Flowering Rush in Detroit Lakes: From Research to an Operational Management Program

John D. Madsen, PhD
Associate Professor, Mississippi State University
jmadsen@gri.msstate.edu

3rd Northern Rockies Invasive Plant Council Conference, February 10-14, 2014, Spokane, WA

Flowering Rush (*Butomus umbellatus* L.)

- Long, flexuous or erect leaves growing from a basal rhizome, up to10’ tall
- May grow submersed or emersed in 1 to 10’ water depth, may also grow in moist soil or as facultative wetland plant
- Inflorescence is separate stalk with an umbel of pink flowers; each flower has six petals

Flowering Rush (*Butomus umbellatus*)

- Introduced from Europe and Asia
- Both a diploid and triploid biotypes
- Diploid biotype undergoes sexual reproduction an produces > 20,000 seeds per plant
- Diploid biotype also produces > 100 of vegetative bulbils per plant
- Triploid biotype produces few seeds and relies on vegetative growth for spread

Taxonomy

- *Butomus umbellatus* L.
- Flowering rush
- Member of it's own family, the Butomaceae
- Order Alismatales, or the same order as the arrowhead family

Problems Caused

- Dense stands exclude native plant species
- Interferes with navigation and recreation
- Obstructs flow in irrigation ditches and other flowing waters
- Obstructs use of waterfront
- Reduces the value of waterfront property
  - Reduces local tax revenue

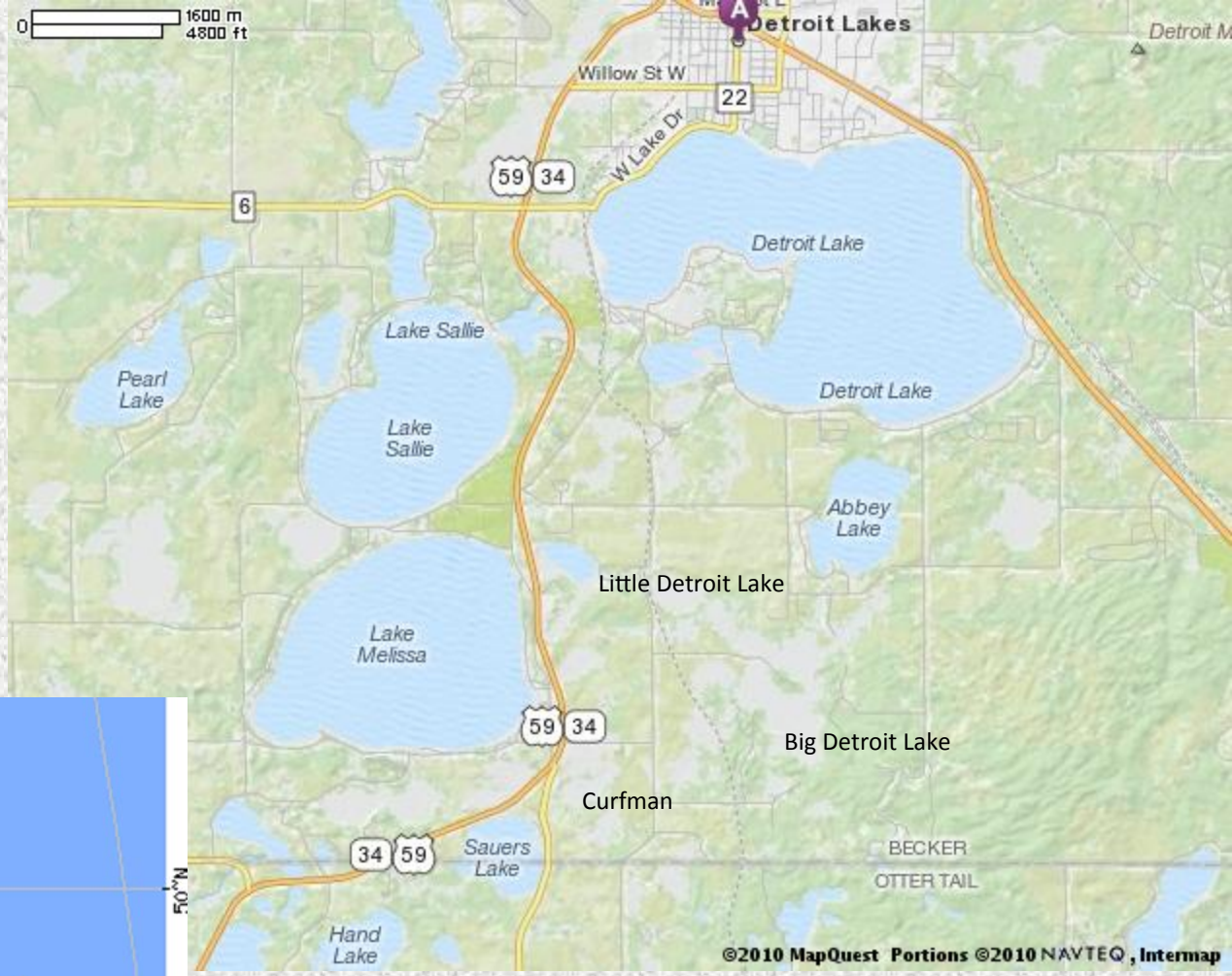
Modes of Spread

- Rhizomes and rhizome buds
- Seed (in diploid)
- Bulbils (in diploid)
- Boating
- Wave action / drift
- Waterfowl

Detroit Lakes Background

- Flowering rush has been a nuisance since 1980's
- No effective management technique found
- Research plan formulated in conjunction with Minnesota Department of Natural Resources
- Basins are Big Detroit, Little Detroit, Curfman, Melissa, and Sallie

Detroit Lakes Map



Project Overview

- Ecology
  - Habitat Range
  - Depth distribution and allocation
- Management
  - Application to submersed plants

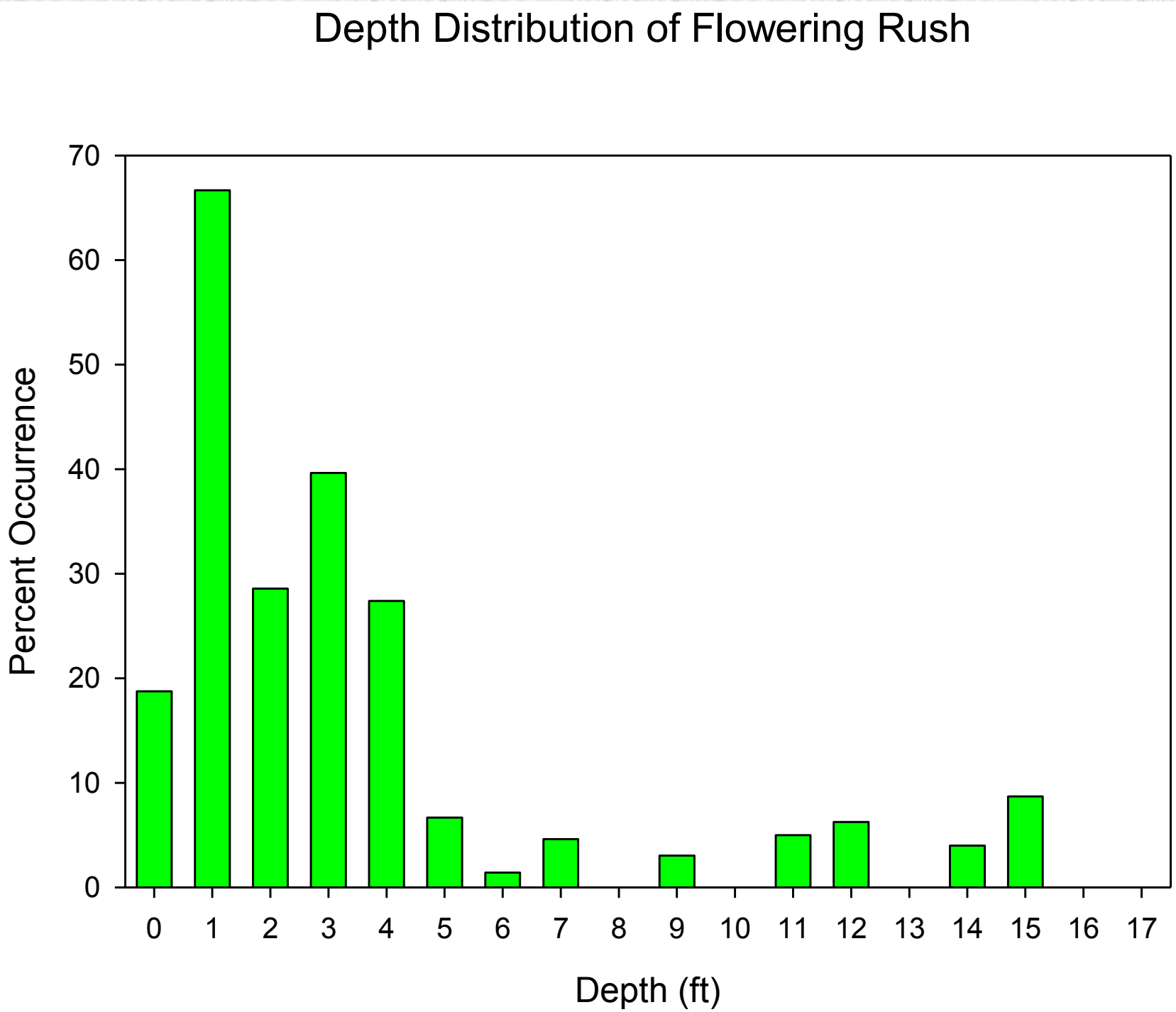
Habitat Range Study

- Point intercept survey of all five impacted Detroit Lakes basins
- 1126 points in 150m grid

Point Intercept

- Pre-established grid of points (150m for Detroit Lakes)
- Navigate to points with GPS
- Record species presence and depth

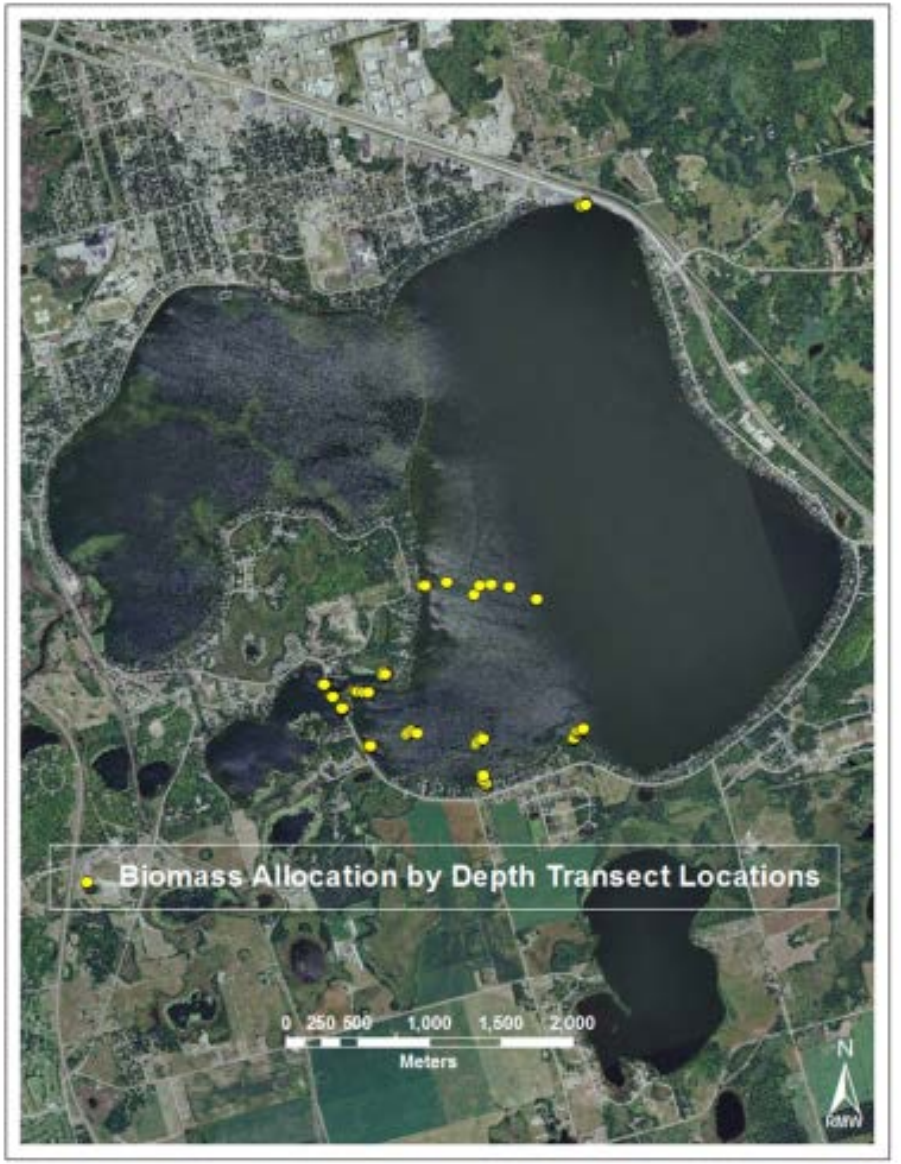

Detroit Lakes Chain Flowering Rush Locations
0 0.25 0.5 1 1.5 2
Kilometers
N


Depth Distribution of Flowering Rush
Percent Occurrence
70
60
50
40
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Depth (ft)

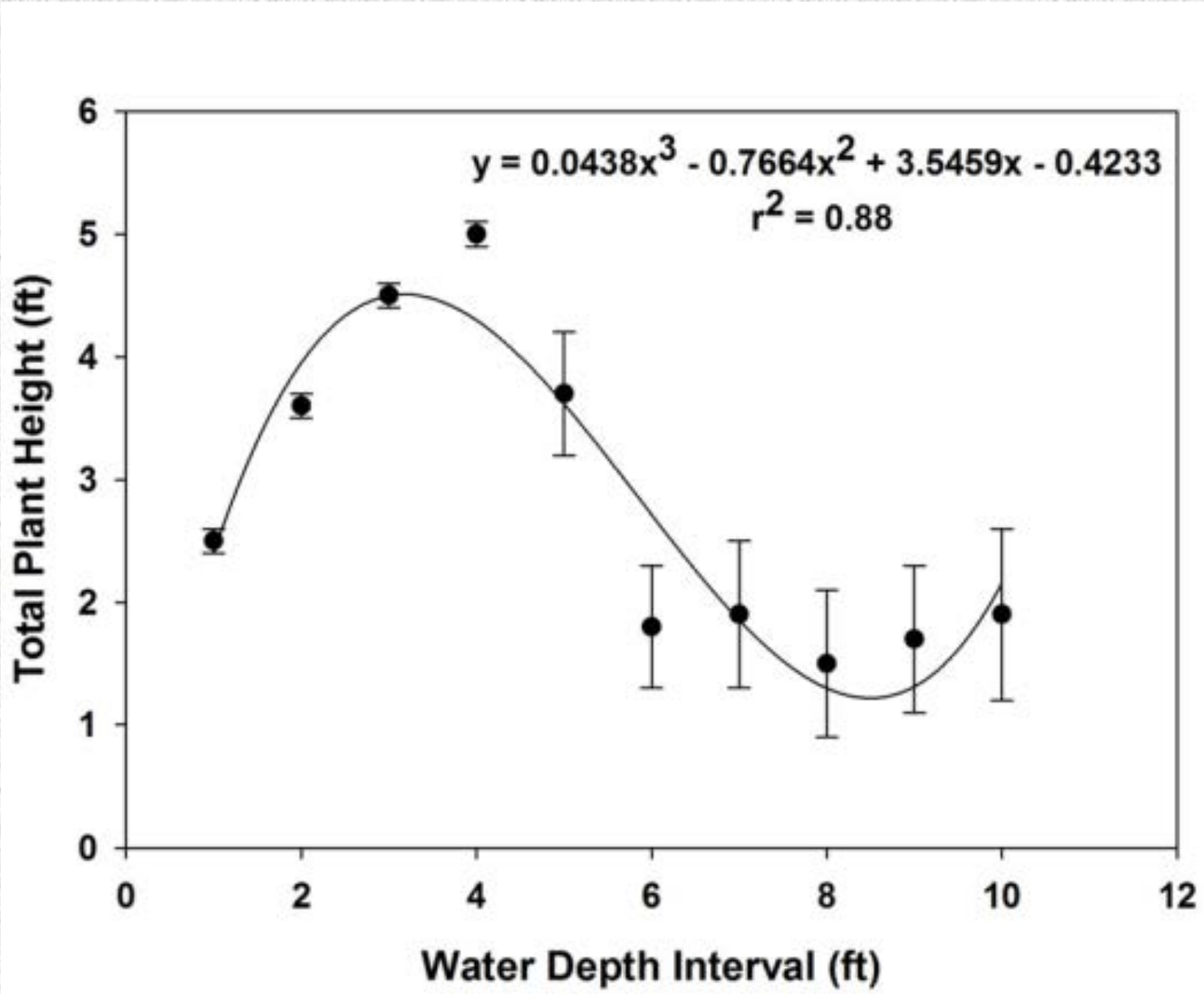
Rhizome Buds

Figure 6A. The rhizome of flowering rush with two rhizome buds, indicated by the yellow arrows. Rhizome buds initiate new shoots and are the main form of vegetative propagation in flowering rush. Photo by J. Madsen, GRI.

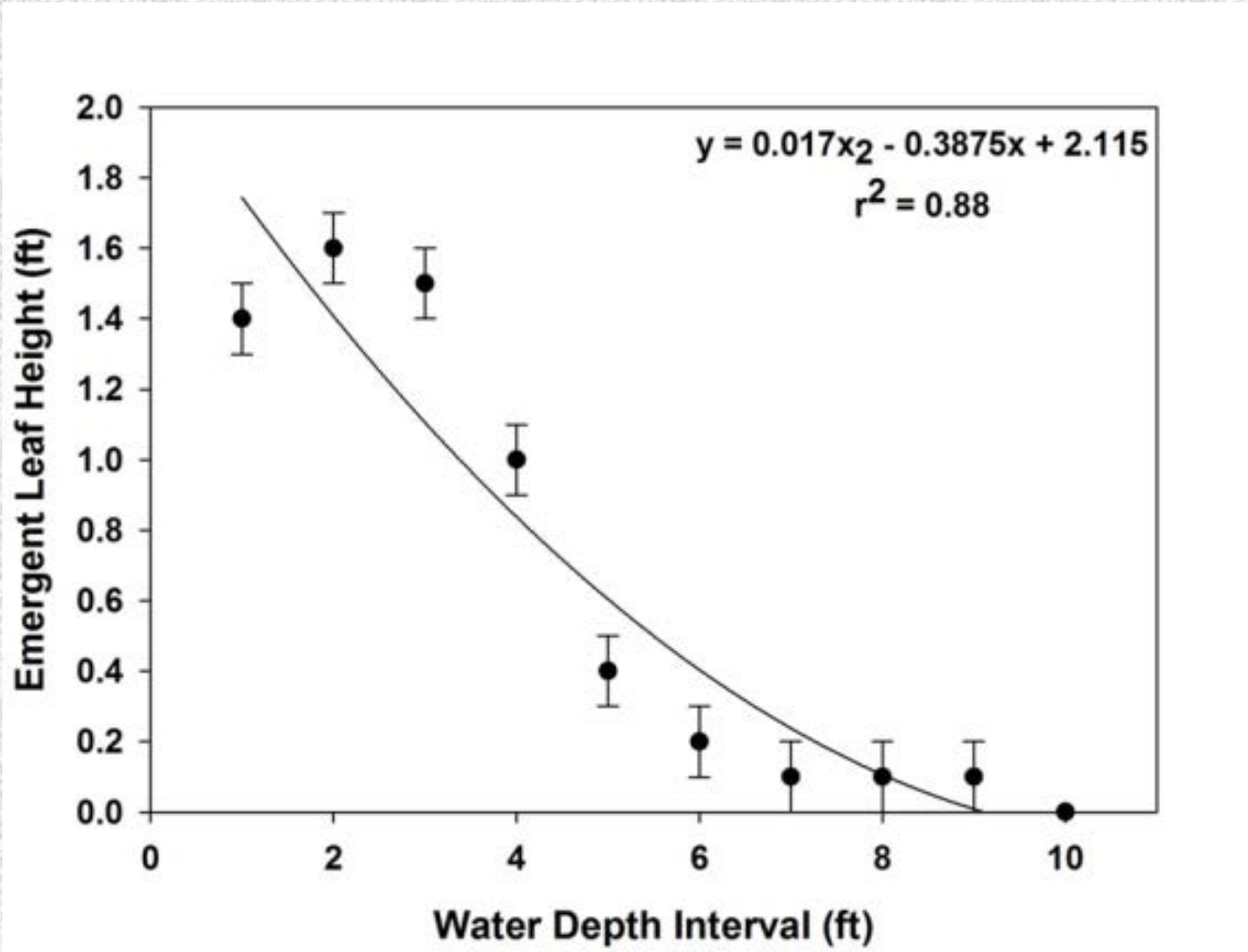
Depth Allocation Transects



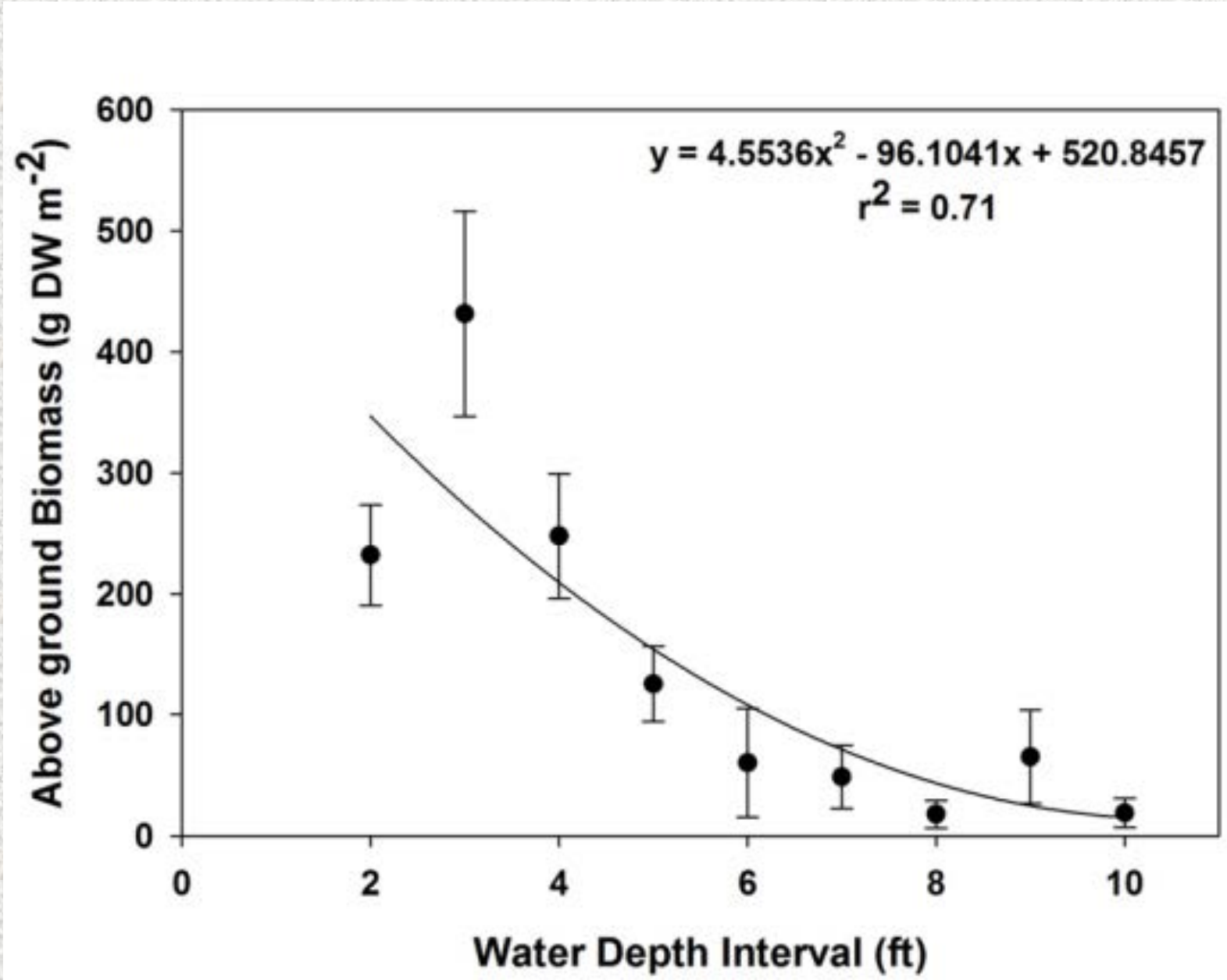
Depth and Plant Height



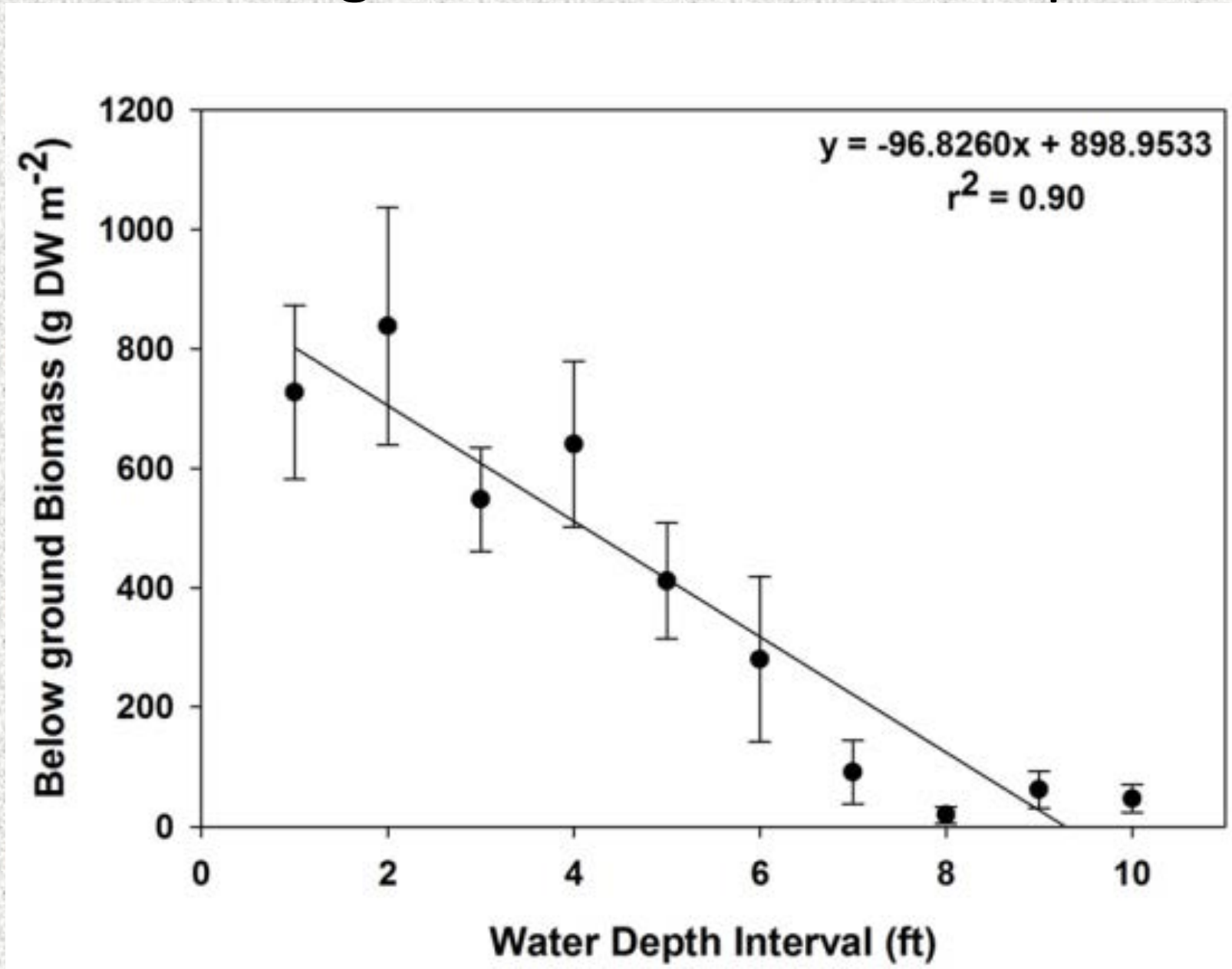
Height above water surface



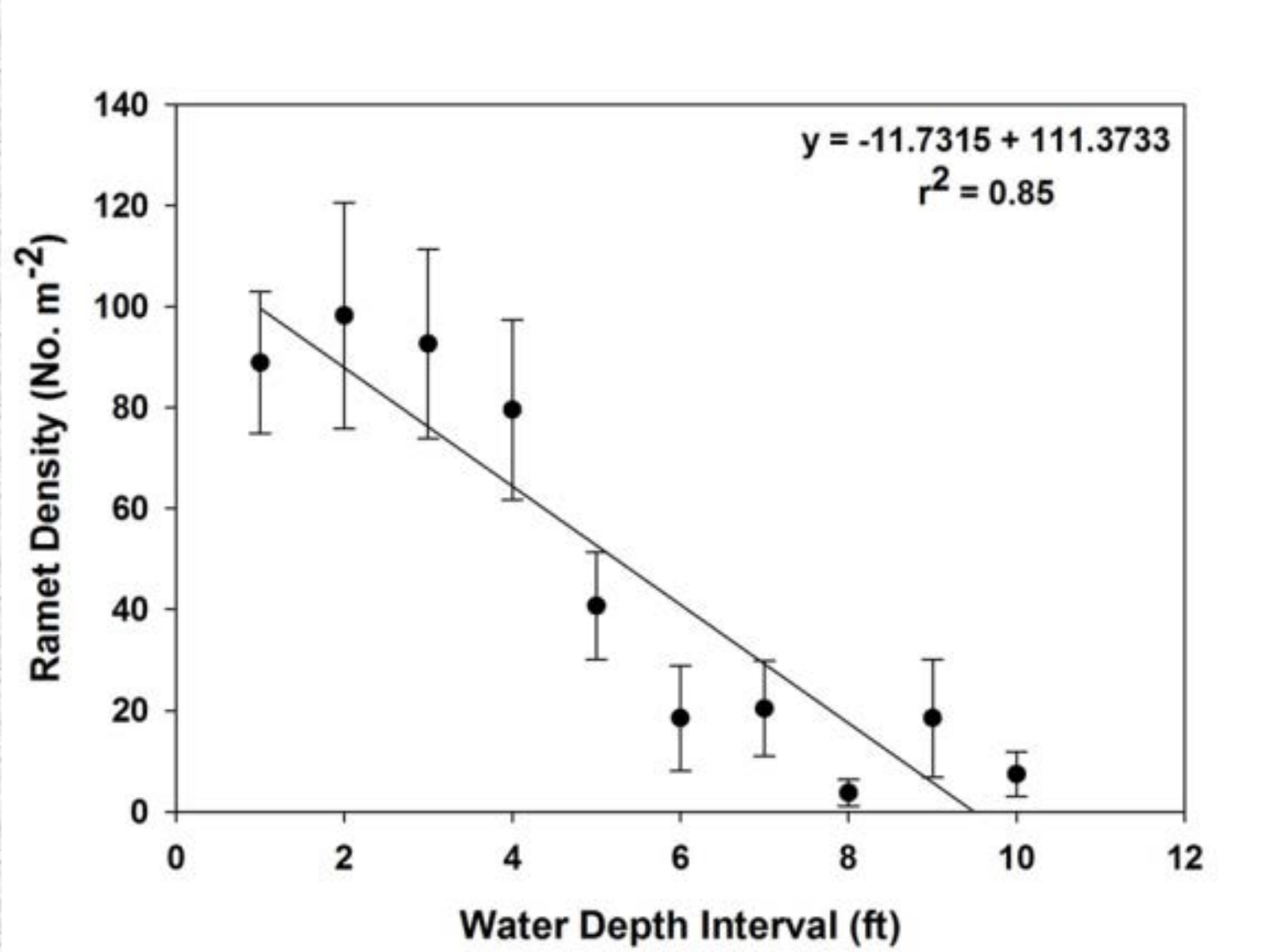
Aboveground Biomass and Depth



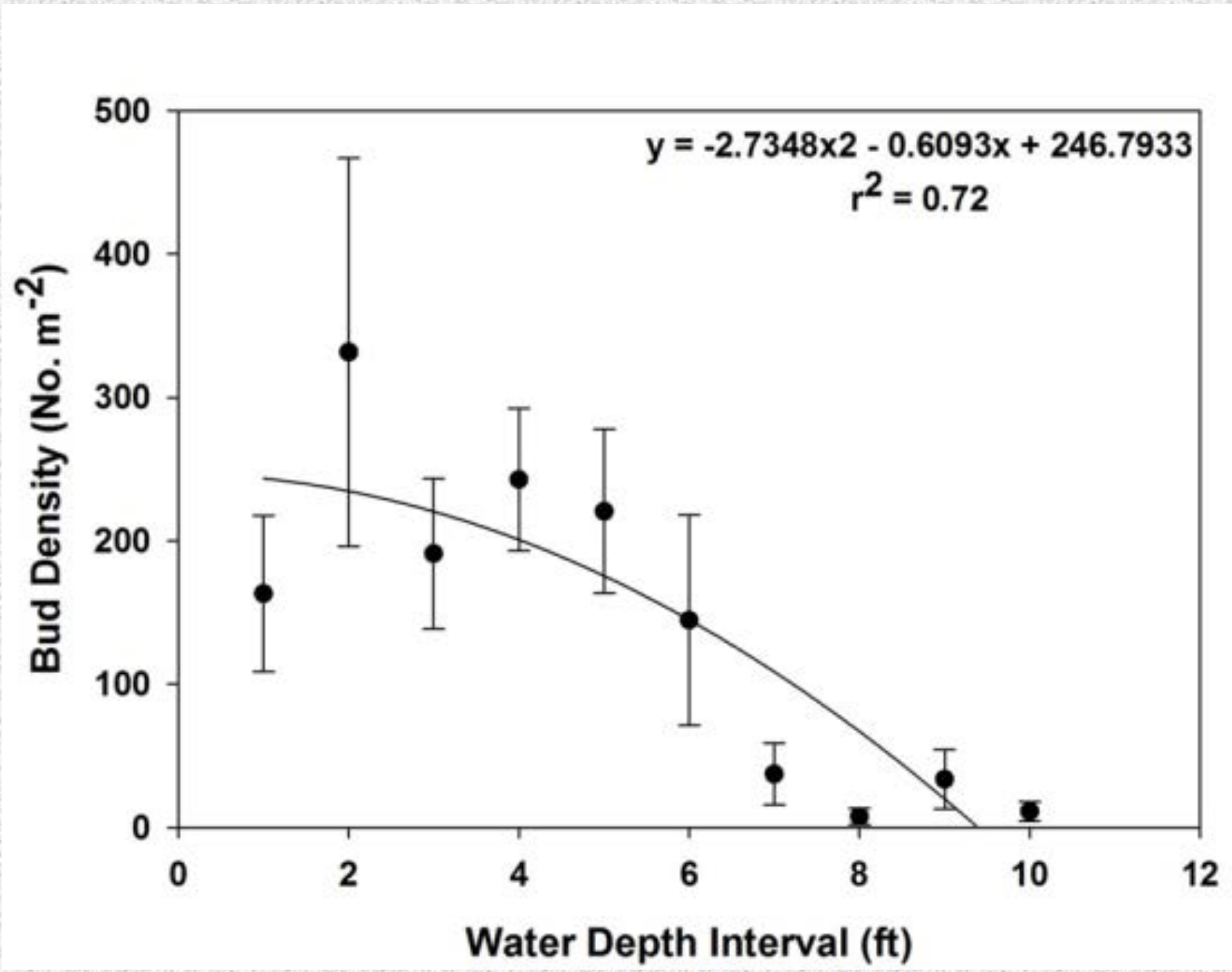
Belowground Biomass and Depth

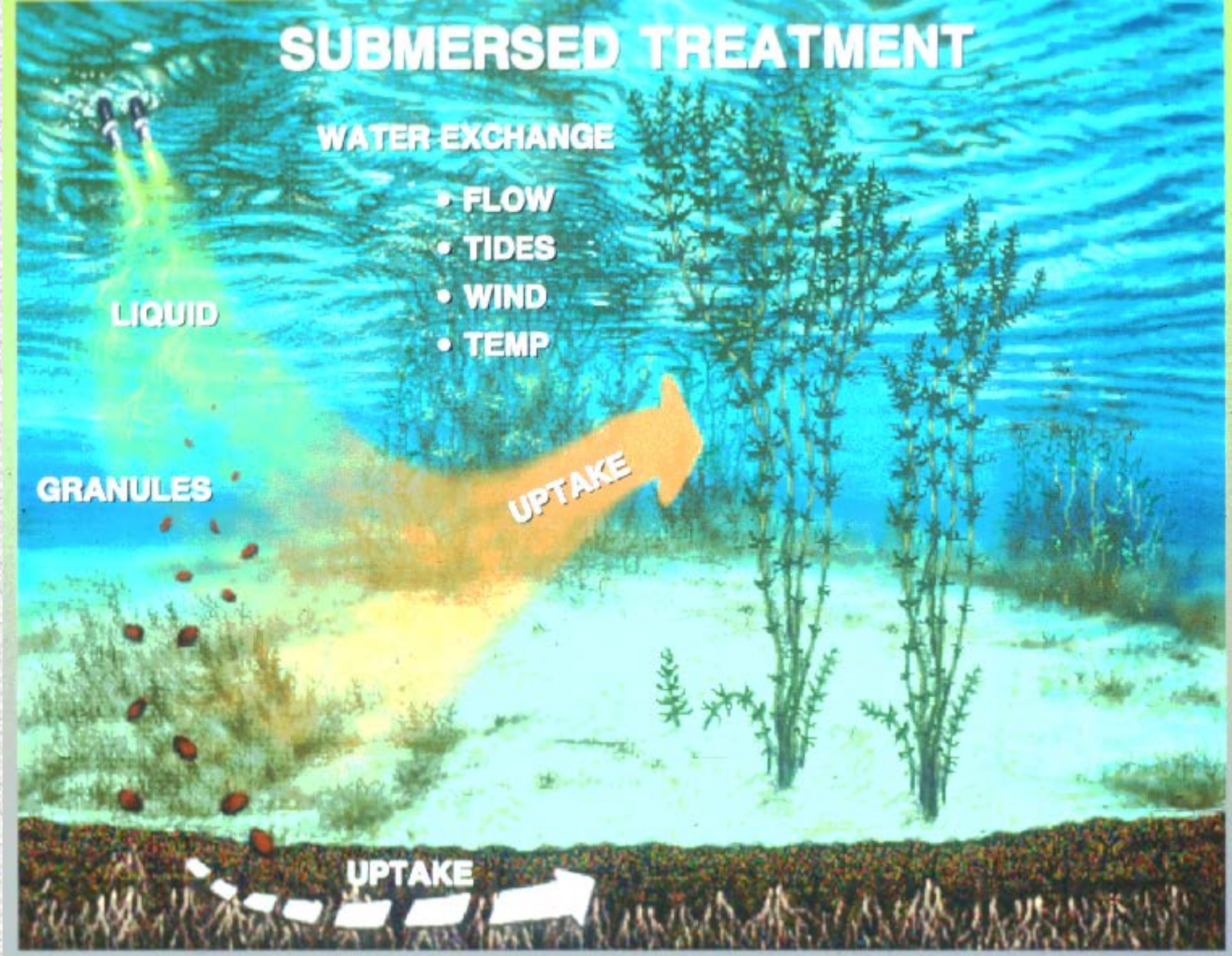


Ramet Density and Depth



Rhizome Bud Density by Depth

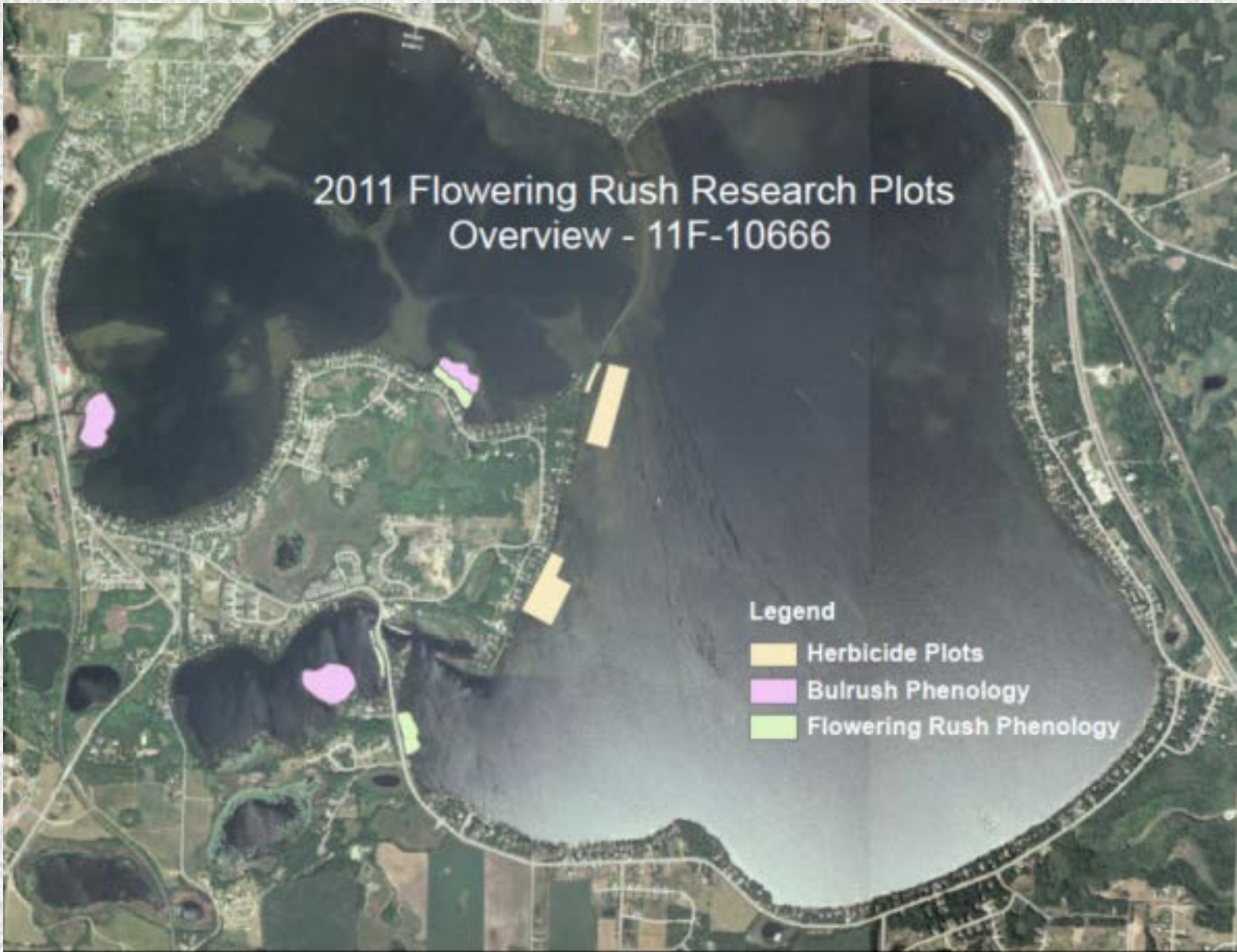



SUBMERSED TREATMENT
WATER EXCHANGE
• FLOW
• TIDES
• WIND
• TEMP
LIQUID
GRANULES
UPTAKE
UPTAKE

Herbicide Trial 2011

- Two 10-acre endothall plots
- Two 1-acre diquat plots
- Assessed with point intercept and biomass samples (cores)
- Dye studies indicated half-lives of 3-6 hr, up to 12 hr with appropriate wind
- All treatments on Big Detroit Lake

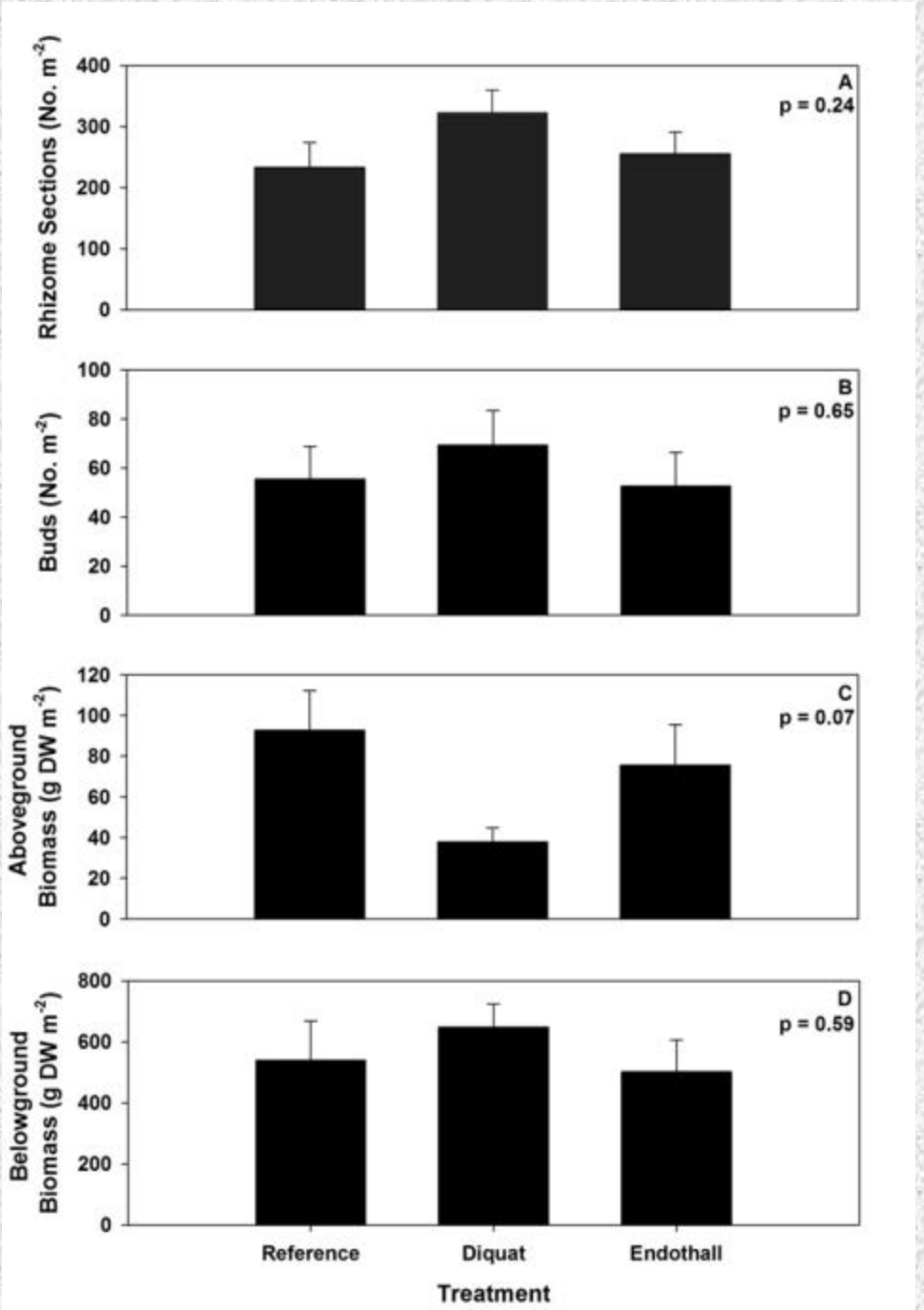
2011 Herbicide Plots



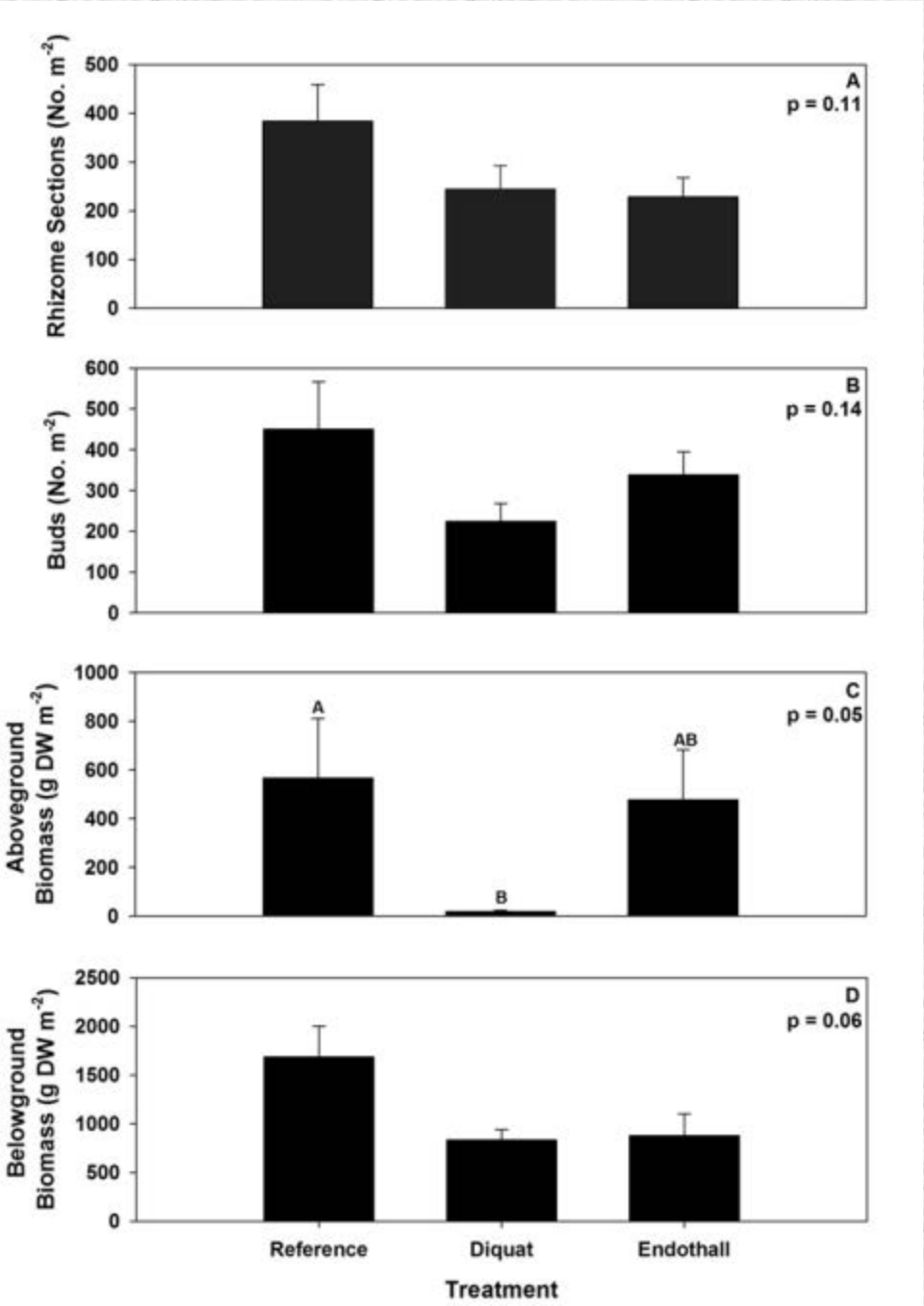
2011 Treatment Results

- Dissipation half-life of endothall plots was 3-6 hours, depending on wind speed and direction
- No control with endothall
- Over 90% control of aboveground biomass with diquat
- No significant effect on belowground biomass or rhizome buds with diquat
- No significant effect on native plant diversity

Pretreatment (June 2011) flowering rush biomass for reference, diquat, and endothall plots in Detroit Lakes: A., Rhizome sections (N/m^2); B., Bud density (N/m^2); C., Aboveground biomass (g DW / m^2); and D., Belowground biomass (g DW / m^2). P-value given for one-way ANOVA comparison between treatments.

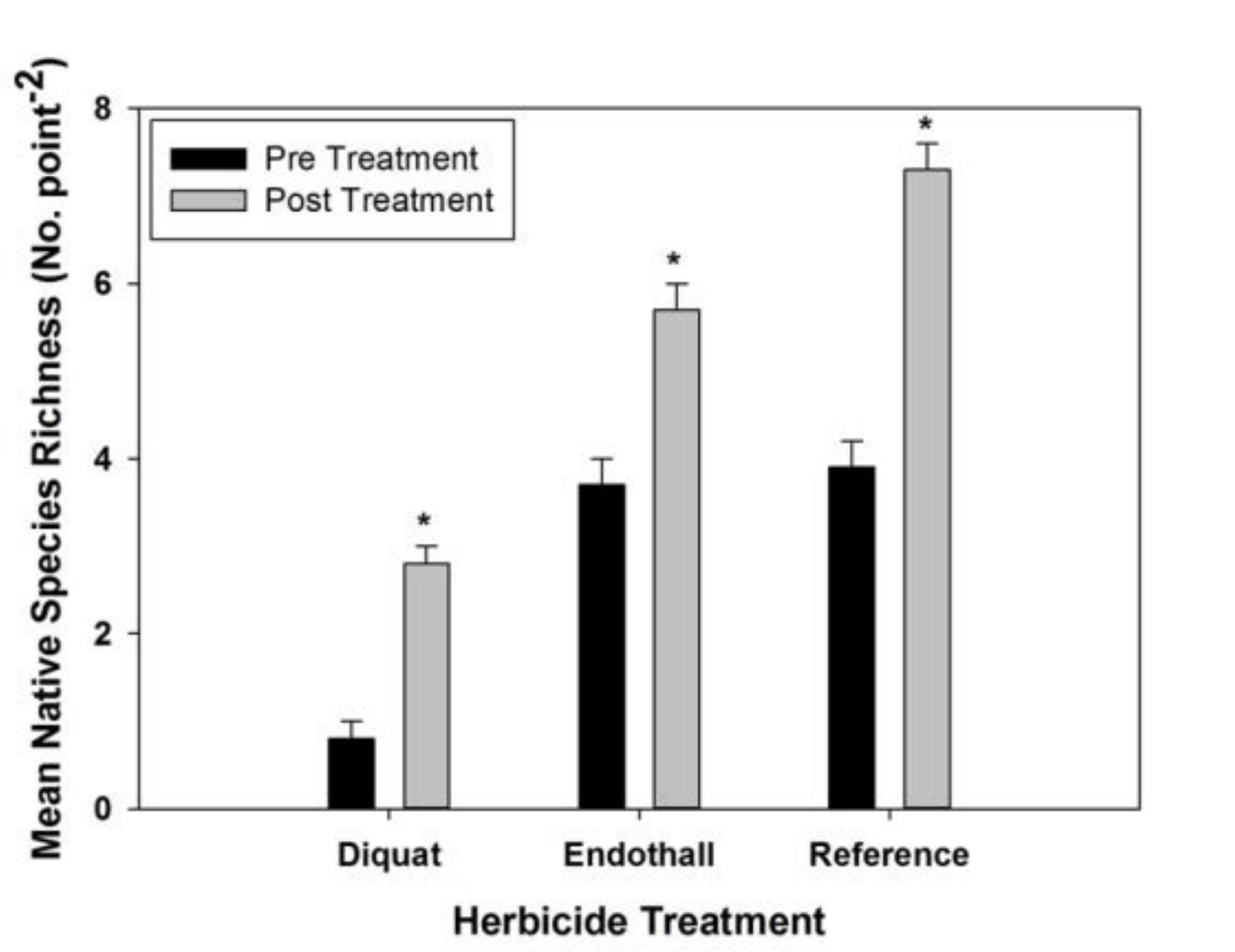


Eight WAT (August 2011) flowering rush biomass for reference, diquat, and endothall plots in Detroit Lakes: A., Rhizome sections (N/m^2); B., Bud density (N/m^2); C., Aboveground biomass (g DW / m^2); and D., Belowground biomass (g DW / m^2). P-value given for one-way ANOVA comparison between treatments.



Native Species Richness

Mean native species richness for diquat, endothall, and untreated reference plots in Detroit Lakes for 2011. Black bars are pretreatment richness, and gray bars are eight weeks posttreatment values. Asterisk indicates a significant difference between post- and pre-treatment values. Y-axis label should read (Number/Point).

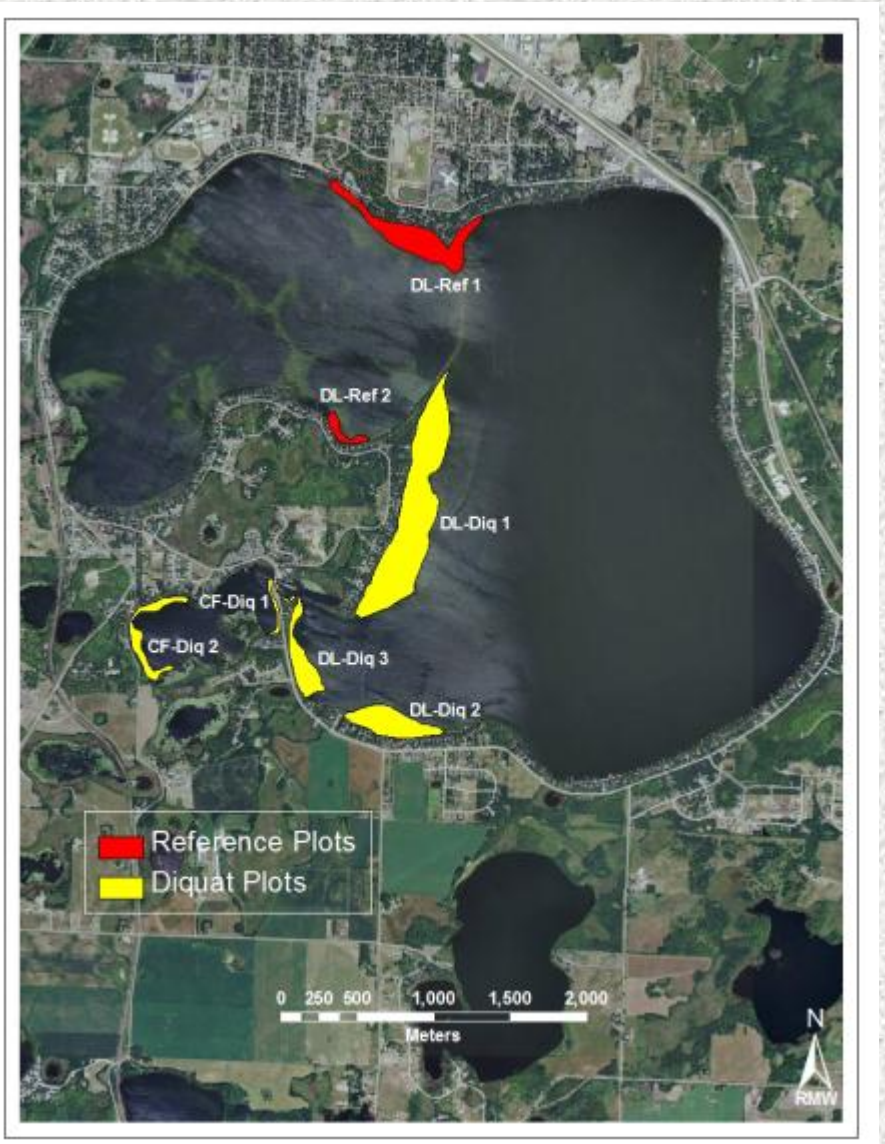


2012 Management Evaluation

- Operational scale demonstration
- Treated 160 acres with diquat
- Collected point intercept and biomass for diquat treatments
- Biomass only for imazapyr treatments
- Report available (next)

The student sampling biomass is my son Kris. This is the week he informed me he was going to be a physics major

2012 Treatments



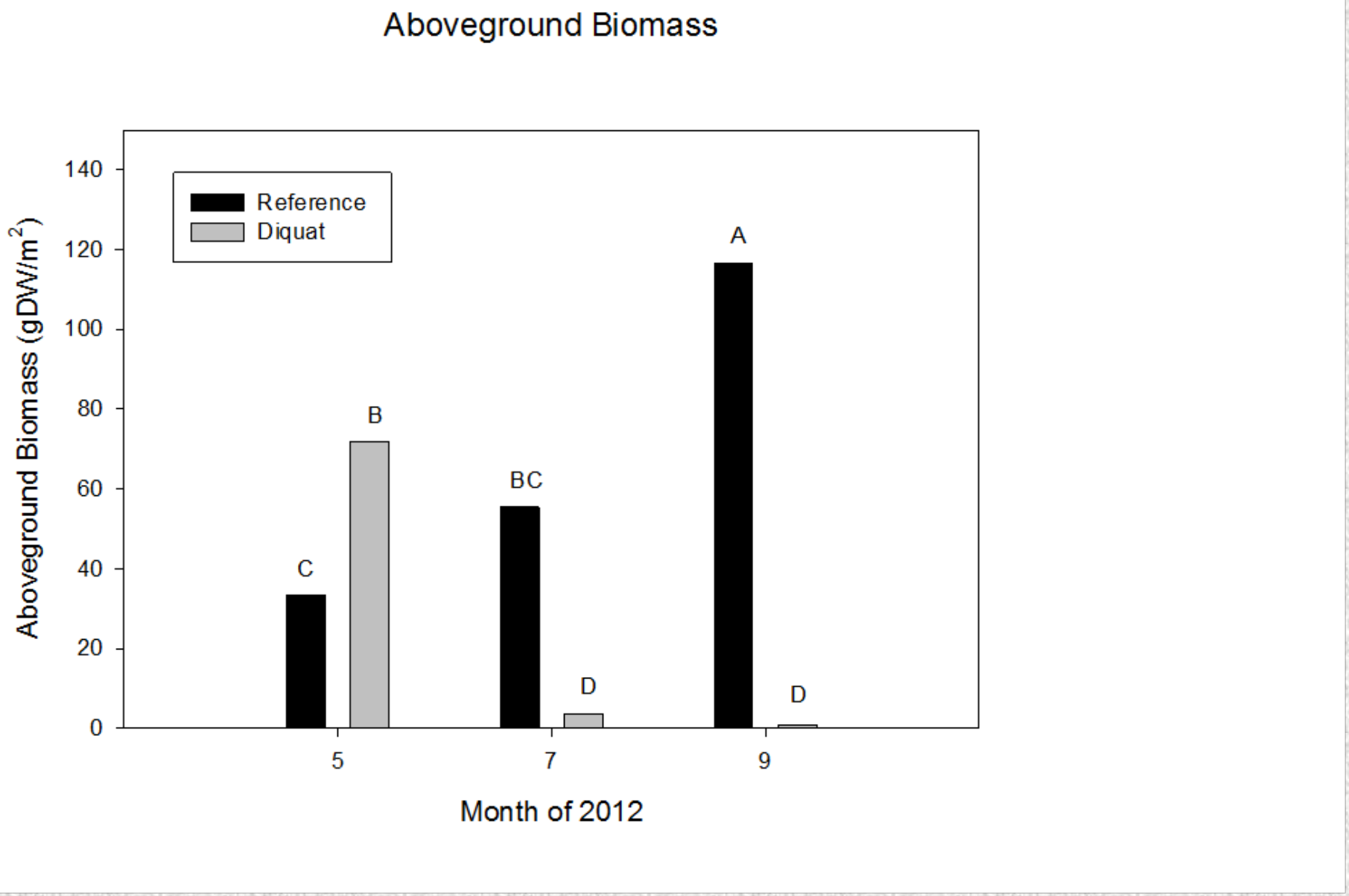
Sallie and Melissa Lakes

2012 Control

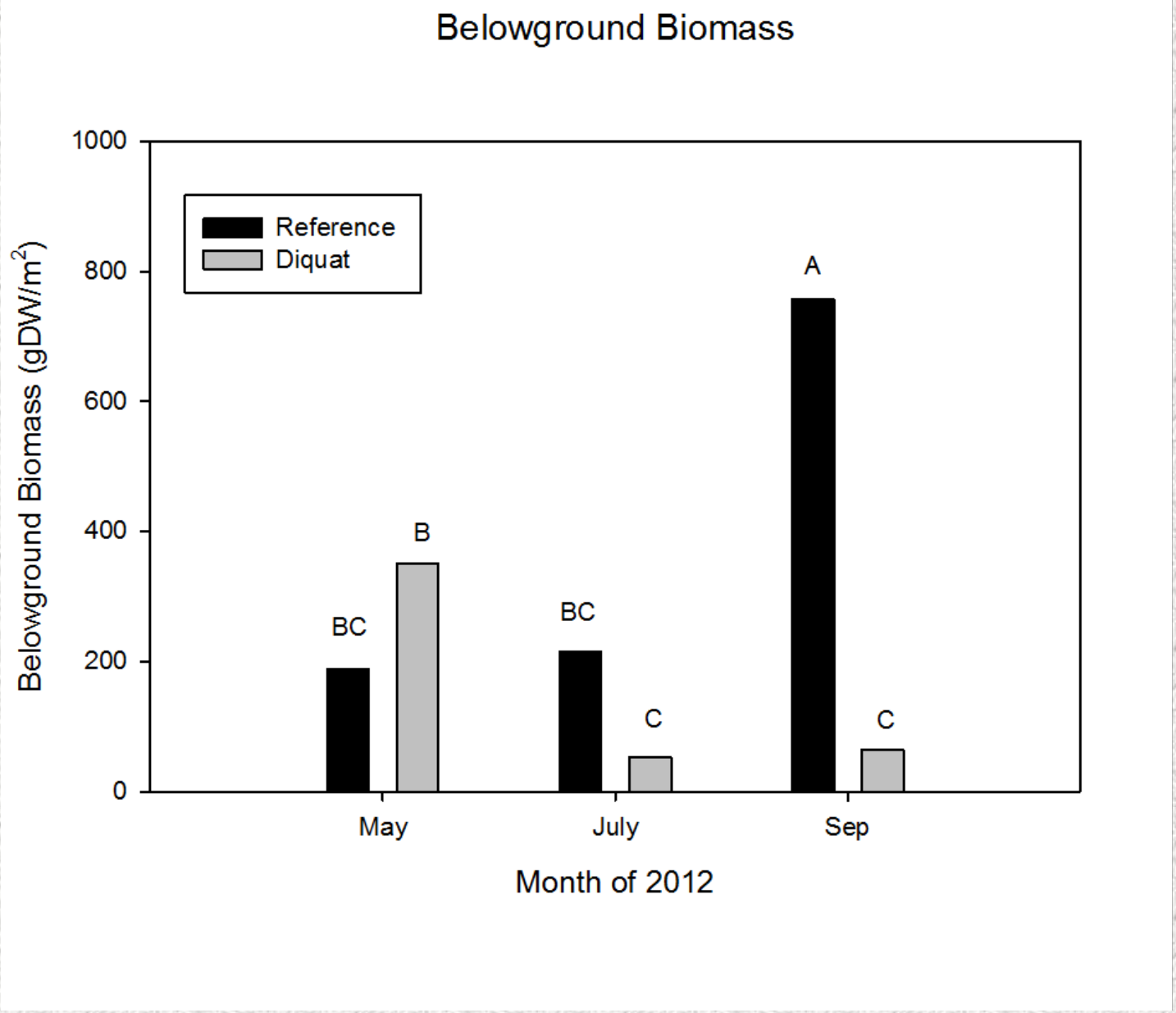
- Over 95% reduction in nuisance biomass
- 85% reduction in belowground biomass
- 85% reduction in rhizome buds
- Minimal impact on native plant species

Table 11. Summary of the change in species percent frequency of occurrence by month for all reference and treatment plots. A plus ("+") indicates a statistical increase in the species for the reference or treatment plot, a minus ("-") indicates a decrease for the reference or treatment plots.

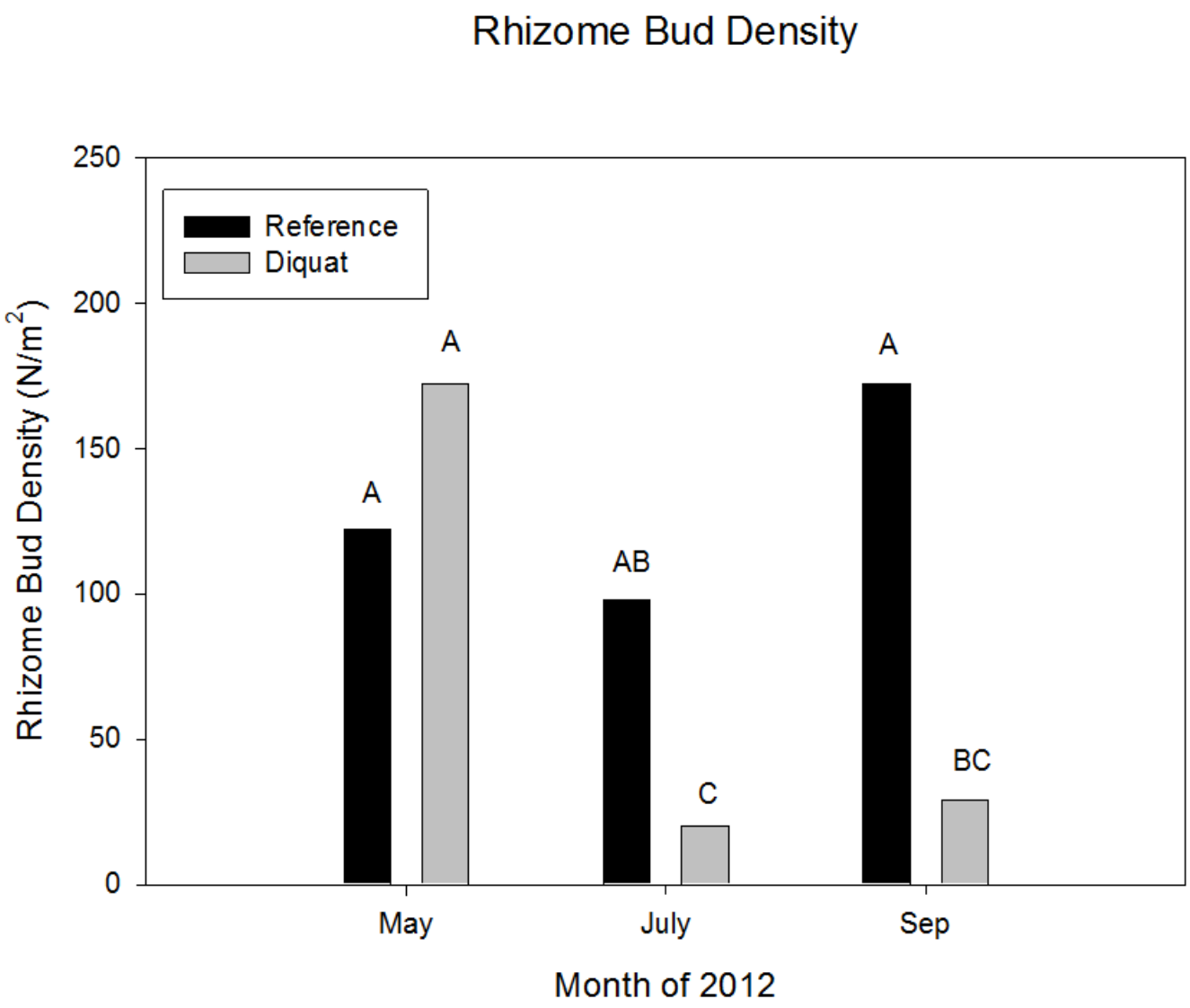
Common Name	SPECIES	Reference	Diquat
Water marigold	*Bidens beckii*		
Flowering rush	*Butomus umbellatus*	-	-
Coontail	*Ceratophyllum demersum*	+	+
Chara	*Chara*	+	+
Moss	*Drepanocladus*	+	+
Elodea	*Elodea canadensis*		-
Water stargrass	*Heteranthera dubia*		
Common duckweed	*Lemna minor*		
Forked duckweed	*Lemna trisulca*		
Northern water milfoil	*Myriophyllum sibiricum*		
Slender naiad	*Najas flexilis*	+	+
Yellow pond lily	*Nuphar lutea*		+
White water lily	*Nymphaea odorata*	+	
Curly leaf pondweed	*Potamogeton crispus*	-	-
Leafy pondweed	*Potamogeton foliosus*		-
Variable pondweed	*Potamogeton gramineus*		
Illinois pondweed	*Potamogeton illinoensis*		
Floating pondweed	*Potamogeton natans*		
White stem pondweed	*Potamogeton praelongus*	-	
small pondweed	*Potamogeton pusillus*		
American pondweed	*Potamogeton nodosus*		
Clasping leaf-pondweed	*Potamogeton richardsonii*		-
Fern-leaf pondweed	*Potamogeton robbinsii*		
Flat-stem pondweed	*Potamogeton zosteriformis*	+	+
Water crowfoot	*Ranunculus sp.*		
Spiral ditch-grass	*Ruppia cirrhosa*	-	
White water crowfoot	*Ranunculus longirostris*	-	-
Hardstem bulrush	*Schoenoplectus acutus*		
Sago pondweed	*Stuckenia pectinata*		-
Bladderwort	*Utricularia macrorhiza*		-
Cattail	*Typha sp.*		
Water celery	*Vallisneria americana*	+	+
Increasers		7	7
Decreasers		5	8
No change		20	17



Grand means of aboveground biomass (gDW/m2) from ANOVA of untreated reference vs. diquat treated plots for four treated and four reference plots in Detroit Lakes basins in 2012. Means with the same letter are not significantly different at the p=0.05 level.



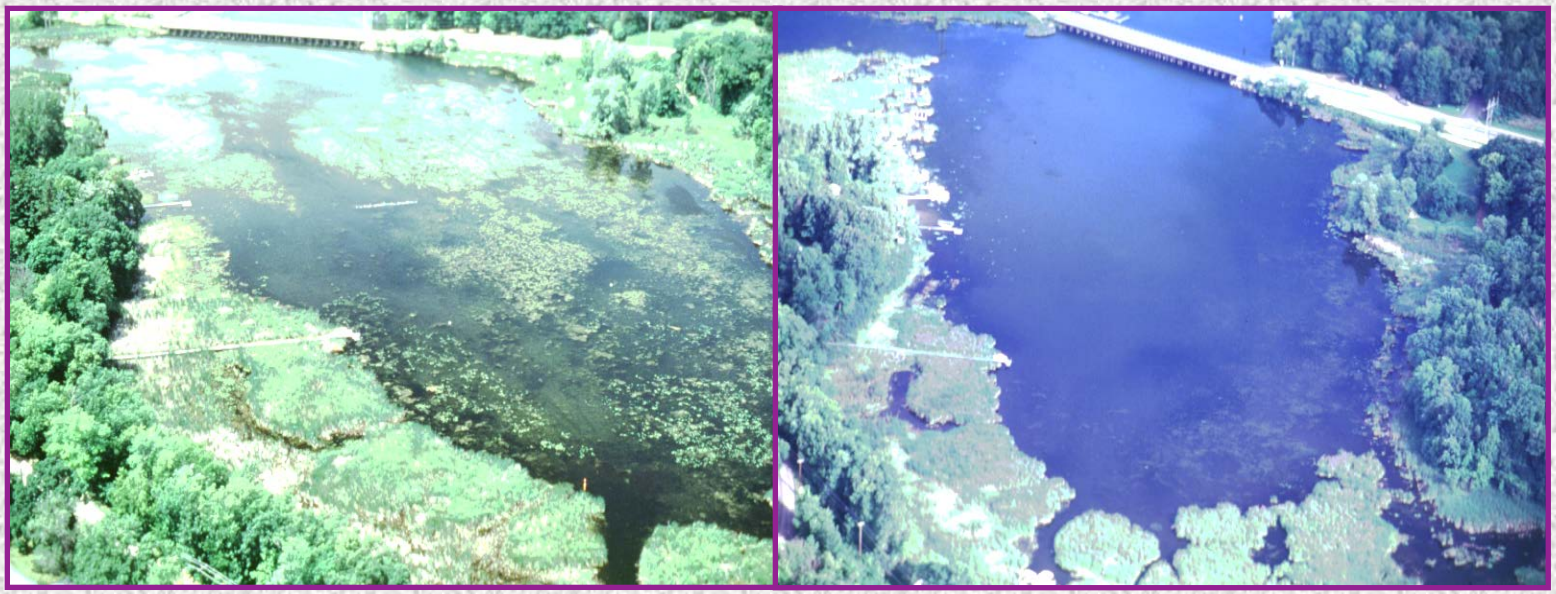
Grand means of belowground biomass (gDW/m^2) from ANOVA of untreated reference vs. diquat treated plots for four treated and four reference plots in Detroit Lakes basins in 2012. Means with the same letter are not significantly different at the p=0.05 level.



Grand means of rhizome bud density (N/m^2) from ANOVA of untreated reference vs. diquat treated plots for four treated and four reference plots in Detroit Lakes basins in 2012. Means with the same letter are not significantly different at the p=0.05 level.

Aquatic Plant Restoration Goal

Remove invasive plants and restore a diverse community of desirable native plant species using economically and environmentally compatible methods



Carsons Bay, MN before treatment

Carsons Bay, MN after treatment

Contact Information

John D. Madsen
Mississippi State University
Geosystems Research Institute
Box 9627
Mississippi State, MS 39762
jmadsen@gri.msstate.edu
662-625-2428
www.gri.msstate.edu