ENDOTHALL BEHAVIOR IN EURASIAN WATERMILFOIL (*MYRIOPHYLLUM SPICATUM*) AND HYDRILLA (*HYDRILLA VERTICILLATA*)

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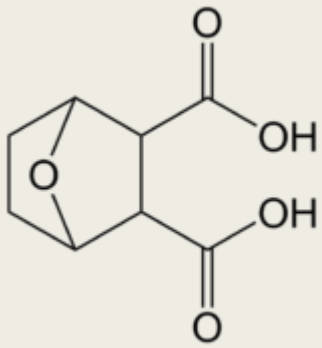
Endothall

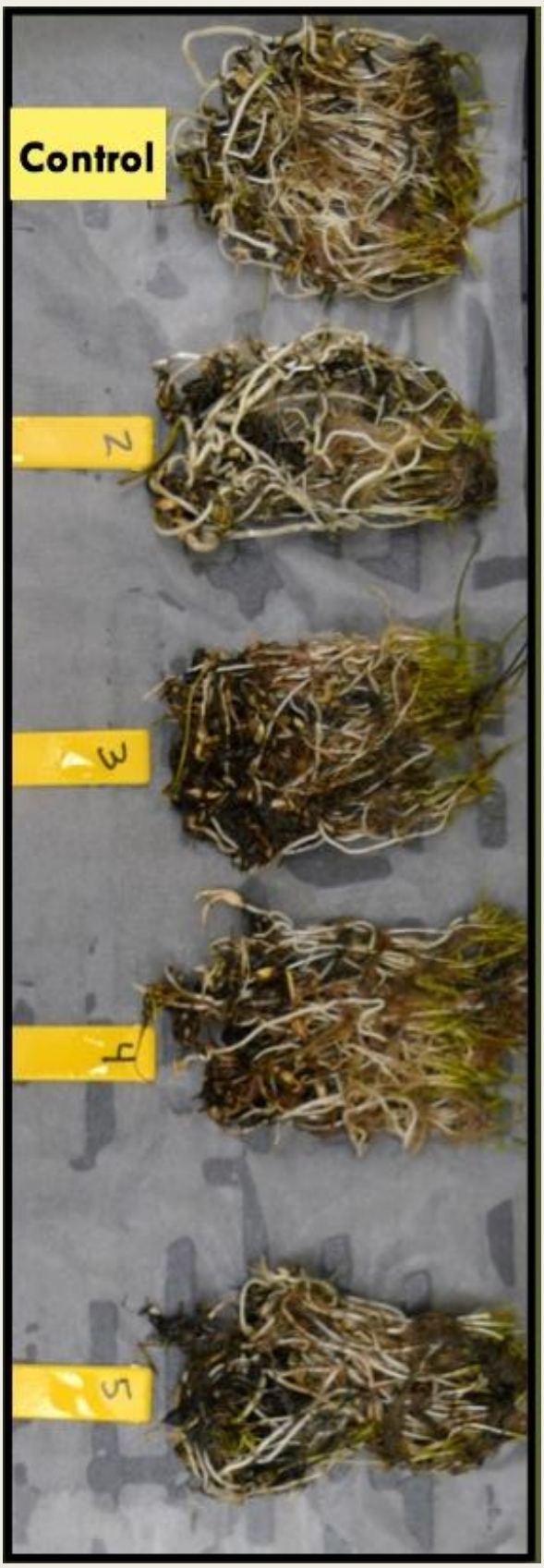


- Considered a contact herbicide in aquatic systems[1]; however, many field observations suggest that it could have some systemic activity.
- Broad-spectrum herbicide – controls both monocotyledons (hydrilla) and dicotyledons (EWM)[2].
- Aquatic weed control in ponds, lakes, and flowing water (since 2010).

1: **Gettys, L.A.**, W.T. Haller, and D.G. Petty (2014). Biology and Control of Aquatic Plants, A Best Management Practices Handbook: Third Edition. pp 74.

2: **Madsen, J.** (1997). Methods for management of nonindigenous aquatic plants, pp. 145-171. *In*: J. G. Luken and J. W. Thieret, eds. Assessment and Management of Plant Invasions. Springer-Verlag, New York.


Cascade
1
2
3
4
5


Control
2
3
4
5

Research Objectives

- To determine endothall's behavior by examining:
  - *1) herbicide absorption,*
  - *2) translocation from shoots to roots,*
  - *3) herbicide desorption.*

Materials and Methods

Preparation:

- Eurasian watermilfoil (CO)
- Monoecious Hydrilla (NC)
- Dioecious Hydrilla (FL)
- Abs/Transl: transferred from field soil to test tubes filled with fine, unwashed sand – sealed with eicosane.
- Desorp: 10cm apical meristem shoots

Materials and Methods

Conditions:

- Laboratory temperature: 21 C
- Water pH: 6.5 - 7
- 12h day/12h night
- 3.5/1 L of tap water/tank
- Stirred twice a day for 30 minutes
- 3 reps – each experiment was repeated

Materials and Methods

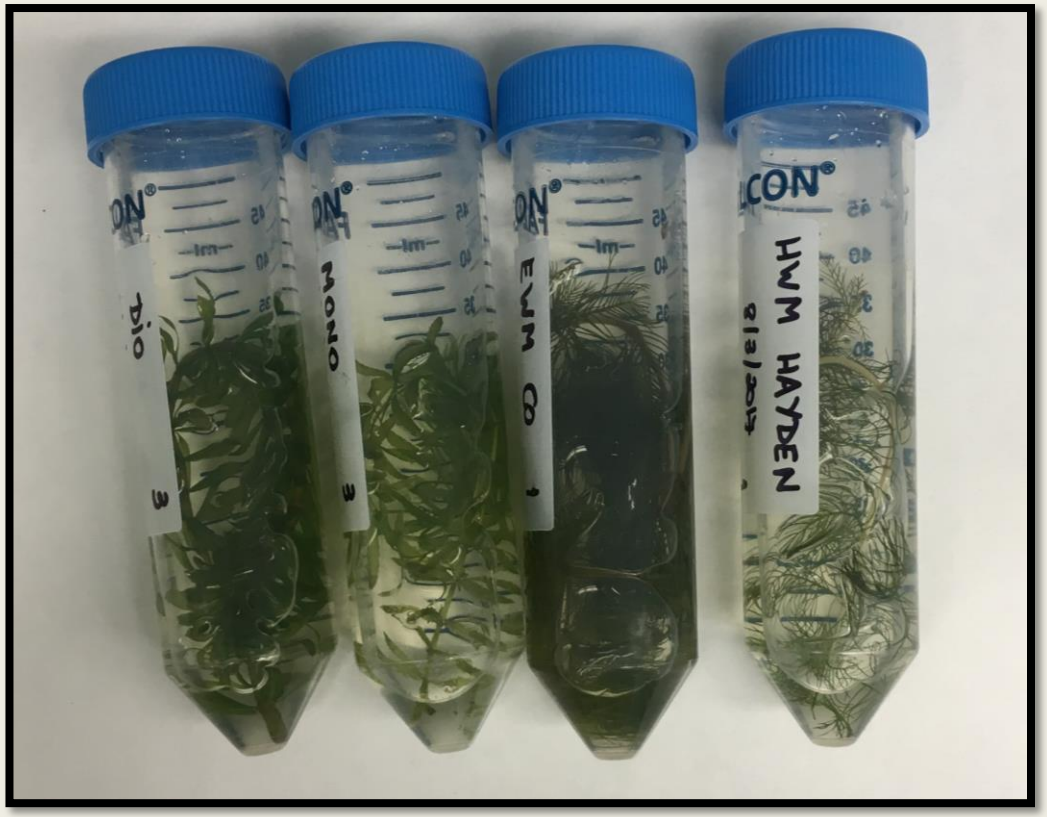
Treatment Absorption and Translocation:

- 5.7 µl L^{-1} endothall (Aquathol K®, UPI)
- 18.8 KBq L^{-1} ^{14}C-endothall (ring labeled)
- Final concentration: 3mg L^{-1}

Materials and Methods

Treatment Desorption:

- 5.7 µl L^{-1} endothall (Aquathol K®, UPI)
- 116.9 KBq L^{-1} ^{14}C-endothall (ring labeled)
- Final concentration: 3mg L^{-1}



Materials and Methods

Data Collection Absorption/Translocation:

- Time points: 6, 12, 24, 48, 96, 192 hours after treatment
- Fresh and dry biomass
- All samples dried at 60 C for 48 h
- Oxidized all root samples – biological oxidizer
- ^{14}C quantified by liquid scintillation spectroscopy (LSC)

Materials and Methods

Data Collection Desorption:

- Shoots were exposed for 24h, triple rinsed and transferred to clean water
- Time points: 0, 12, 24, 48, 96 hours after treatment (shoot+water)
- Fresh and dry biomass
- All samples dried at 60 C for 48 h
- Oxidized all shoot samples – biological oxidizer
- ^{14}C quantified by liquid scintillation spectroscopy (LSC)

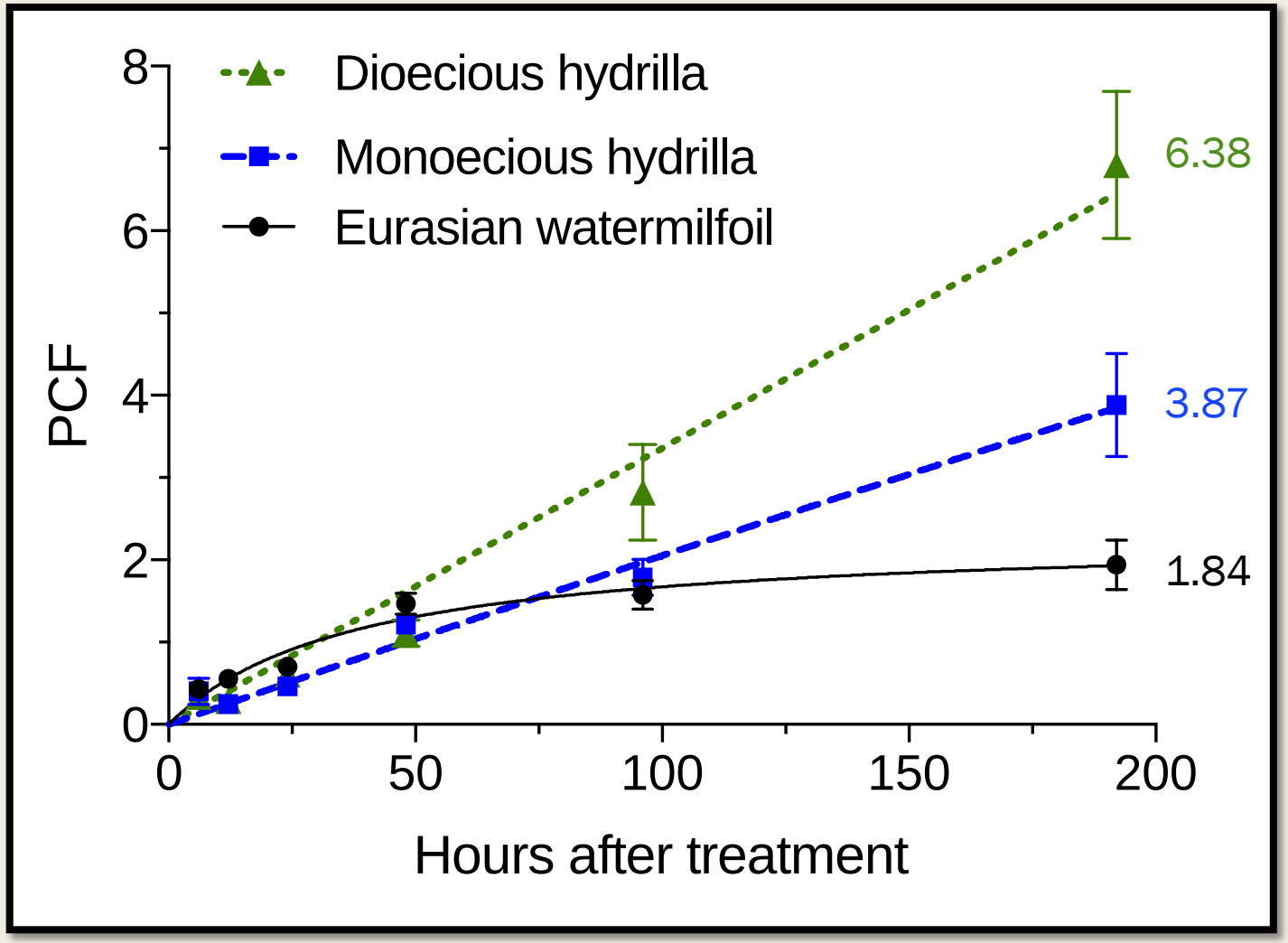
Materials and Methods

Data Analysis:

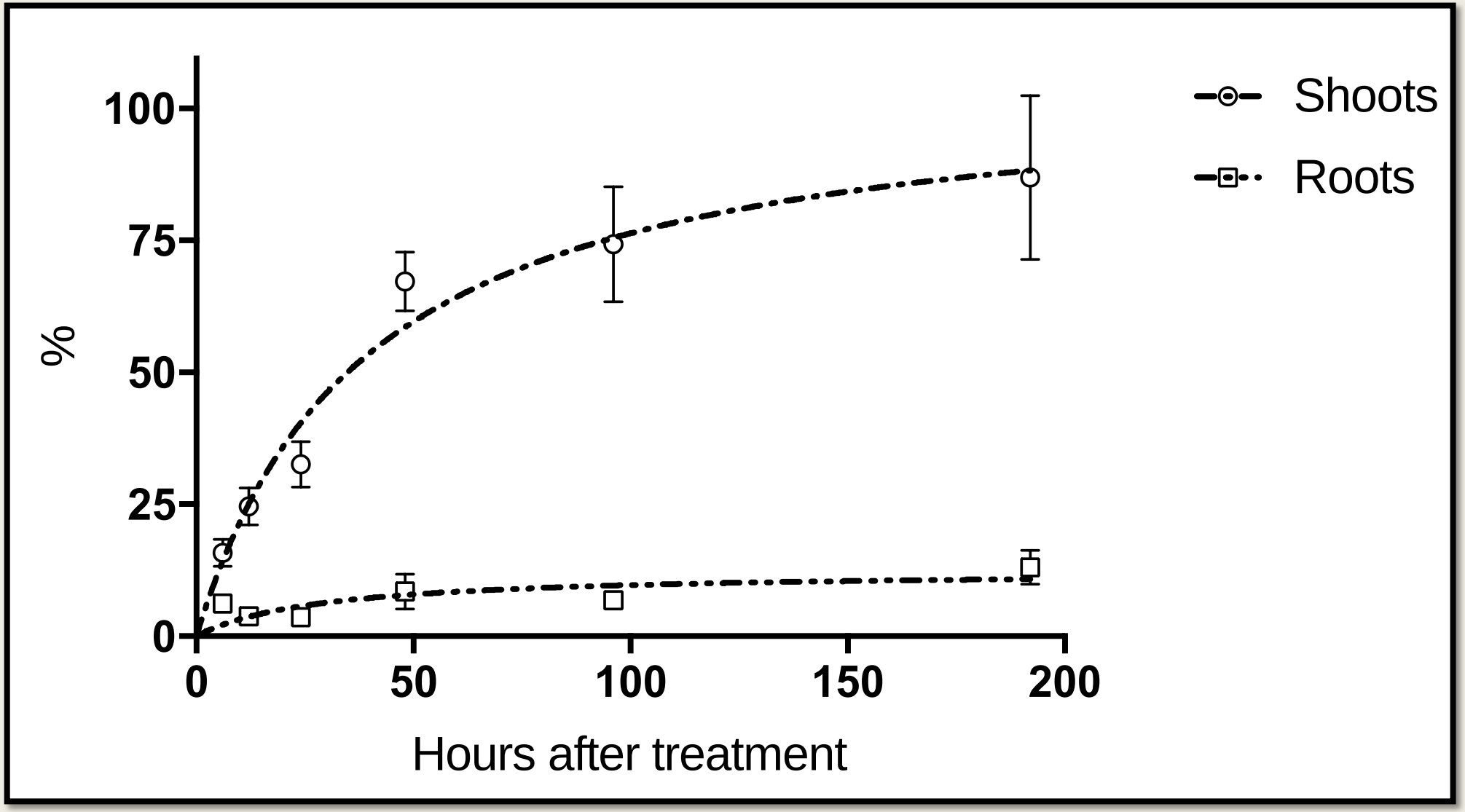
- Nonlinear regression using R and GraphPad Prism 7 program

$$\text{Plant Concentration Factor (PCF)} = \frac{concentration\ in\ plant\ (Bq\ g^{-1})}{concentration\ in\ water\ (Bq\ mL^{-1})}$$

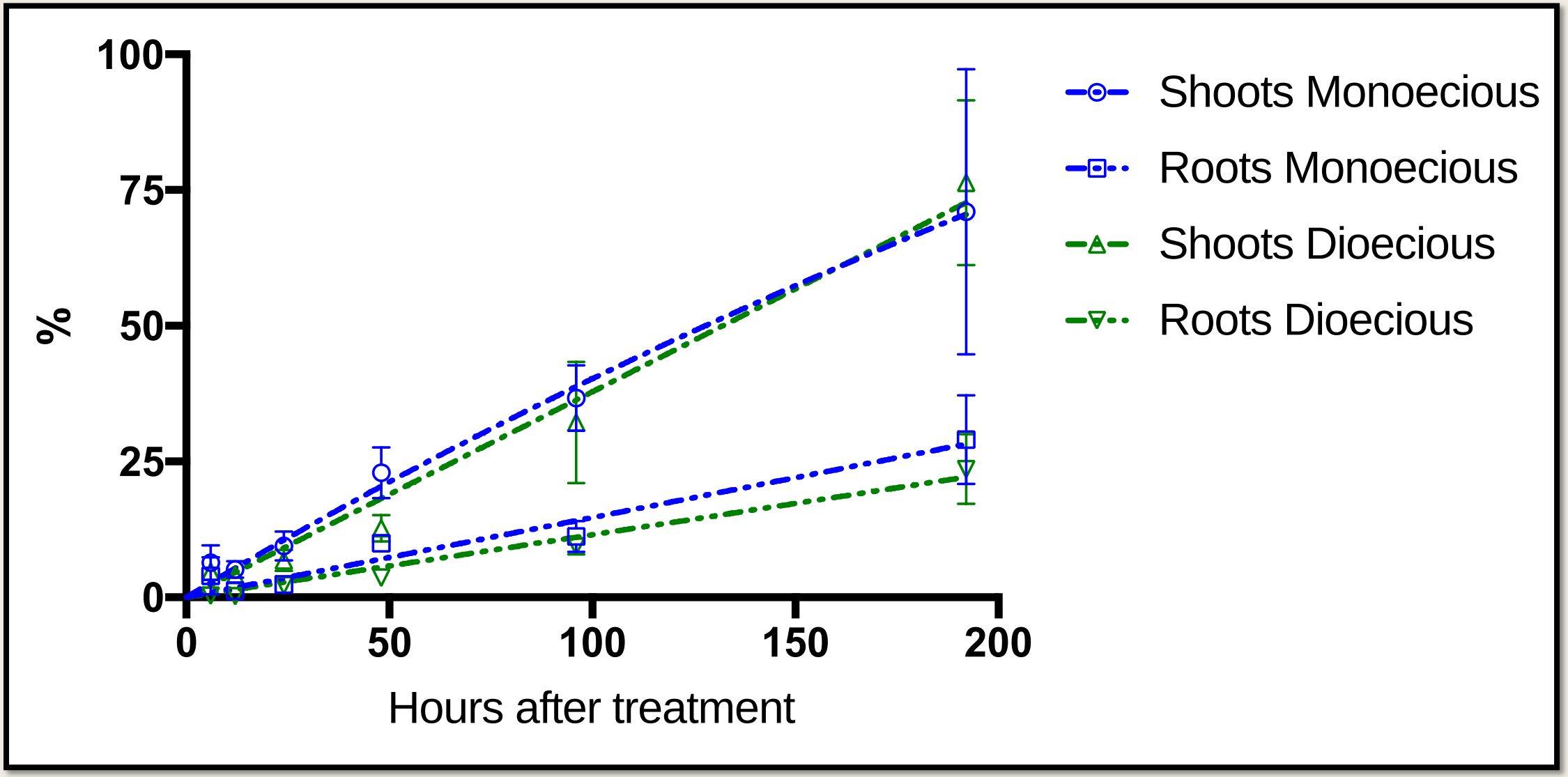
Results: Total Herbicide in the Plant



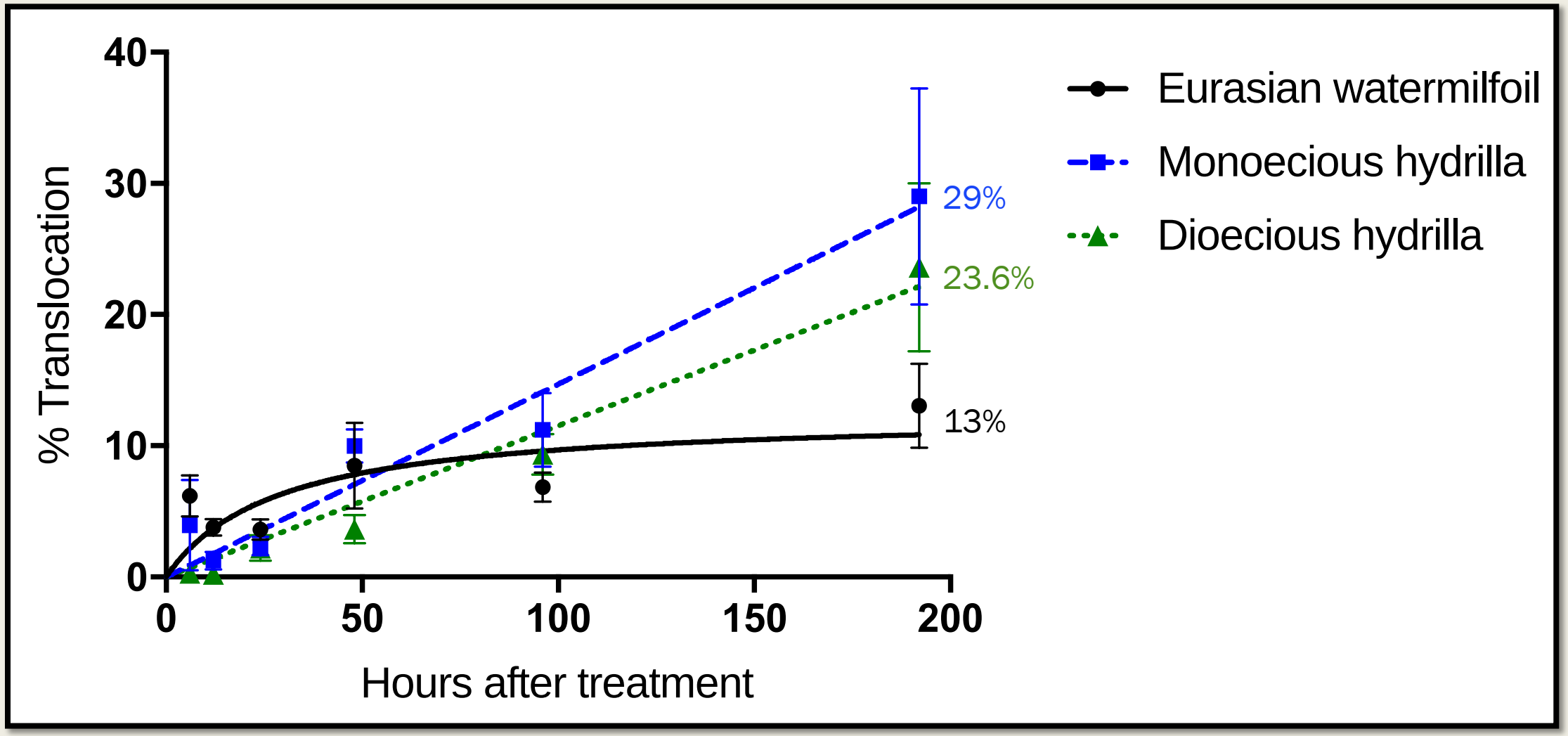
Results: EWM


Shoots
Roots
100
75
50
25
0
%
0
50
100
150
200
Hours after treatment

Results: Hydrilla



Results: Translocation to the roots



Percentage of Total Absorbed Herbicide Present in Roots at 192 HAT

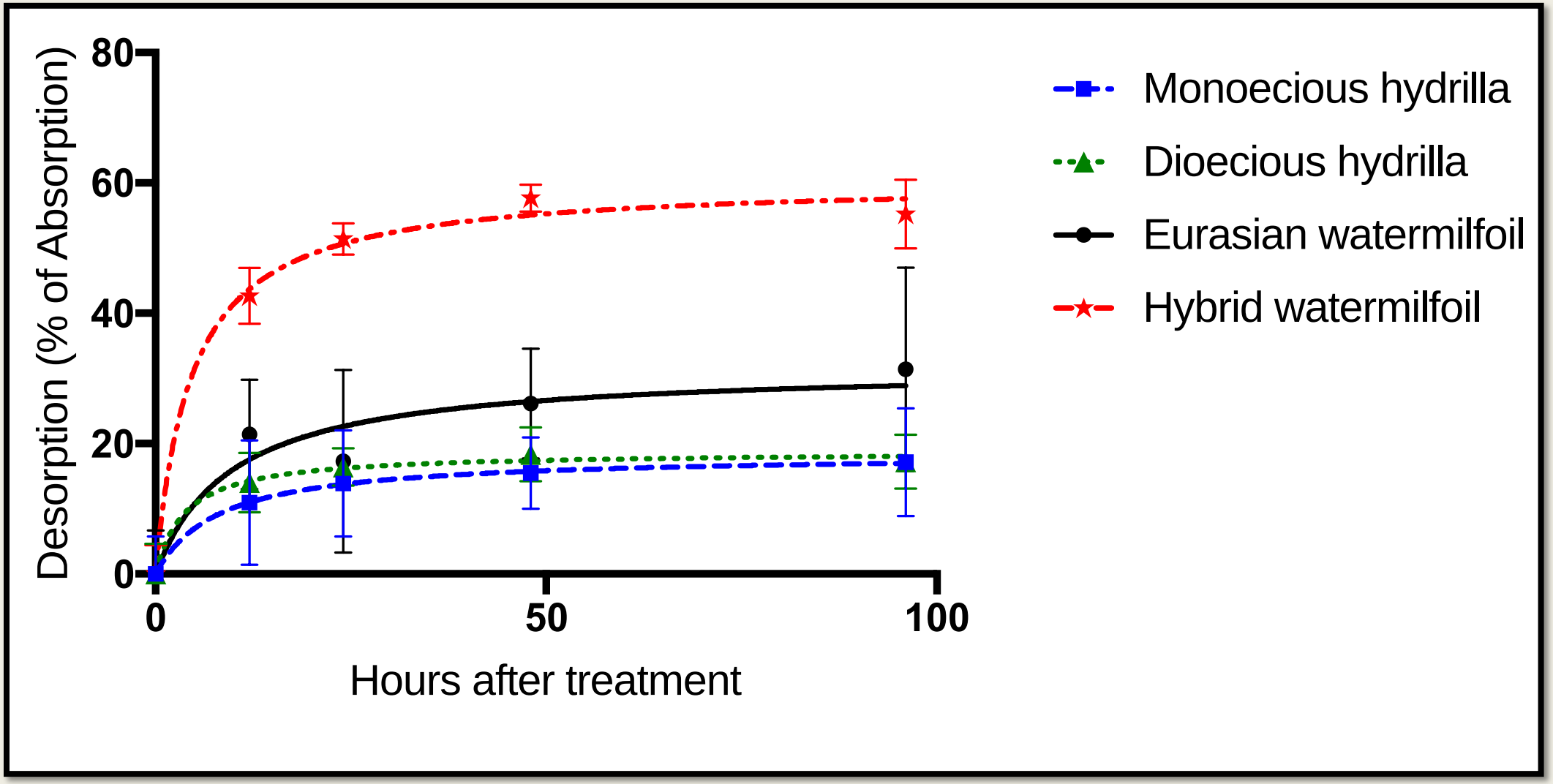
Herbicide	EWM	Dioecious hydrilla	Monoecious hydrilla
Endothall (Aquathol K)	13.0% ± 3.2	23.6% ± 6.4	29% ± 8.2
Fluridone (Sonar)*	2.6% ± 0.3 [3]	9.0% ± 2.2 [3]	
Penoxsulam (Galleon)*	1.3% ± 0.3 [3]	6.1% ± 1.5 [3]	~ 20% [4]
Triclopyr (Renovate)*	2.0% ± 0.4 [3]		

3: **Vassios, J.D. et al.** (2014). Triclopyr Absorption and Translocation by Eurasian Watermilfoil (Myriophyllum spicatum) Following Liquid and Granular Applications Weed Science, 62(1):22-28.
4: **Meadows, S.L.T.** (2013). Monoecious Hydrilla Biology and Response to Selected Herbicides (Doctoral dissertation). Retrieved from https://repository.lib.ncsu.edu/bitstream/handle/1840.16/9246/etd.pdf?sequence=2

Summarizing: Absorption and Translocation

- Endothall did bio-accumulate above the concentration in the water column and translocated to roots in all three aquatic weeds.
- EWM showed a hyperbolic increase in herbicide absorption, and limited translocation to the roots (13%).
- Monoecious and dioecious hydrilla showed a linear increase in herbicide absorption and did not reach a maximum absorption or translocation 192 HAT (71% shoot:29% root and 76% shoot:24% root, respectively).

Results: Desorption



Summarizing: Desorption

- Endothall desorption was very low in all the three species, reaching a plateau after 96h of exposure to untreated water.
- EWM had 31% of desorption (as a percentage of absorbed) and both hydrilla biotypes had 17%.
- Hybrid EWM reached equilibrium with clean water less than 48 HAT.

Conclusions

- Endothall is translocated more than fluridone, penoxsulam, and triclopyr in Eurasian watermilfoil, monoecious hydrilla and dioecious hydrilla, based on percentage of absorbed.
- Endothall desorption was very low in all the three species
- Endothall should be reclassified as a systemic aquatic herbicide.

Future Research

- Endothall metabolism rates
- Many of the current observations could be explained by understanding endothall metabolism

Acknowledgements

- UPI for funding this research
- Dr. Scott Nissen

Colorado State University

Questions?

- 1: **Gettys, L.A.**, W.T. Haller, and D.G. Petty (2014). Biology and Control of Aquatic Plants, A Best Management Practices Handbook: Third Edition. pp 74.
- 2: **Madsen, J.** (1997). Methods for management of nonindigenous aquatic plants, pp. 145-171. *In*: J. G. Luken and J. W. Thieret, eds. Assessment and Management of Plant Invasions. Springer-Verlag, New York.
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