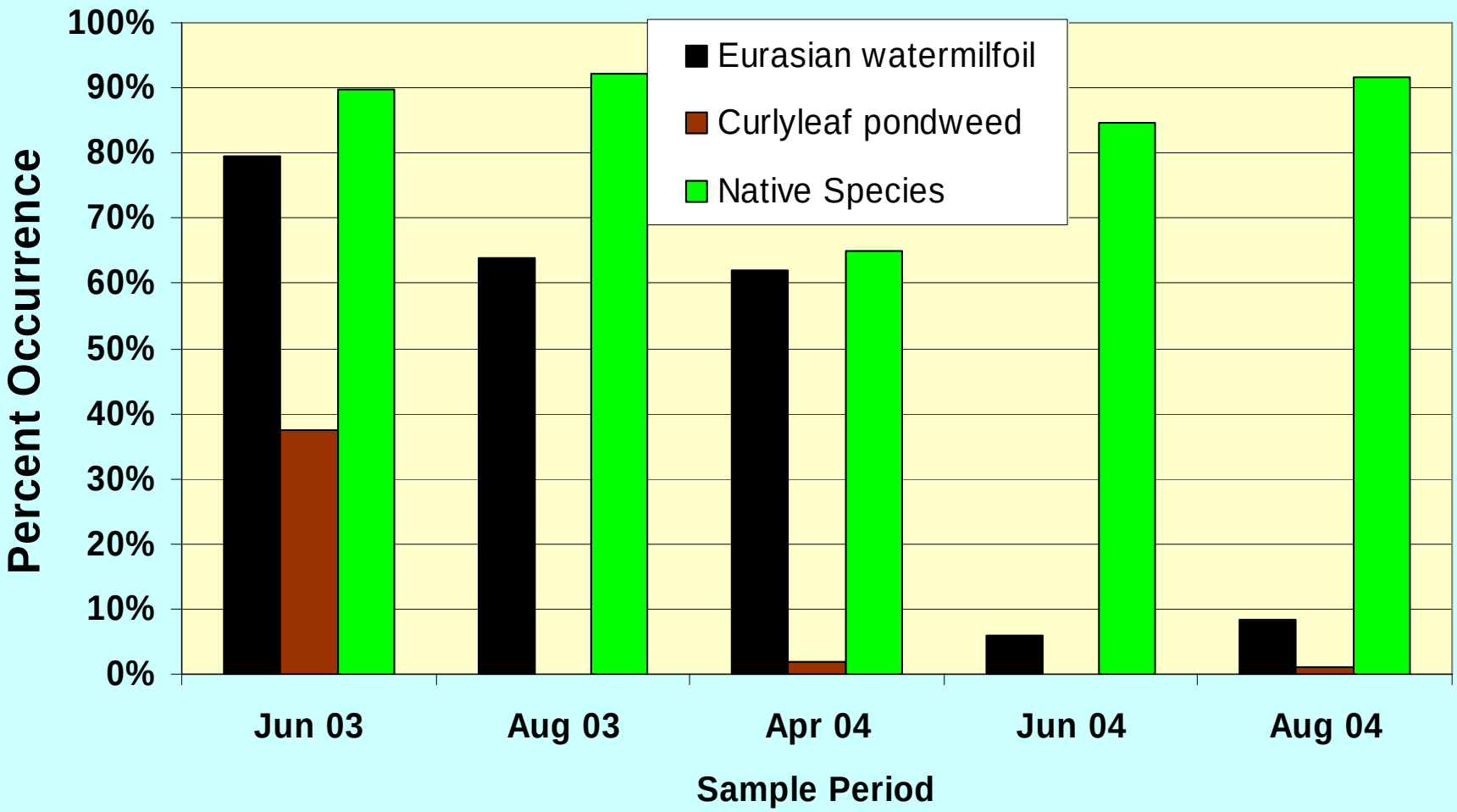


Zumbra Lake: Species/Sample Point*



*Includes points within the Littoral Zone (depth ≤ 15 ft)

Zumbra Lake: Percent Occurrence



*Includes points within the Littoral Zone (depth ≤ 15 ft)

Zumbra Lake: Percent Occurrence*

Species	Jun 03	Aug 03	Jun 04	Aug 04
Ceratophyllum demursum	76.2%	85.0%	72.6%	91.3%
Elodea canadensis	5.8%	6.8%	5.3%	1.9%
Myriophyllum sibiricum	2.4%	0.0%	0.0%	5.8%
Najas flexiliss	0.5%	0.5%	0.0%	5.3%
Nymphaea oderata	41.7%	47.3%	37.0%	57.8%
Potamogeton amplifolius	24.8%	14.0%	1.4%	3.9%
Polygonum amphibium	5.8%	2.9%	6.7%	12.6%
Potamogeton foliosus	0.0%	0.0%	0.0%	4.4%
Potamogeton illinoensis	0.5%	12.6%	4.8%	10.2%
Potamogeton natans	0.0%	0.5%	0.0%	0.0%
Studenia pectinata	2.4%	0.5%	1.9%	5.3%
Potamogeton praelongus	0.5%	0.0%	0.5%	0.0%
Potamogeton pusillus	1.0%	0.0%	0.0%	1.0%
Potamogeton zosteriformis	1.0%	0.0%	0.0%	0.5%
Ranunculus longirostris	1.9%	0.0%	0.0%	0.0%
Scirpus validus	5.8%	4.8%	3.4%	8.3%
Utricularia vulgaris	0.5%	0.0%	0.0%	0.0%
Zannichellia palustris	0.0%	0.0%	0.0%	0.0%
Zosterella dubia	0.0%	0.0%	0.0%	2.4%
Chara sp.	3.9%	0.0%	1.0%	3.9%

*Includes points within the Littoral Zone (depth ≤ 15 ft)

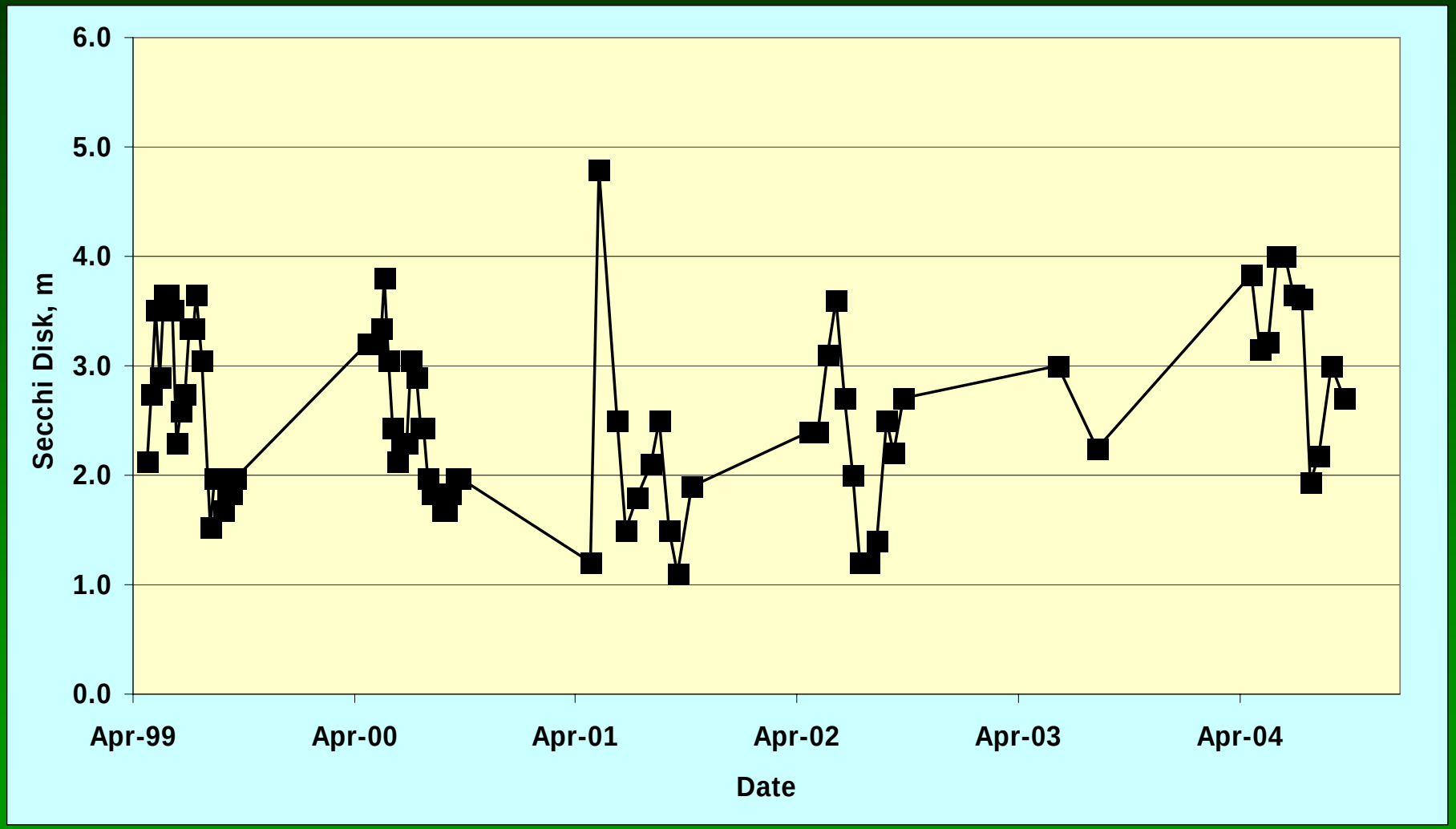
Water Quality Hydrolab Datasondes

- **Water quality parameters**
  - **Dissolved oxygen (DO)**
  - **pH**
  - **Temperature**
  - **Specific conductance**

Water Quality Nutrients

- **Water quality parameters**
  - **Total Phosphorous**
  - **Turbidity**
  - **Alkalinity**
  - **Chlorophyll a**
  - **Secchi disk**

Zumbra Lake, Secchi Disk Readings 1999-2004



Fish and Macroinvertebrate Sampling

- Boat Electrofishing
- Popnets (effectively samples in vegetation)
- Seines
- Light traps (larval fish)
- Dipnet (macroinvertebrates)

Sampling Gear

seine

Light trap

Results

Conclusions

Zumbra Lake, Post Treatment

Early spring application of endothall combined with 2,4-D provided effective, selective control of Eurasian watermilfoil and curlyleaf pondweed

Future Work

- Continue to manage aquatic plant community to maintain invasive, exotic plants at non nuisance levels
- Monitor management effects on native plant communities
- Monitor management effects on water quality
- Monitor management effects on fish communities

Acknowledgements

Bush Lake, Post Treatment

- Aquatic Ecosystem Restoration Foundation
- Cerexagri
- MN DNR
- Three Rivers Park District
- City of Bloomington
- Lake Restoration, Inc
- Midwest AquaCare, Inc