The Investigation of Allelopathy and its Potential Effect on Trophic Dynamics in Aquatic Systems

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How Does Plant Chemistry Affect an Aquatic System

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Plants and Management

- Native and non-native plants
- Habitat
- Life history traits
- Trophic Dynamics

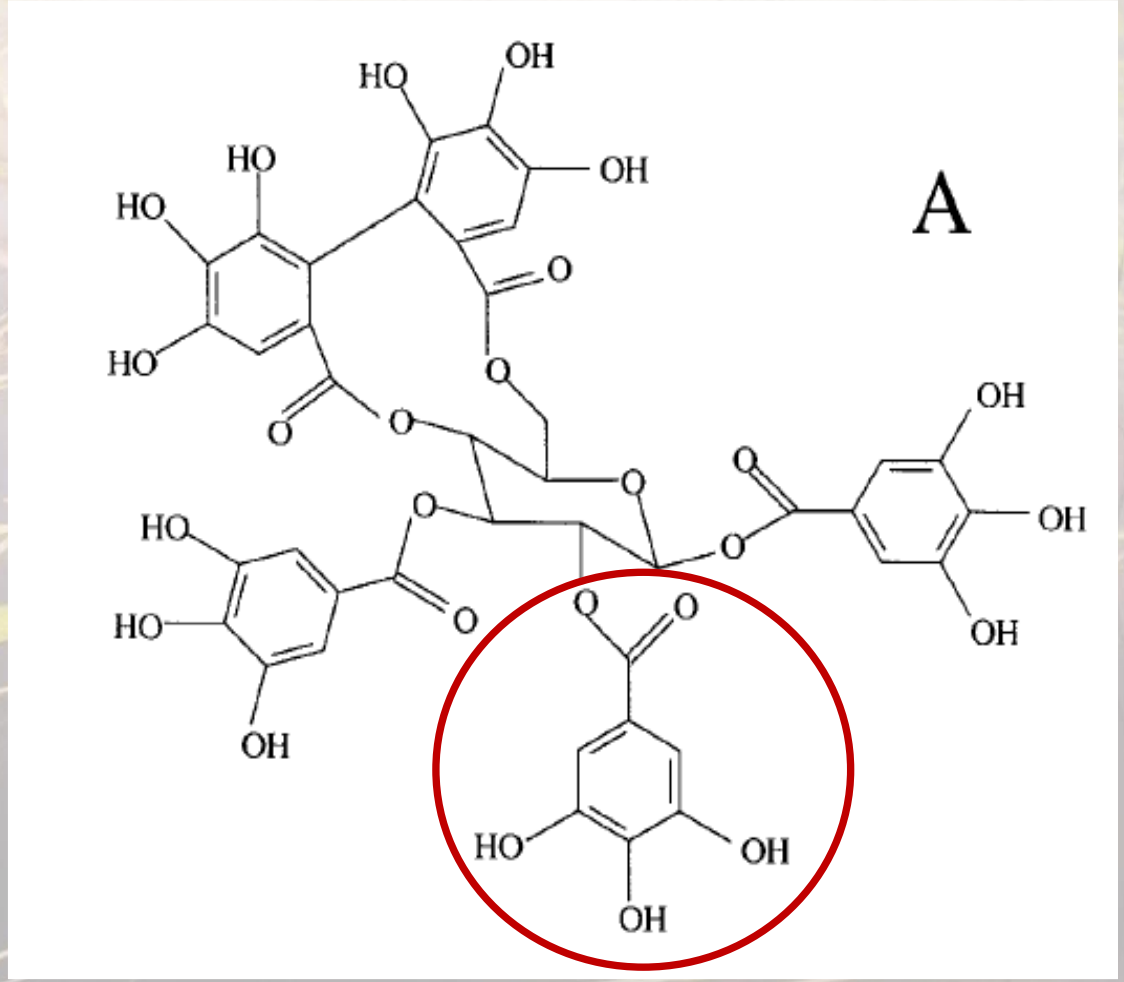
http://en.wikipedia.org/wiki/File:Micropterus_salmoides_2.jpg

Basic Trophic Level

- Lindeman (1942)
- Plants and associated organisms
- Epiphyton (Goldsborough et. al 2005)
- Competition of resources
- Allelopathy(Molisch 1937)

Inhibitory Compounds

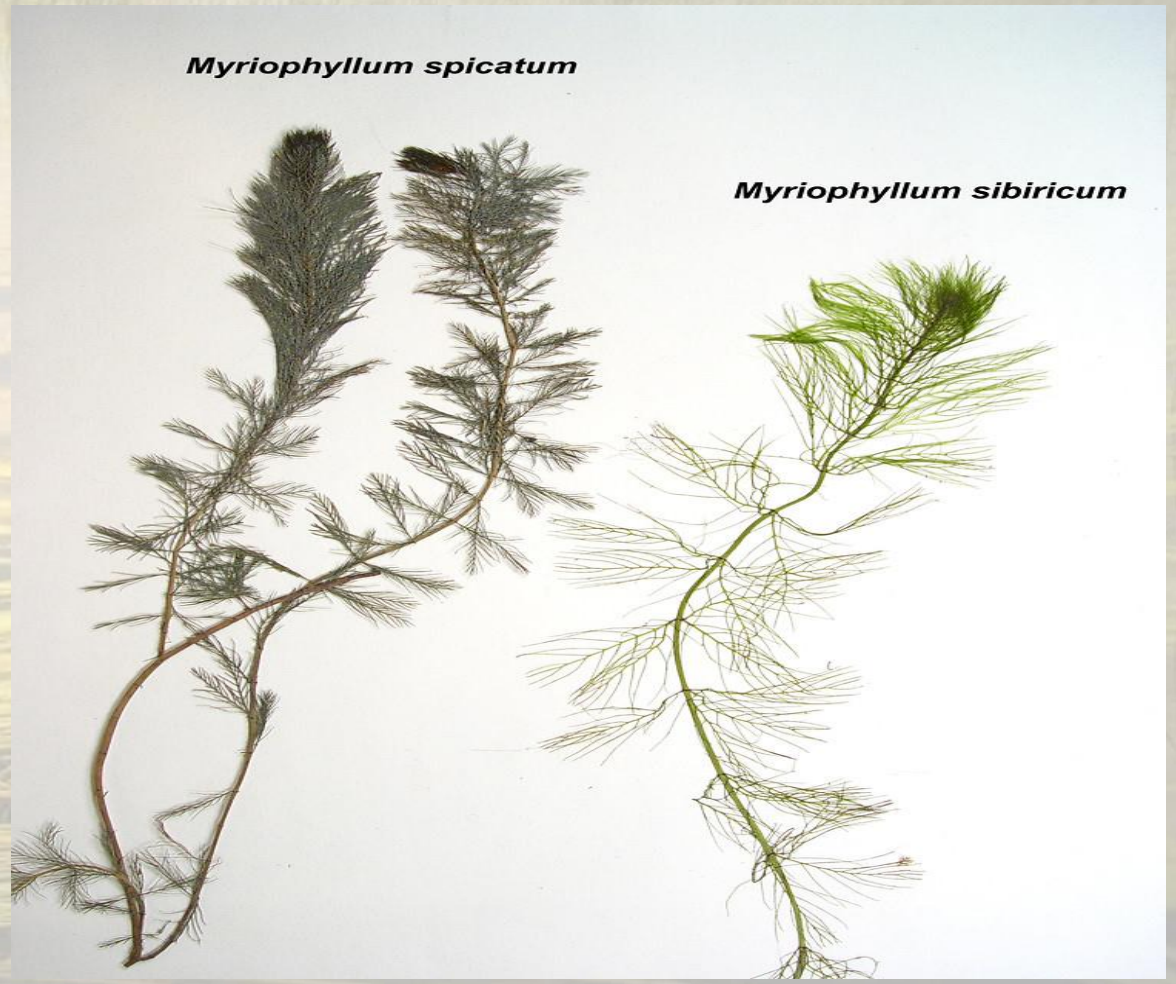
- Gross et. al (1996)
- Polyphenols
- 3 main inhibitory compounds
    1. Tellimagrandin II
    2. Gallic acid
    3. Ellagic acid



Structure of Tellimagrandin II compound
(figure taken from Glomski et. al 2002)

Chemical Profile

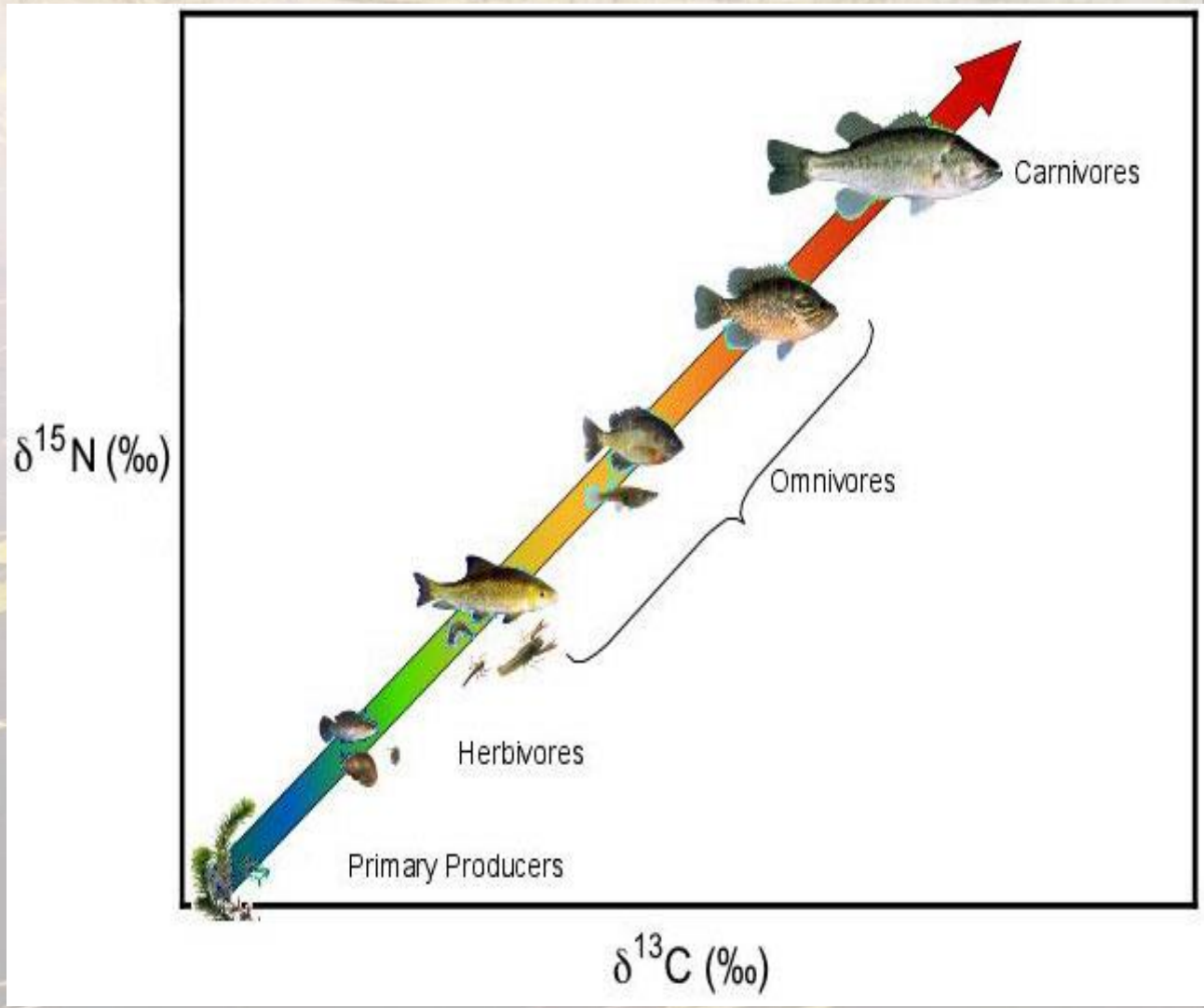
- Marko et. al (2008)
- Apical meristem concentrations
- Tellimagrandin II
- 2x higher polyphenol content



https://gobotany.newenglandwild.org/species/myriophyllum/sibiricum/

Trophic Decoupling

- Kovalenko & Dibble (2013)
- Investigated the effects on trophic structure and energy flow
- Macro-invertebrate and Fish isotope values



http://www.ansto.gov.au/ResearchHub/IER/Research/IsotopesforWater/AquaticEcosystems/index.htm

Hypotheses

Hypothesis 1: Differences in allelopathic polyphenols between non-native *M. spicatum* and native *M. sibiricum* influence the community structure of colonizing epiphyton

Hypothesis 2: Differences in the community structure of colonizing epiphyton between non-native *M. spicatum* and native *M. sibiricum* influence trophic dynamics in aquatic systems.

Prediction & Measurements for Hypothesis 1

Prediction: If differences in allelopathic polyphenols between non-native *M. spicatum* and native *M. sibiricum* are present, then there will be differences in community structure of colonizing epiphyton

Measurements:

- Epiphyton diversity and species richness
- Alellopathic polyphenols
    1. Tellimagrandin II
    2. Gallic acid
    3. Ellagic acid

Sample Collection and Processing

- Allelopathic polyphenols
  (Glomski et. al 2002)
- Temporally collected
  - Days 21, 35, & 49
- Plant and water sample collection
- Clemson Multi-User Analytical Lab

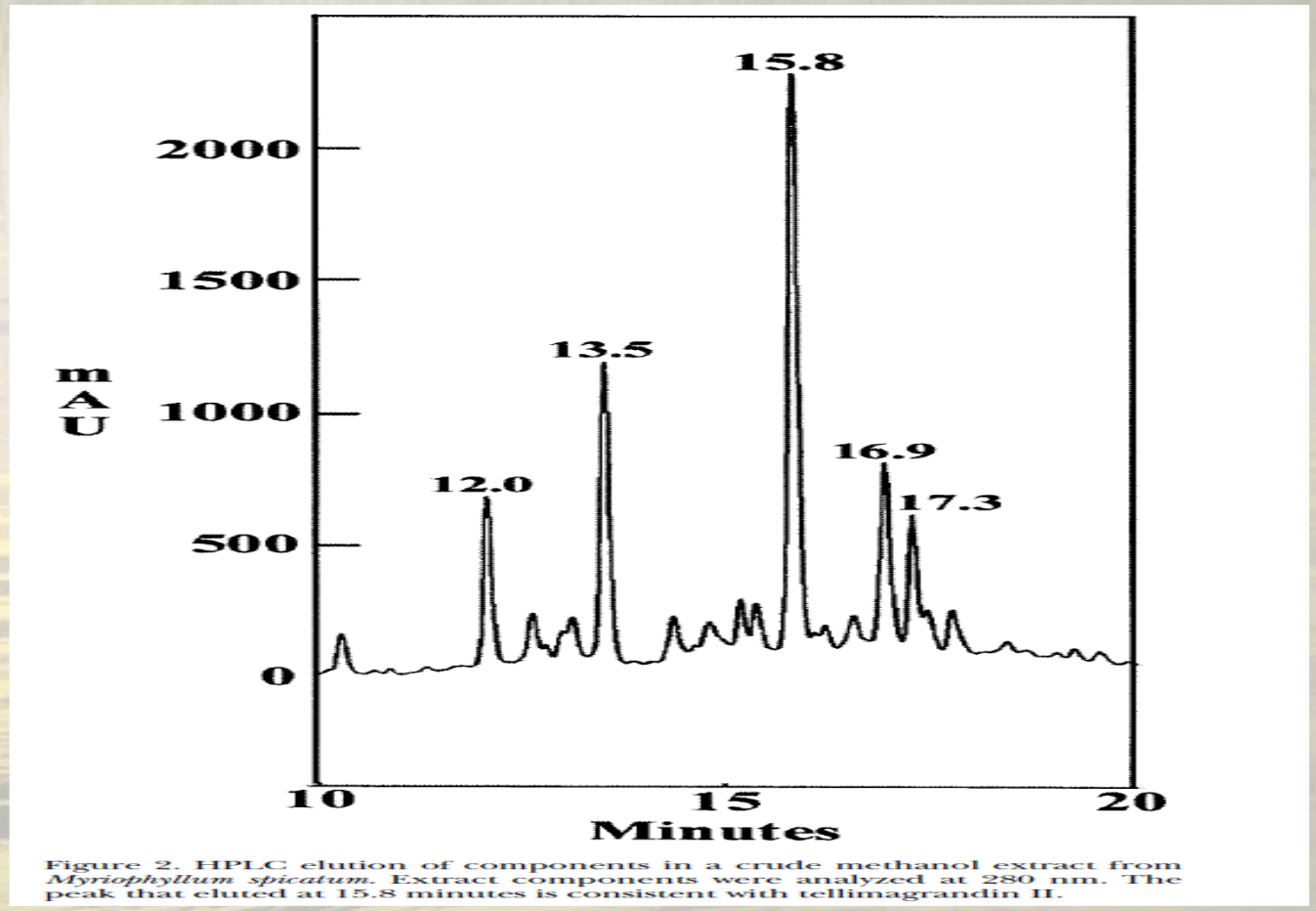


Figure 2. HPLC elution of components in a crude methanol extract from *Myriophyllum spicatum*. Extract components were analyzed at 280 nm. The peak that eluted at 15.8 minutes is consistent with tellimagrandin II.

HLPC analysis of Tellimagrandin II
(figure taken from Glomski et. al 2002)

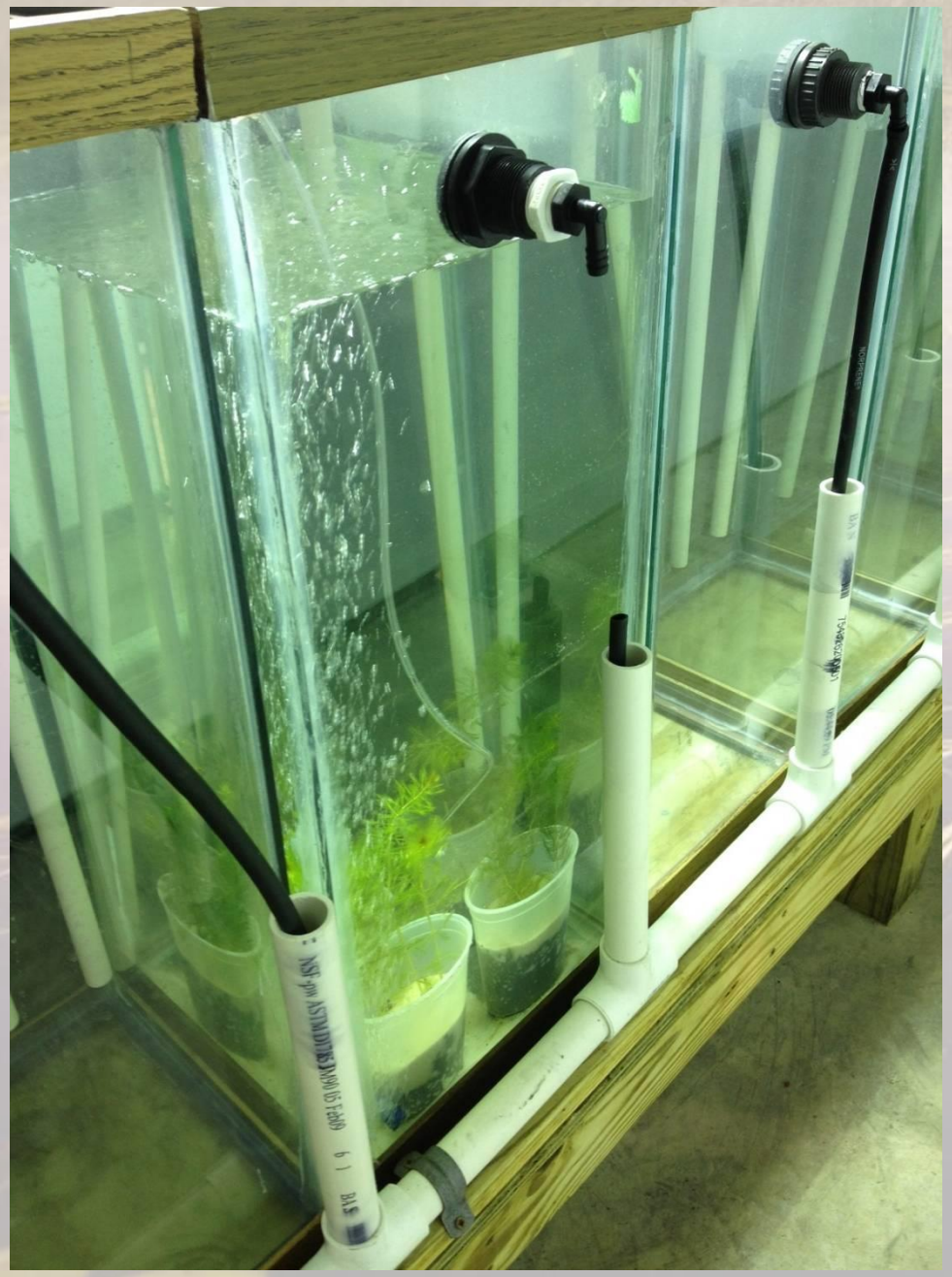
Plant Collection Sites

Northern Watermilfoil- Red Cedar Lake, WI

Eurasian Watermilfoil- Emily Lake, MN

ERDC Controlled Environment Growth Chamber

- 22ºC Temperature
- 14:10 light:dark Photoperiod



Experimental Design

Non-Native	Non-Native vs. Native	Native
4 4 4 4 55 L	4 4 4 4 55 L	4 4 4 4 55 L
4 4 4 4 55 L	4 4 4 4 55 L	4 4 4 4 55 L
4 4 4 4 55 L	4 4 4 4 55 L	4 4 4 4 55 L

Sampling Schedule

Start
Plant Cultivation
(Mudge 2013, Wetzel 2001)
Day 0

Cultured
Epiphyton
Day 7

Injected
Culture
Day 14

Plant & Water
Samples
Day 21

Plant & Water
Samples
Day 35

End
Sample Collection
Day 49

Epiphyton Collection

- Epiphyton removal (Aloi 1990)
- 5 cm apical meristems
- Shake, scrape, and confirm
- Preservative
- Algal Analysis, LLC

28 Genera of Epiphyton

Cladophora

Oscillatoria

Scenedesmus

Leptolyngbya

Spirogyra

Diatoms

Sphaerocystis

Stigeoclonium

Anabaena

Nostoc

Ankistrodesmus

Heteroleibleinia

Calothrix

Phormidium

Oocystis

Mougeotia

Zygnema

Homeothrix

Gomphosphaeria

Chroococcus

Coelastrum

Mallomonas

Cosmarium

Rivularia

Aphanothece

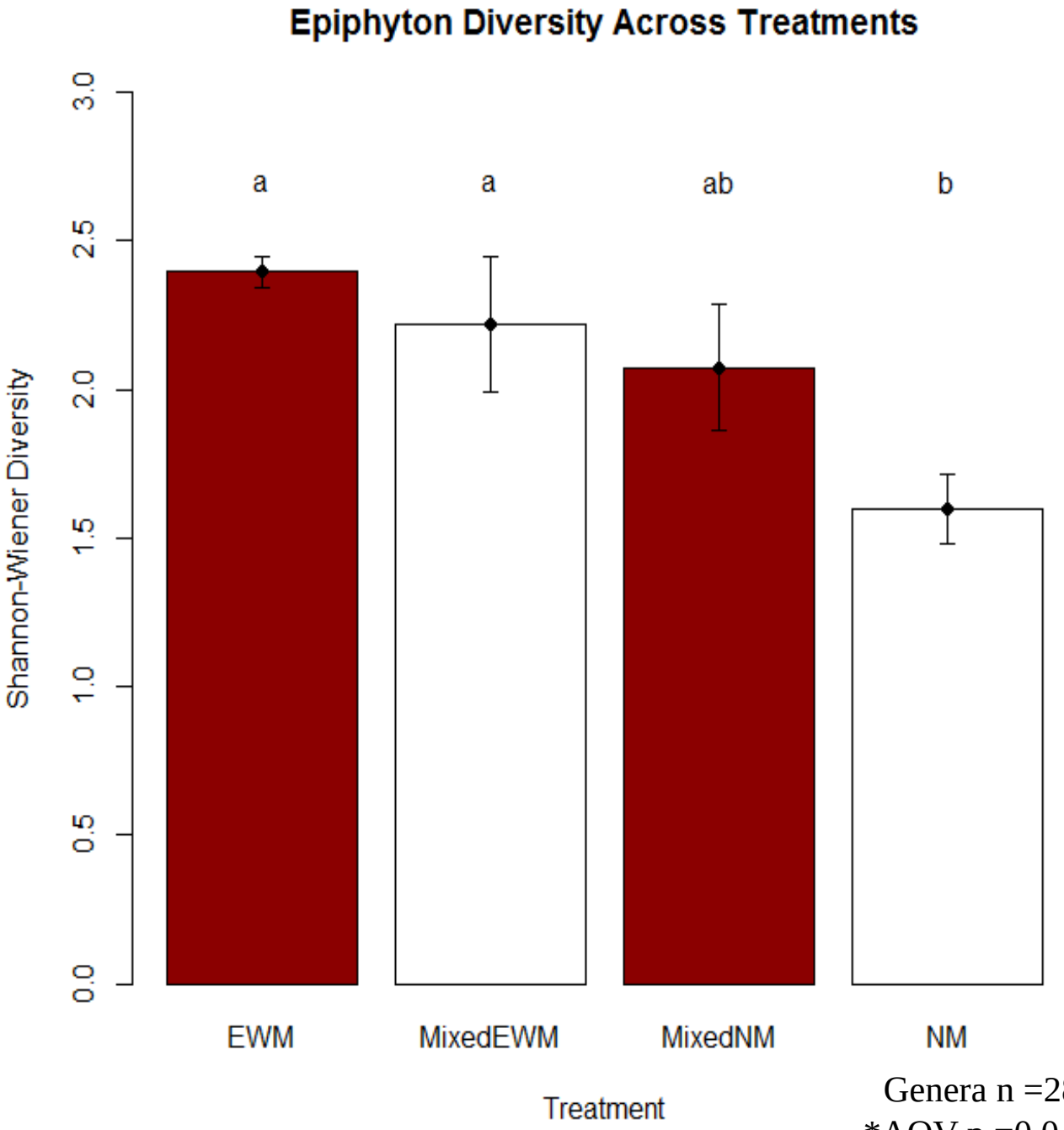
Tribonema

Bulbochaete

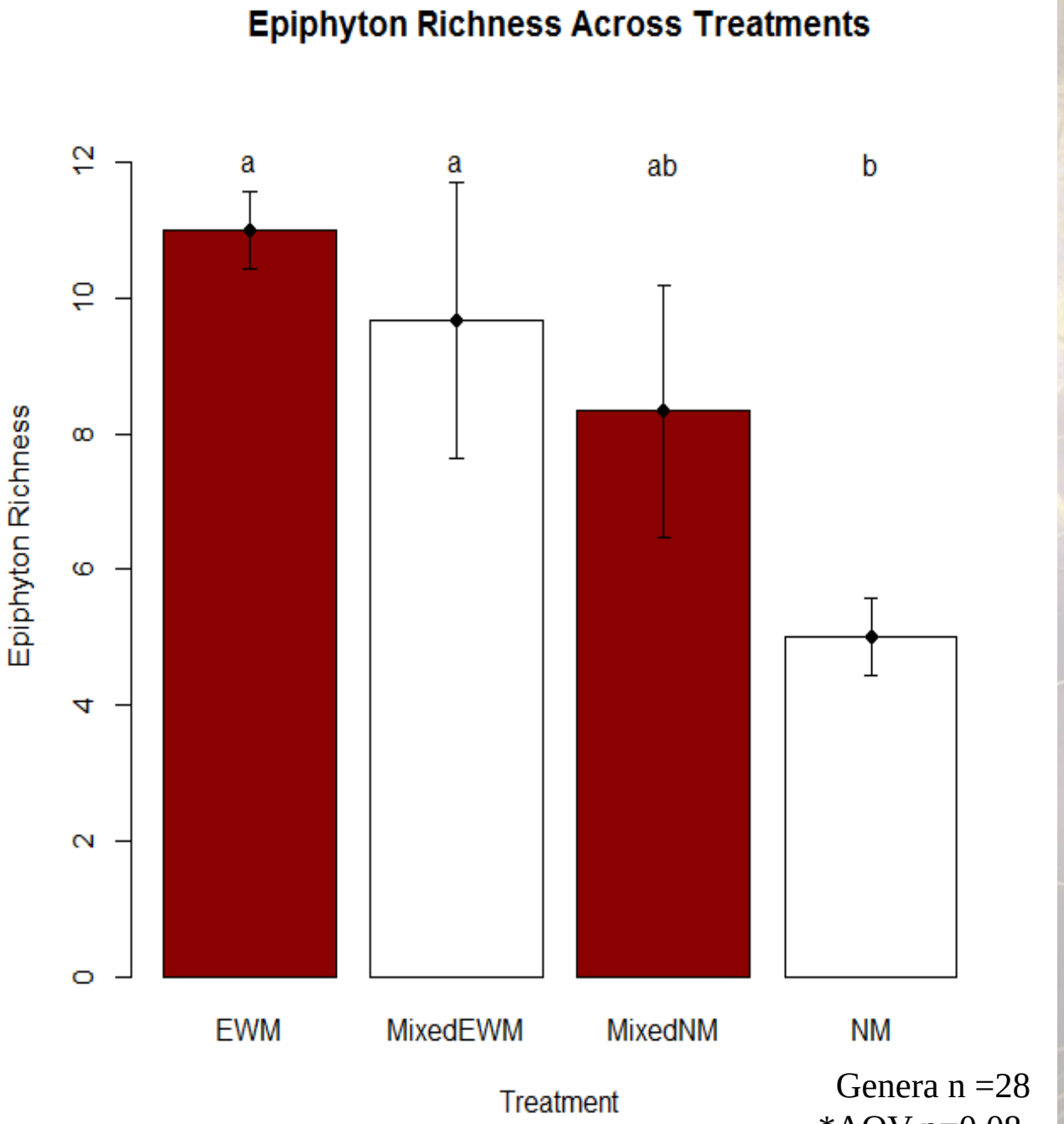
Gloeotrichia

Shannon-Weiner Diversity Index (H')

Rep	EWM	Mixed EWM	Mixed NM	NM
1	2.397895	2.564949	2.484907	1.791759
2	2.302585	2.30255	1.945910	1.386294
3	2.484907	1.791759	1.791759	1.609438

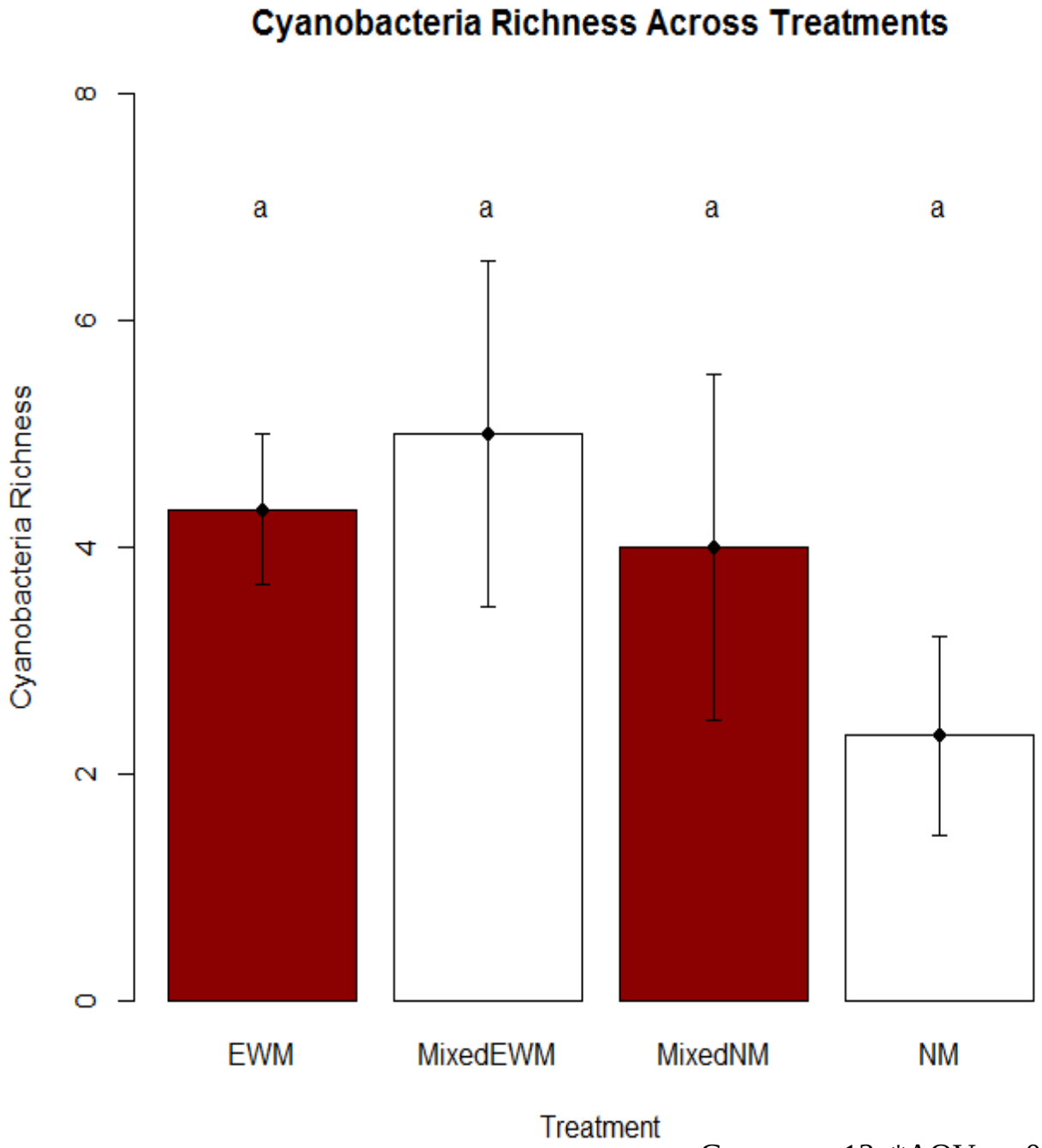


Genera n =28
*AOV p =0.04

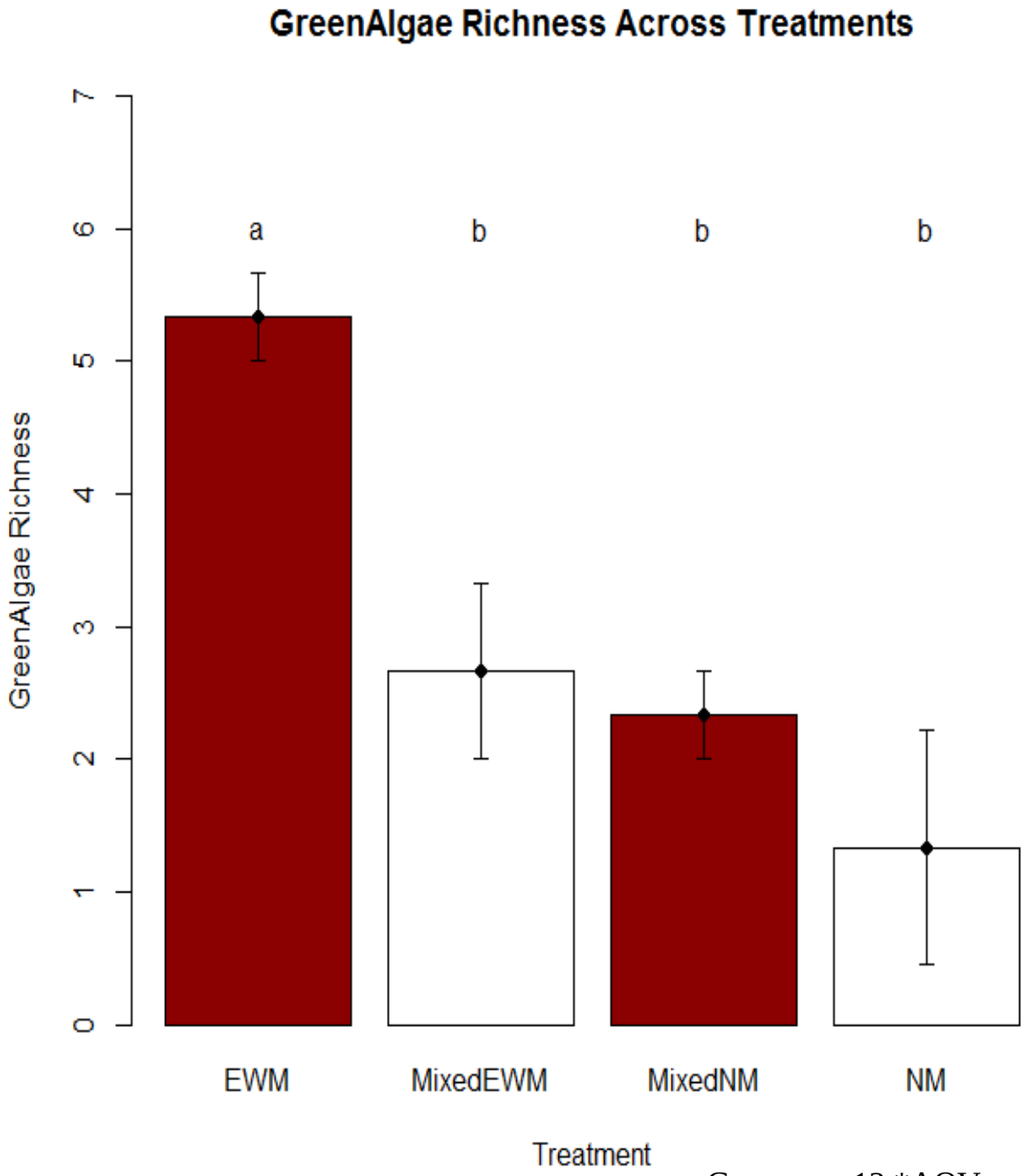


Genera n =28

*AOV p=0.08



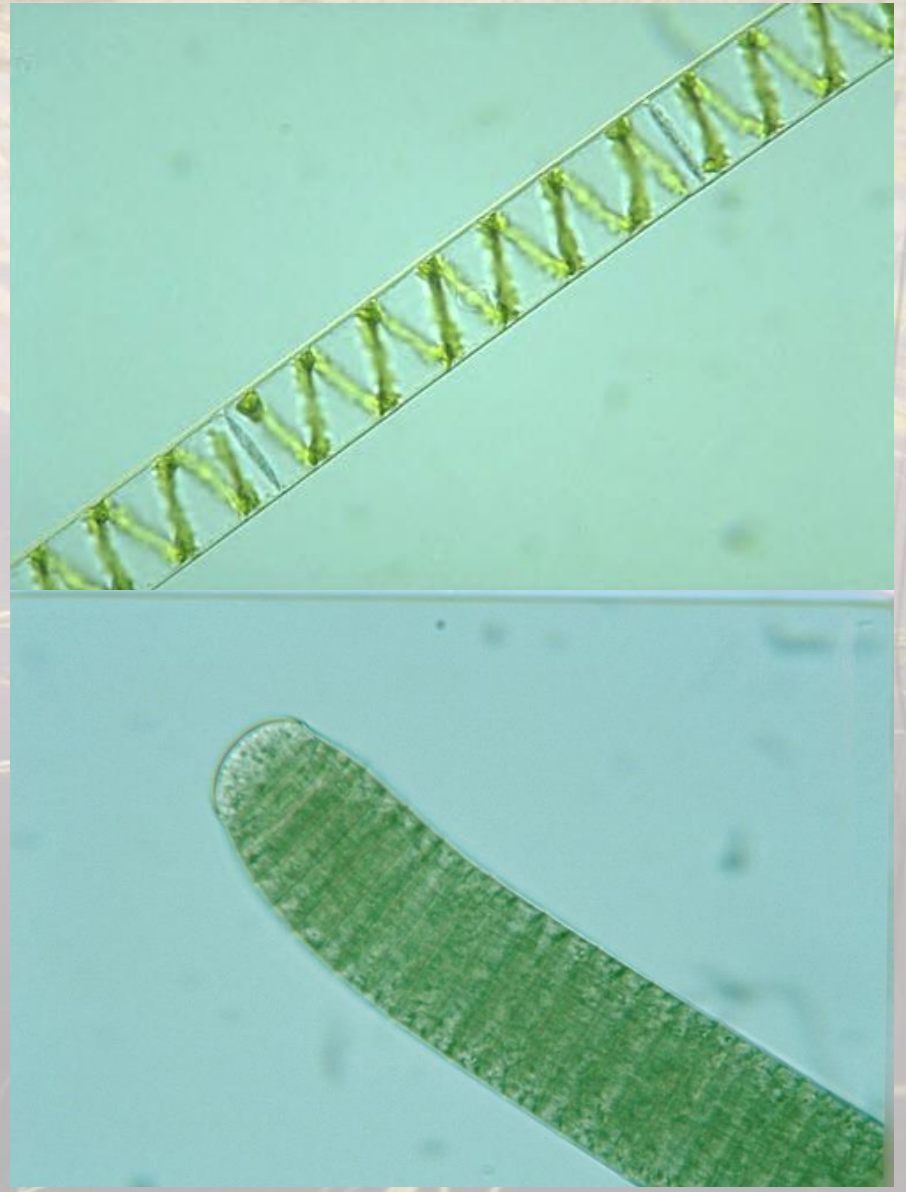
Genera n =13 *AOV p =0.49



Genera n =12 *AOV p =0.00

Conclusion

- Differences in epiphyton
- Allelopathic polyphenols
- Trophic decoupling
- Further research



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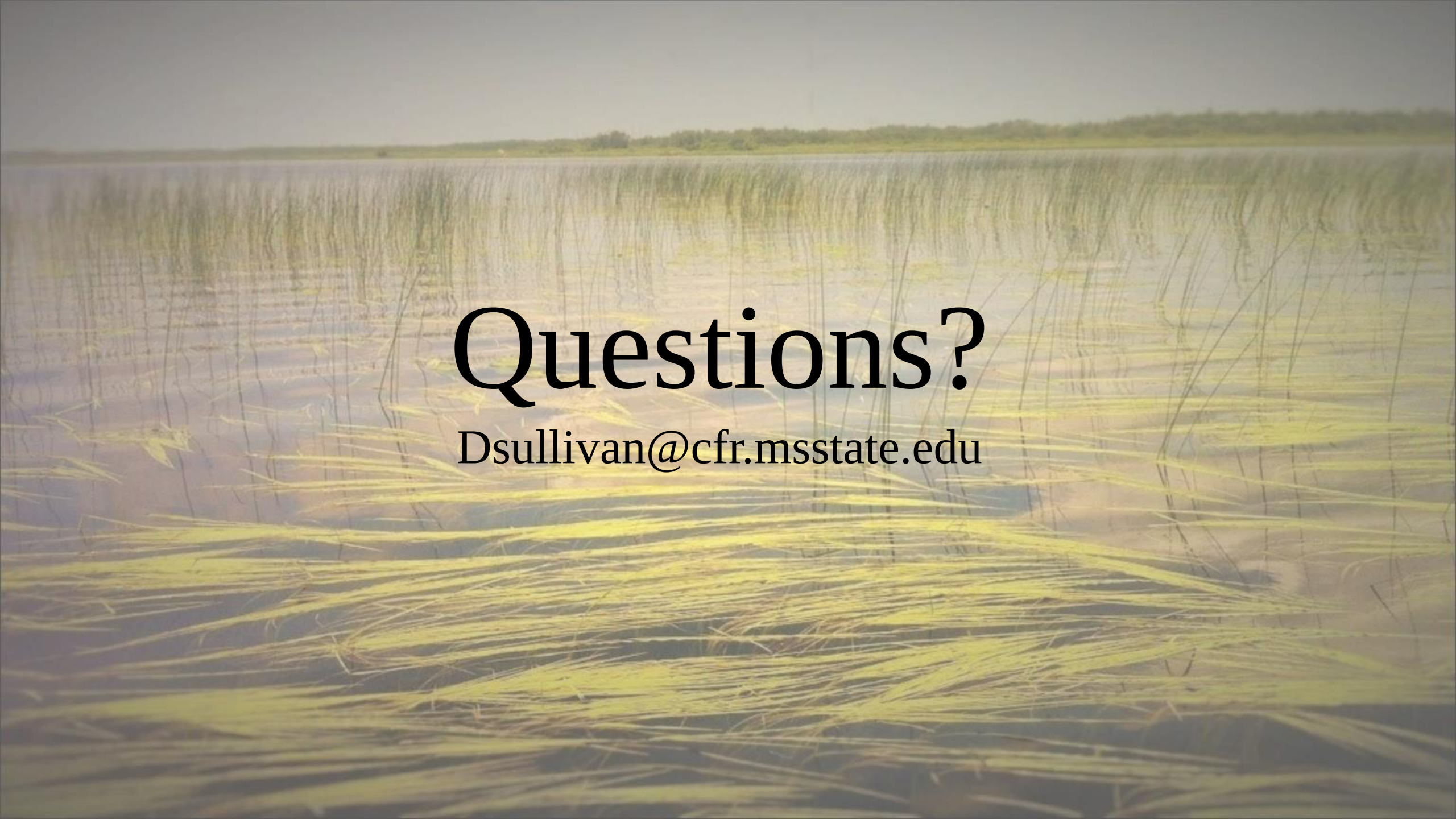
ERDC
Engineer Research and Development Center

College of Forest Resources
Forest and Wildlife Research Center

MISSISSIPPI STATE UNIVERSITY



Questions?

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