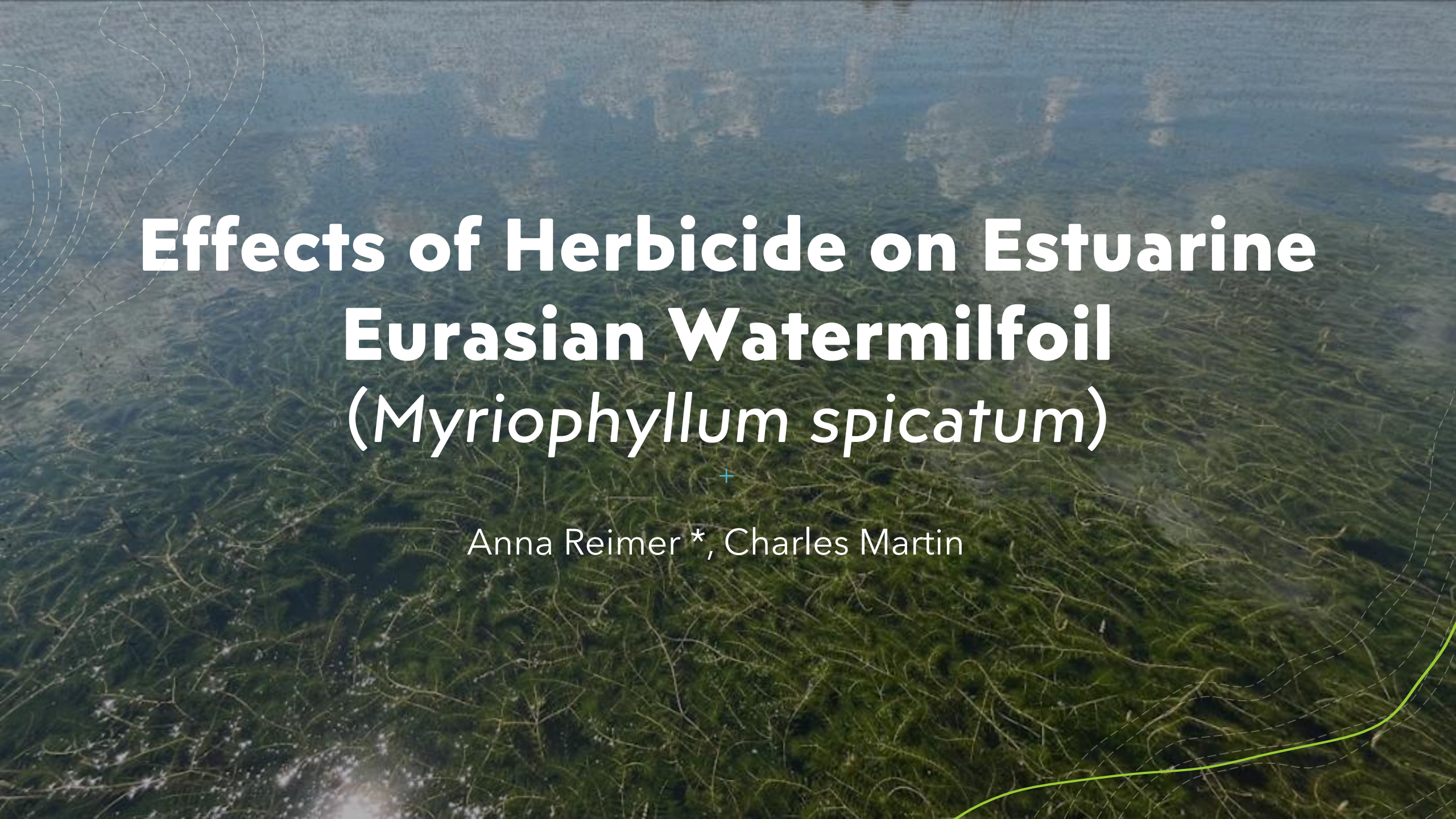




Effects of Herbicide on Estuarine Eurasian Watermilfoil (*Myriophyllum spicatum*)

+

Anna Reimer *, Charles Martin

Introduction: Eurasian milfoil in Estuaries



Eurasian milfoil and oysters
co-occur in the northern
Gulf of Mexico



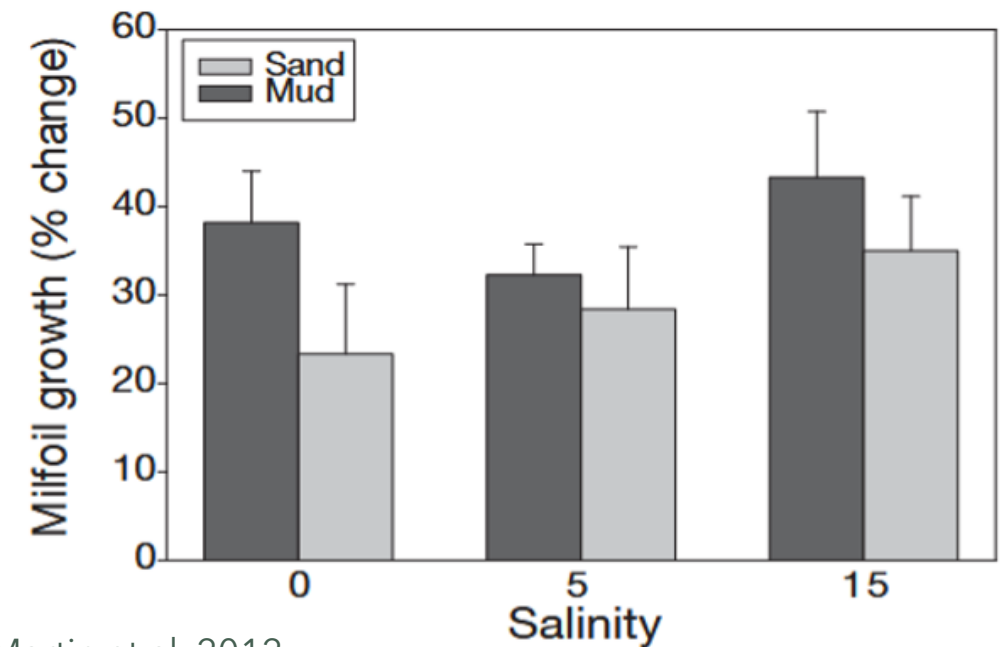
- Eurasian milfoil is a widely distributed and well-known invasive species, frequently found on watchlists and noxious weed lists
- Although a freshwater plant, milfoil can also be found in estuaries where its biology/ecology is less understood
 - Florida (Frazer et al. 2006)
 - Alabama (Martin et al. 2012)
 - Louisiana (Duffy and Baltz 1998)
 - Texas (Valinoti et al. 2011)

Introduction: Eurasian milfoil Salinity Tolerances

- Milfoil is distributed throughout Mobile Bay and is considered a nuisance to the community
- First documented in Mobile in the 1950's
- Aerial surveys indicate it is among the most dominant
- Persists in moderate salinities and little to no management

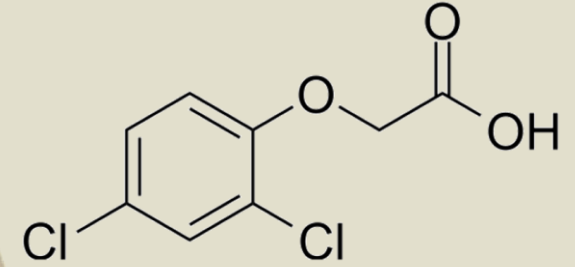
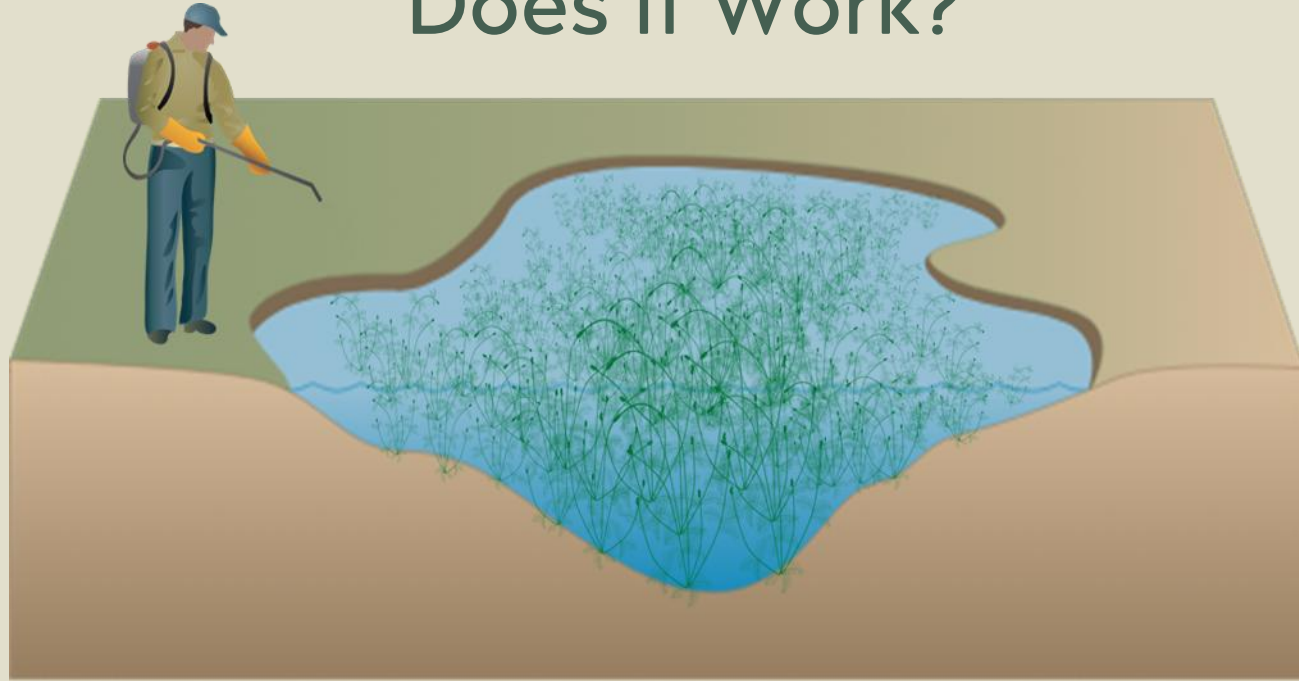


Vittor et al. 2003, 2009, 2015



Martin et al. 2012

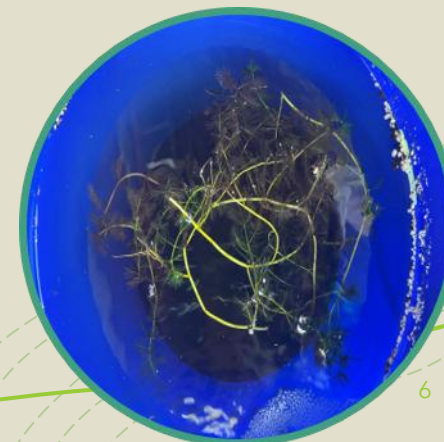
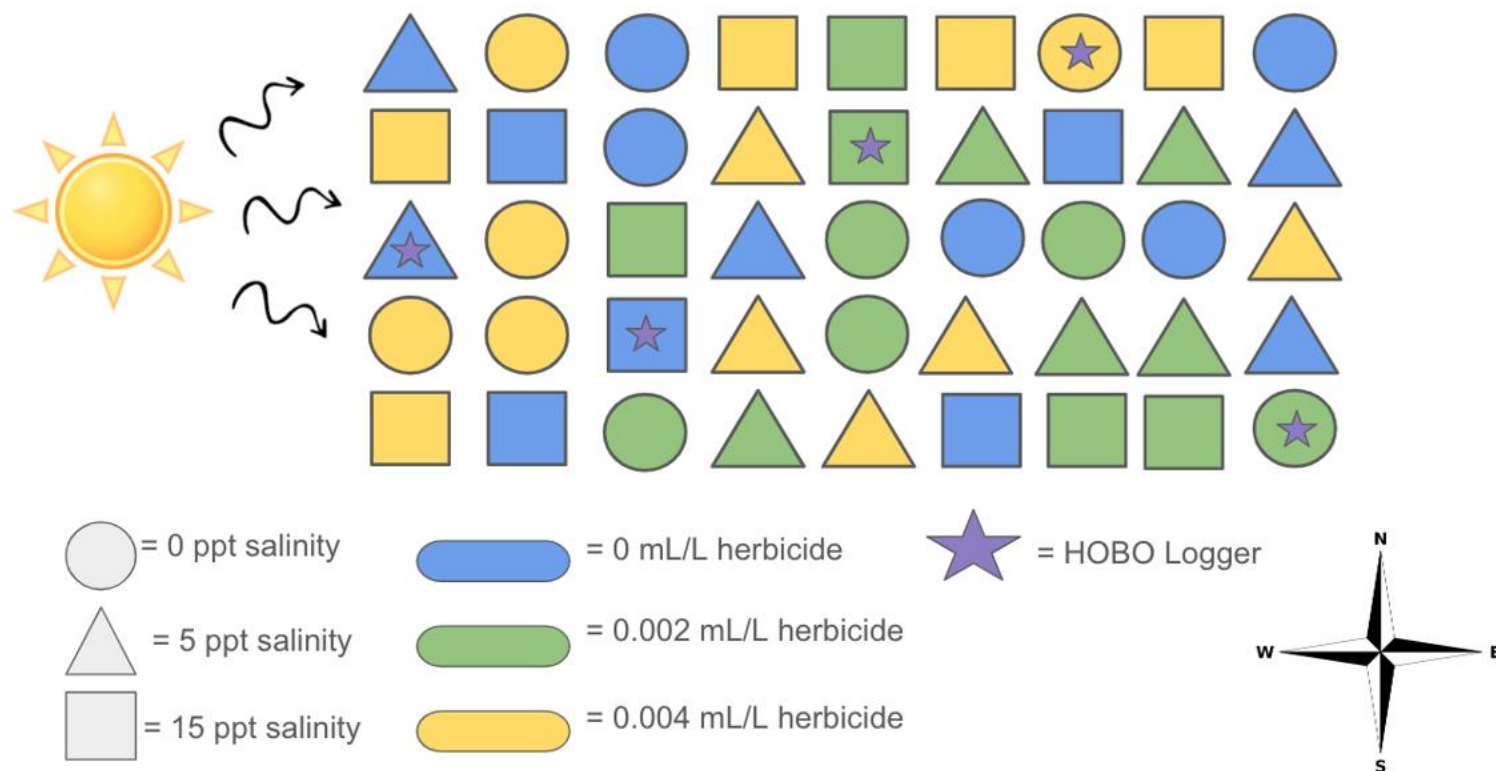
Introduction: What is 2,4-D and How Does it Work?





How effective is 2,4-D at treating Eurasian milfoil in estuarine environments?

Effects of 2,4-D: Methods



Effects of 2,4-D: Plant Metrics and Analysis

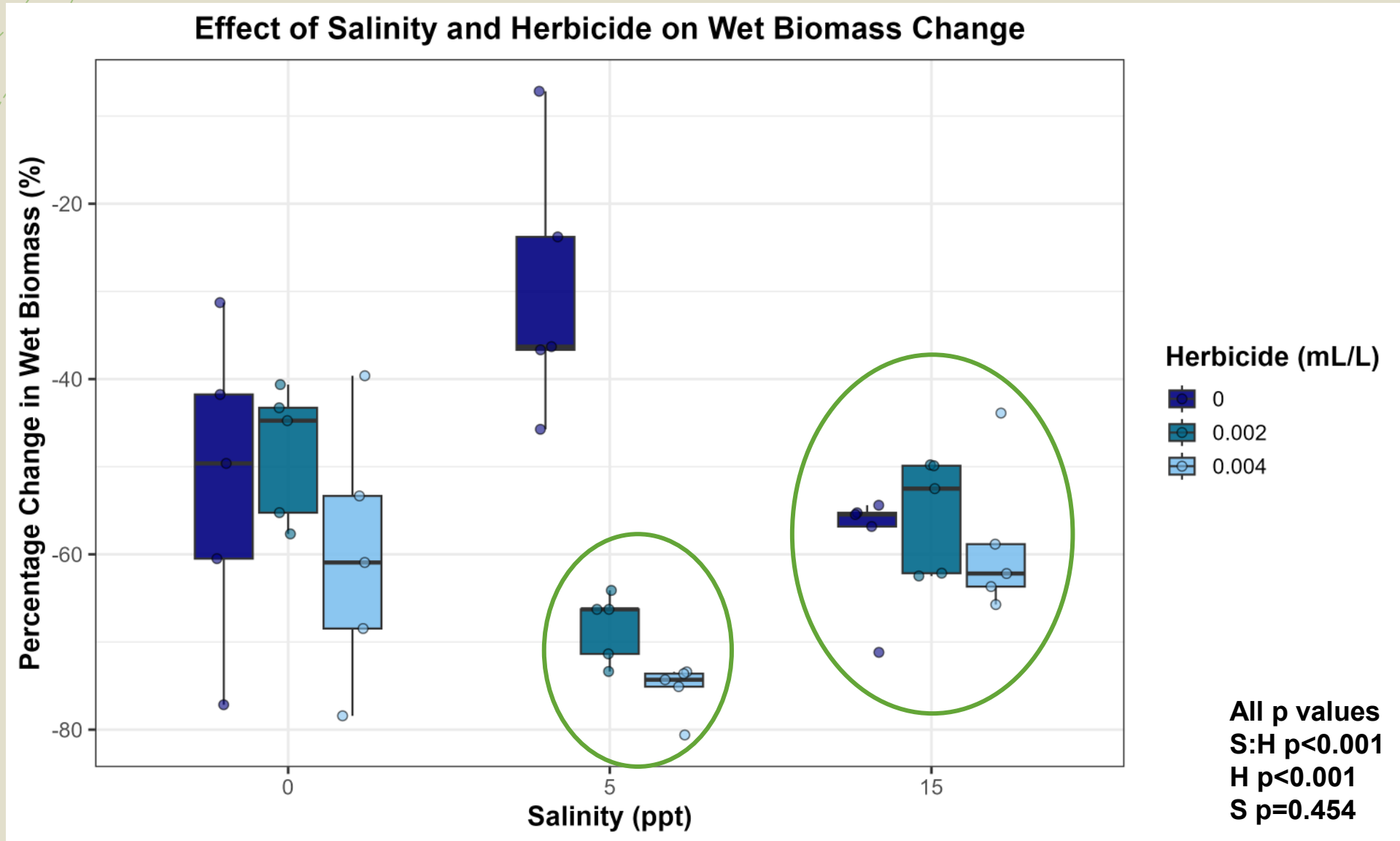
- Percent Change in Wet Biomass
- Dry Biomass (g)
- Percent Change in Length (mm)
- Branching (#)
- Root Presence (presence/absence)
- Root Growth (mm)

Analyzed using ANOVA
with factors:

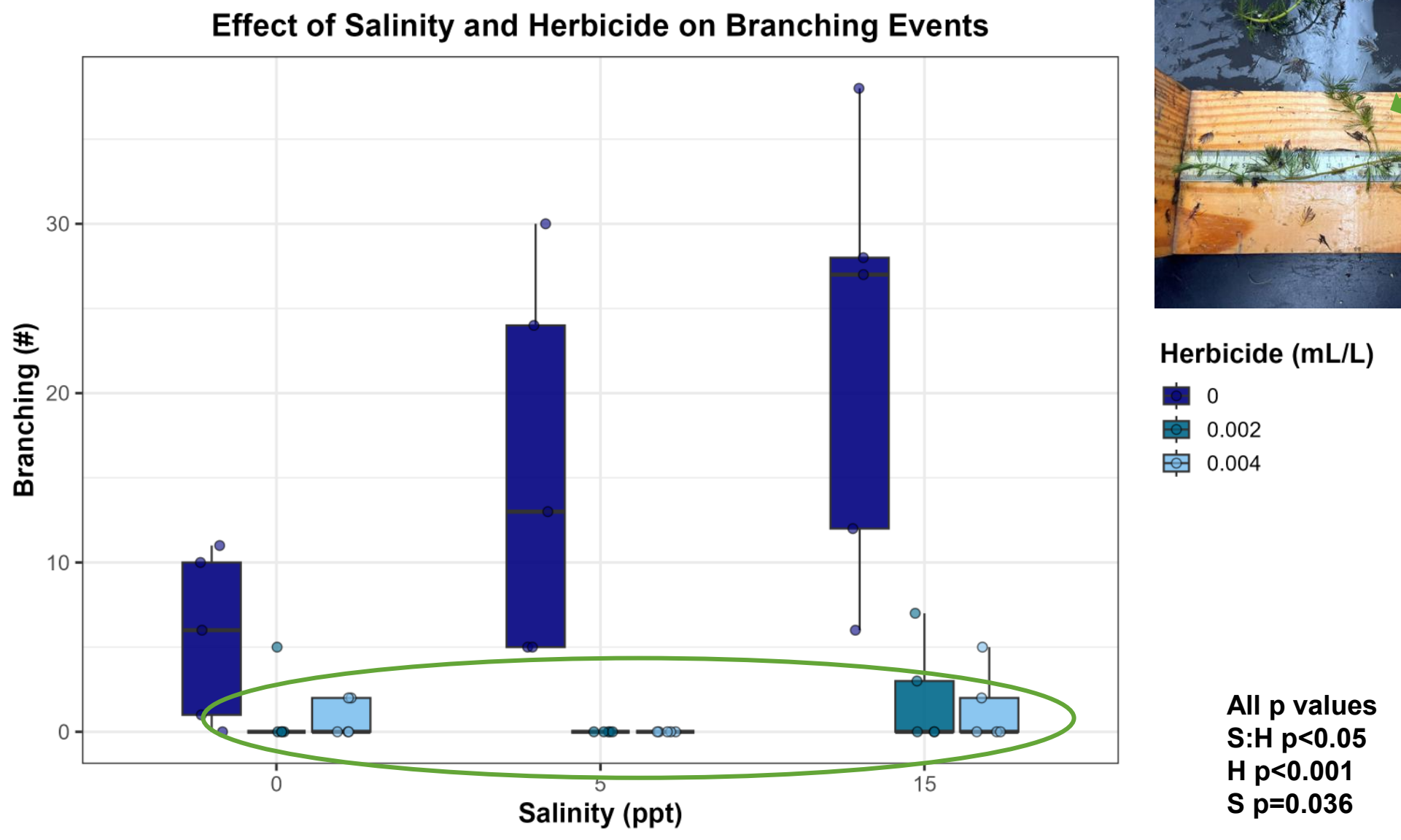
- Salinity (0, 5, 15 ppt)
- Herbicide (no, low, high)
- Salinity*Herbicide



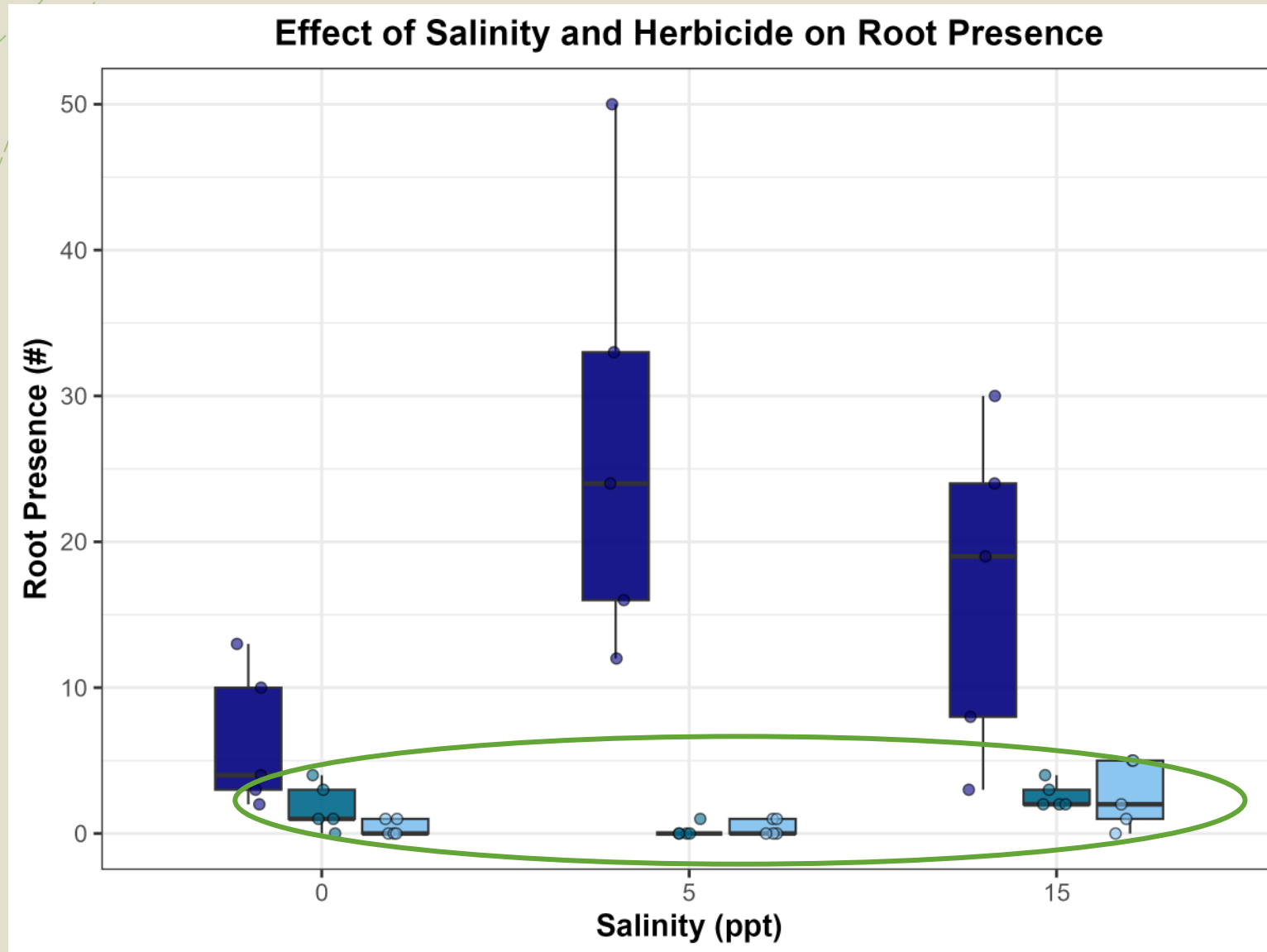
Results: Wet Biomass Reduced in Herbicide*Salinity Treatment



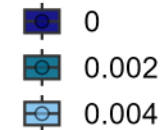
Results: Branching Reduced In All Herbicide Treatments



Results: Root Presence Reduced in All Herbicide Treatments



Herbicide (mL/L)



All p values
S:H $p < 0.01$
H $p < 0.001$
S $p = 0.035$

Effects of 2,4-D: Results in Summary



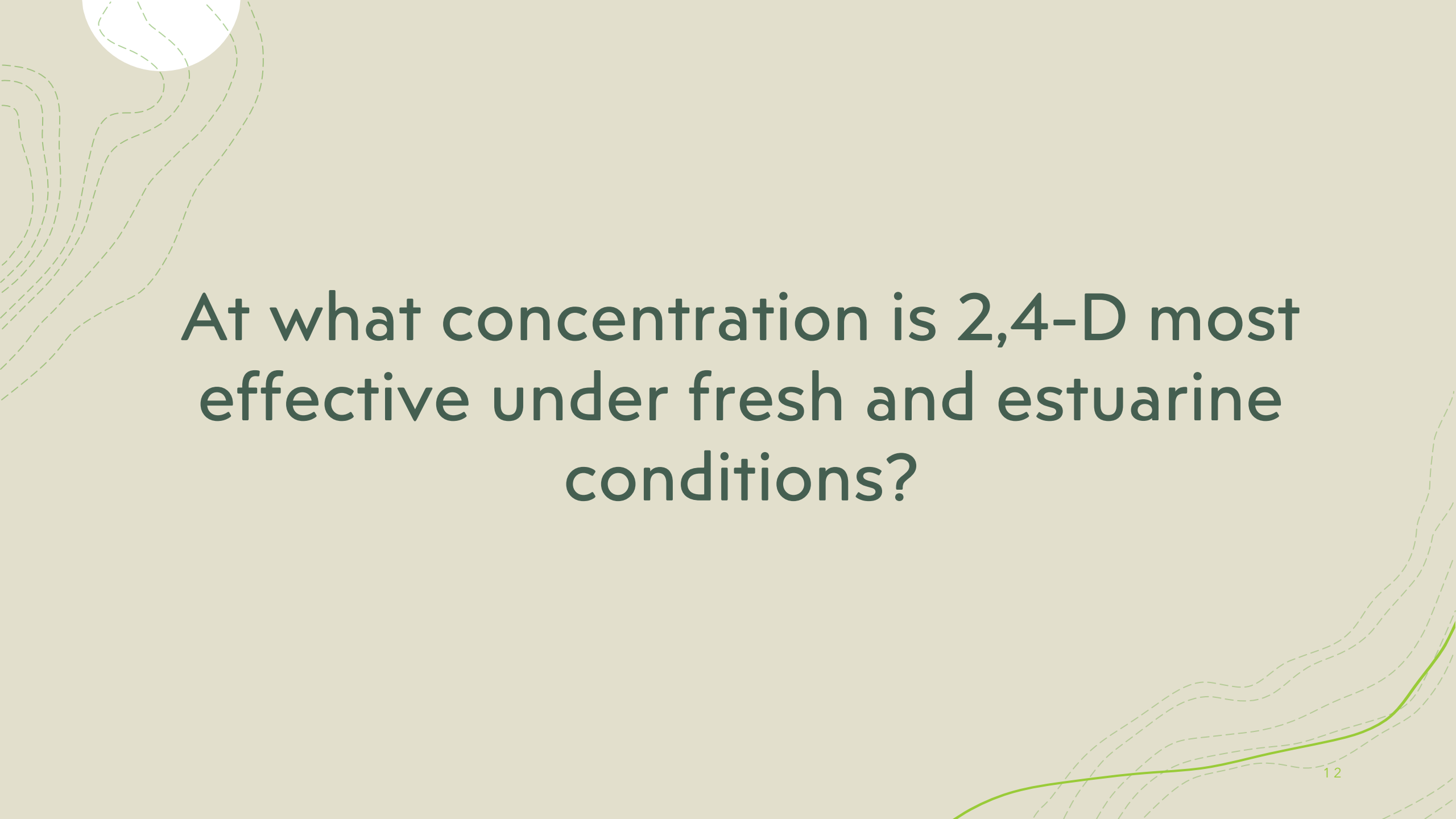
Herbicides at higher salinities
decrease milfoil biomass



While 2,4-D stimulates plant growth,
branching events were less common



Reduced root presence suggest that
primary metabolic functions are
decreased



At what concentration is 2,4-D most effective under fresh and estuarine conditions?

Toxicity of 2,4-D: Methods



Fresh: 0 ppt



Salt: 10 ppt



Toxicity of 2,4-D: Plant Metrics and Analysis

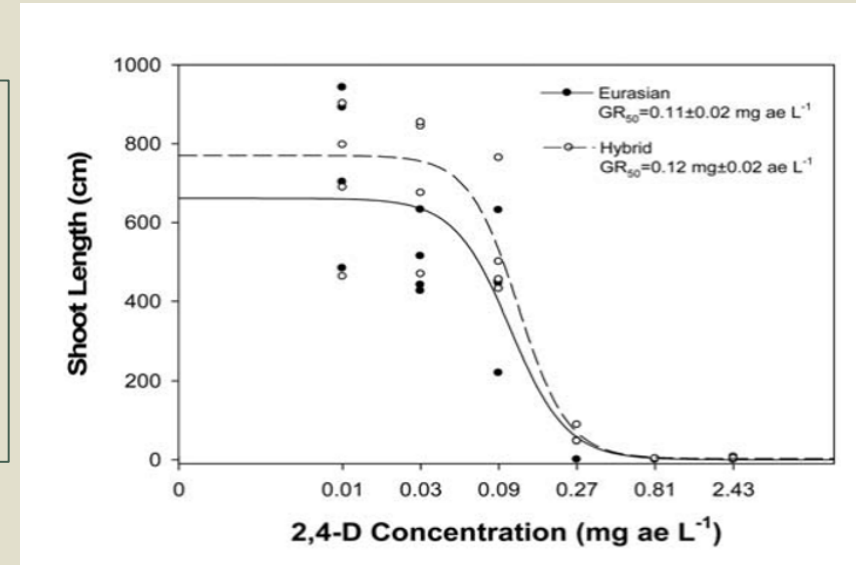
- Percent Change in Wet Biomass
- Dry Biomass (g) *
- Percent Change in Length (mm) *
- Branching (#)
- Root Presence (presence/absence)
- Root Growth (mm)

Analyzed using one way ANOVA:

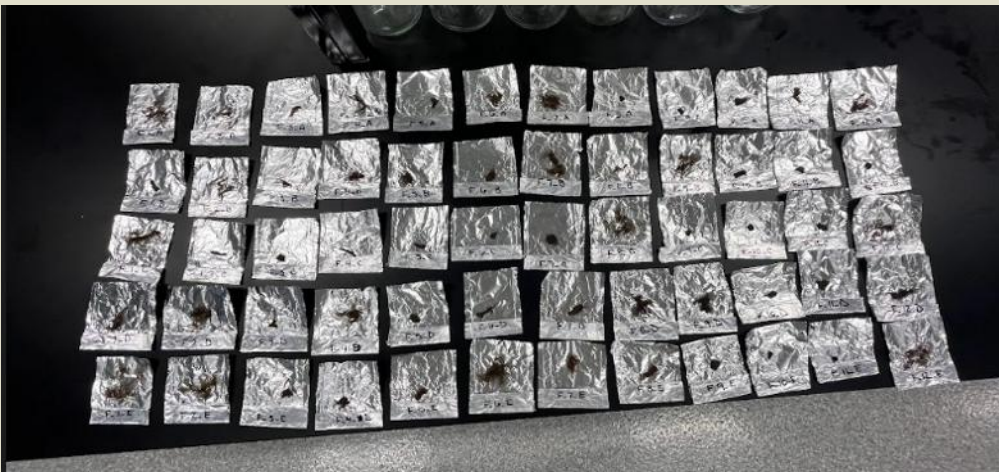
- Concentration (mg ae/L)

Four Parameter Log-Logistic Dose Response Curve

- EC50's for fresh and salt



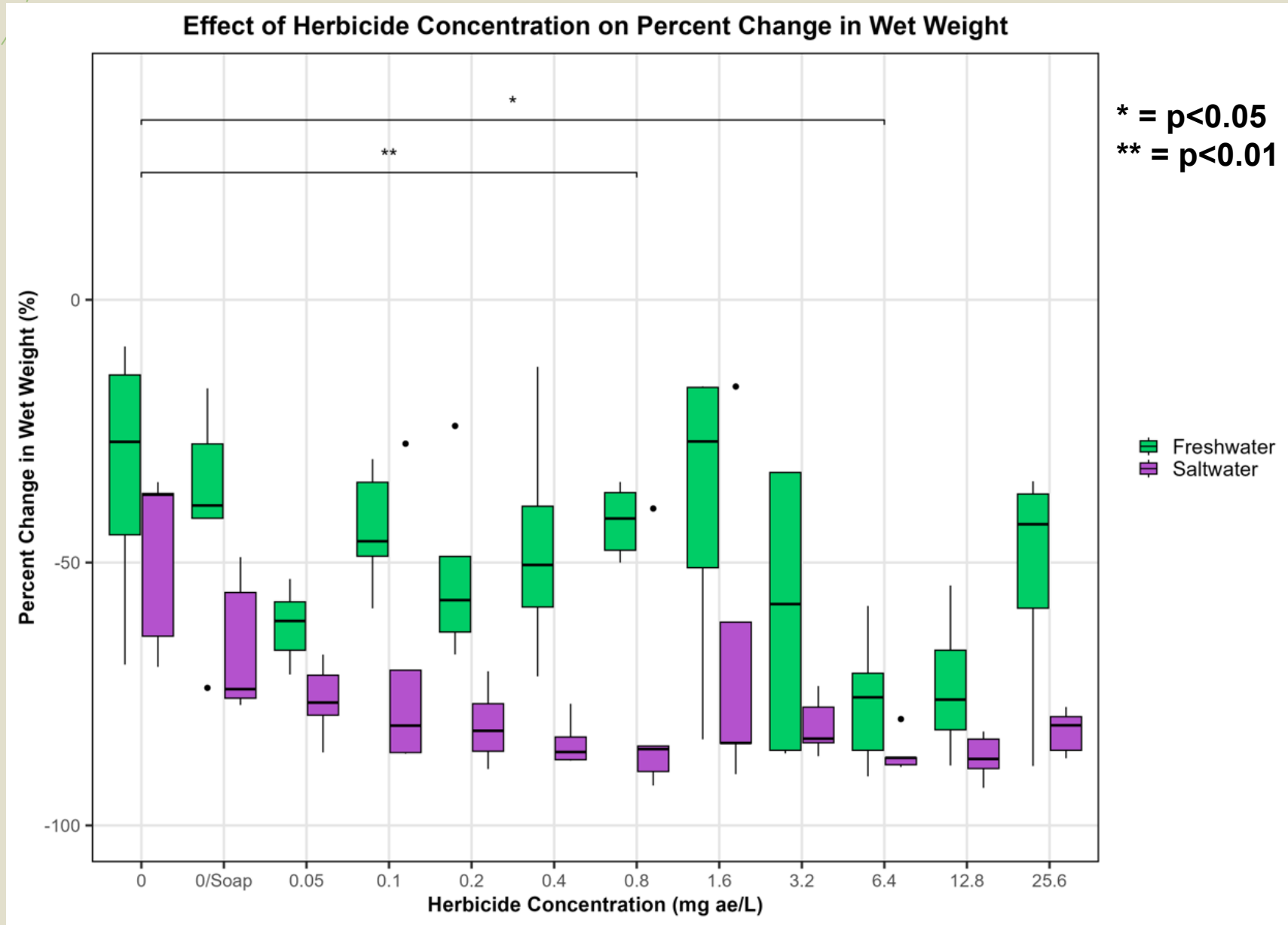
Fresh



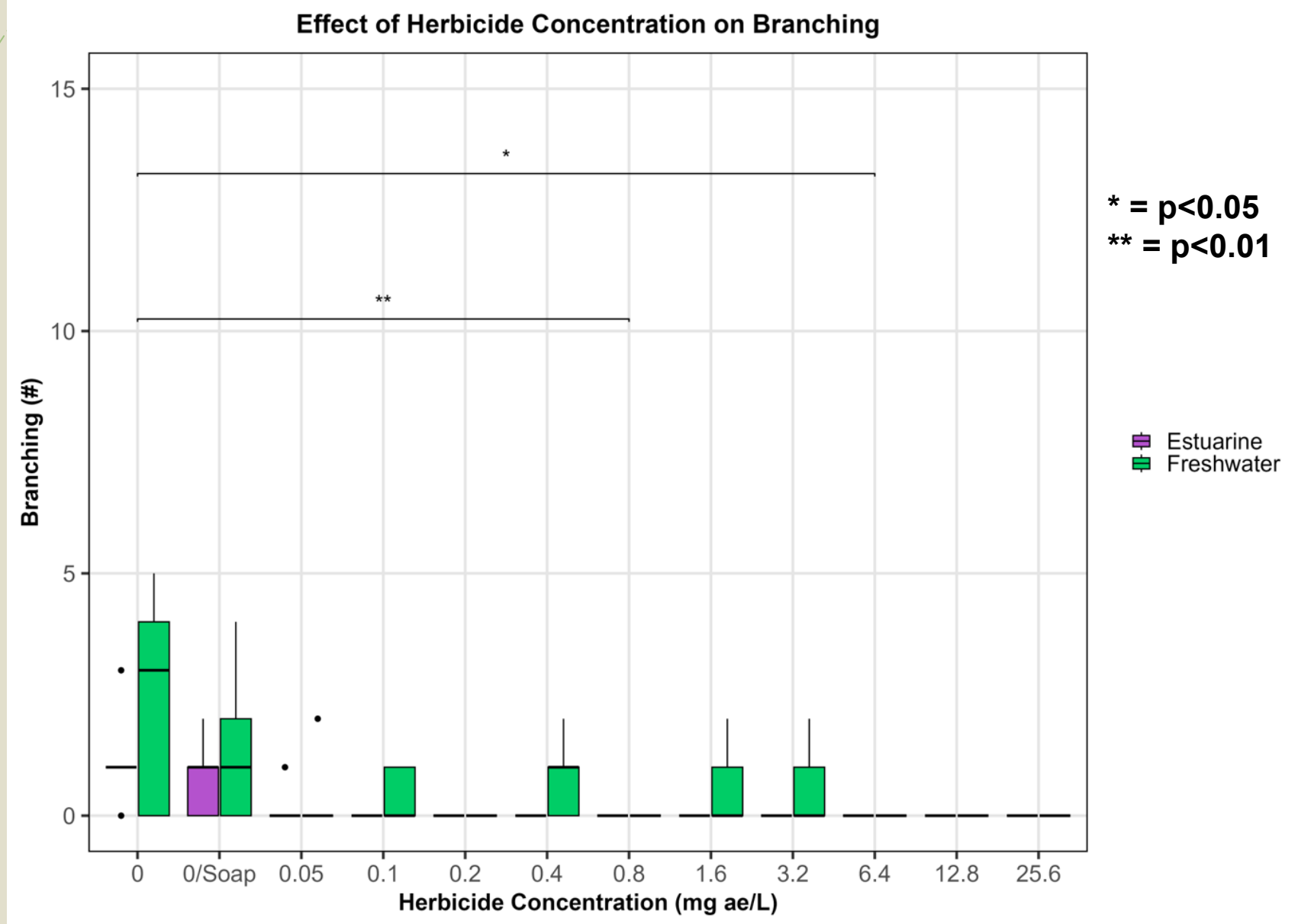
Salt



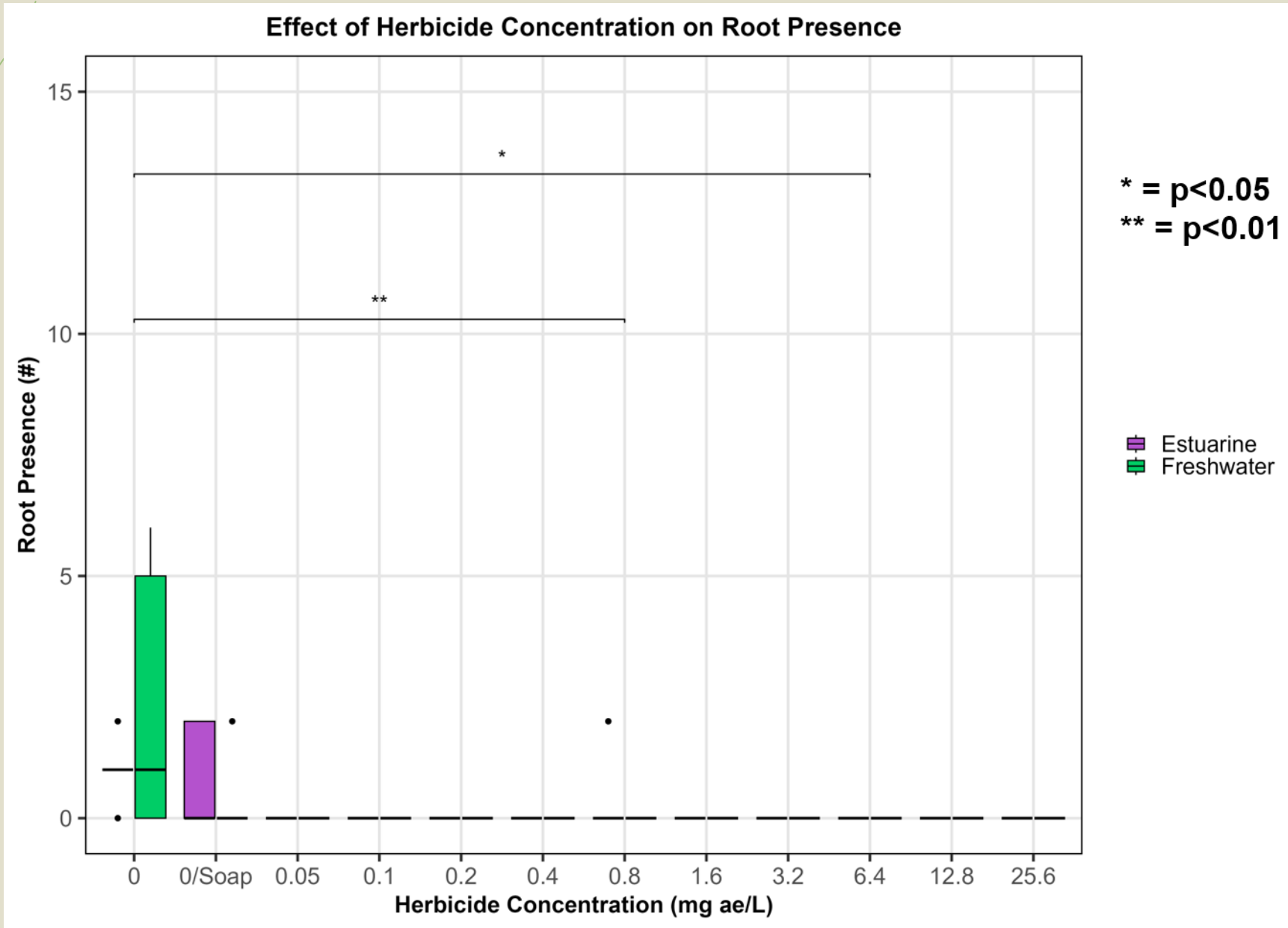
Results: Biomass Reduced more in Salter Milfoil



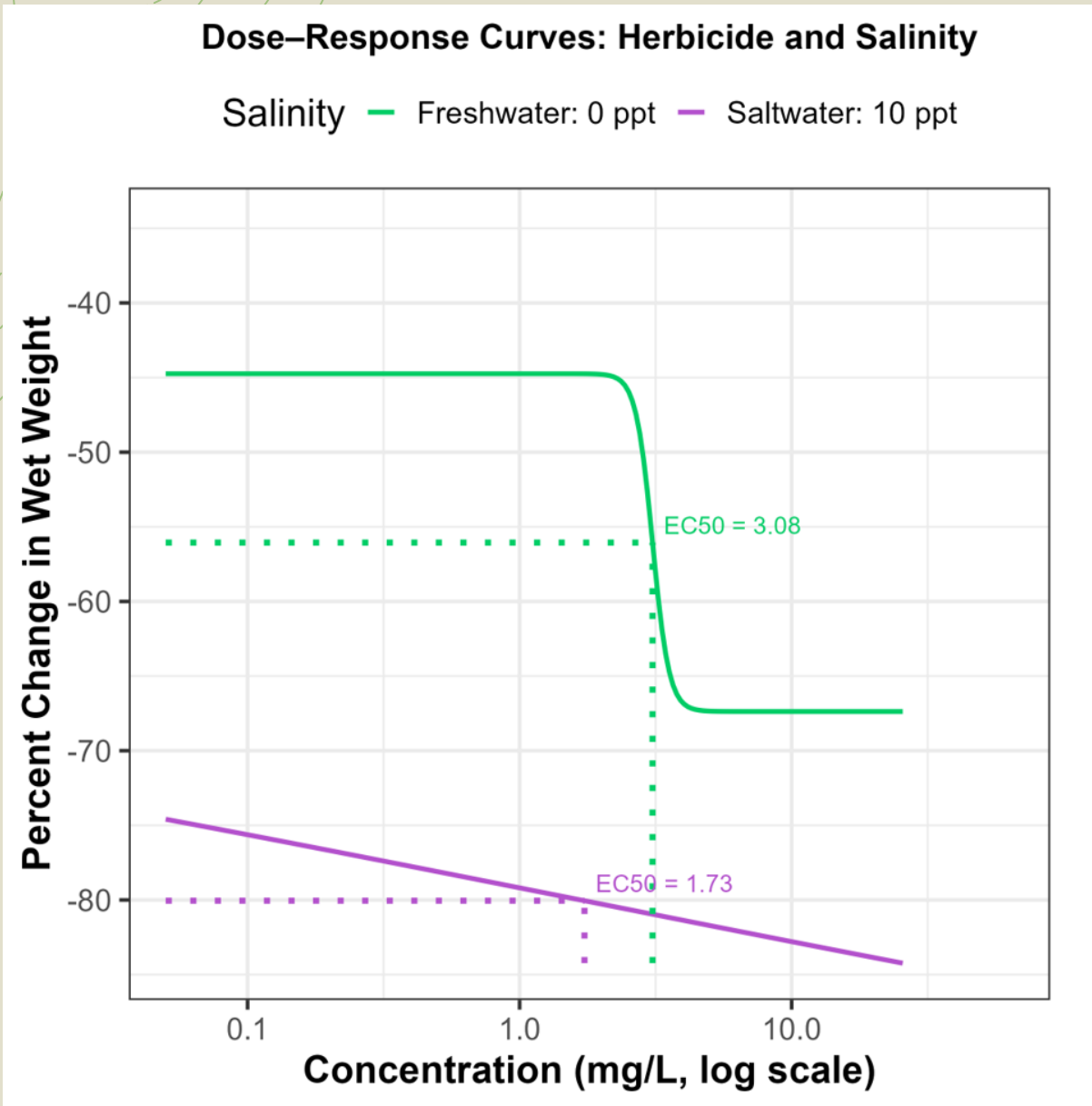
Results: Branching Occurs Mostly in Freshwater



Results: Root Present Only in Controls



Results: Saltwater EC50 Lower Than Freshwater EC50



- Well defined dose response curve for freshwater milfoil
 - EC50 of 3.08 mg ae/L
- Estuarine milfoil experienced a significant effect but variable response curve
 - EC50 of 1.73 mg ae/L
- Freshwater milfoil needs a higher concentration of 2,4-D

Toxicity of 2,4-D: Results



2,4-D showed an effect across all plant metrics

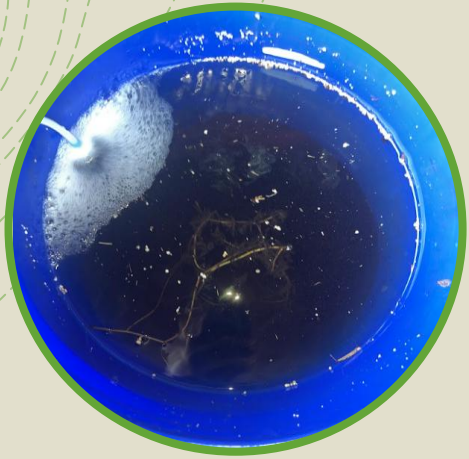


In estuarine conditions, plants were more sensitive to 2,4-D

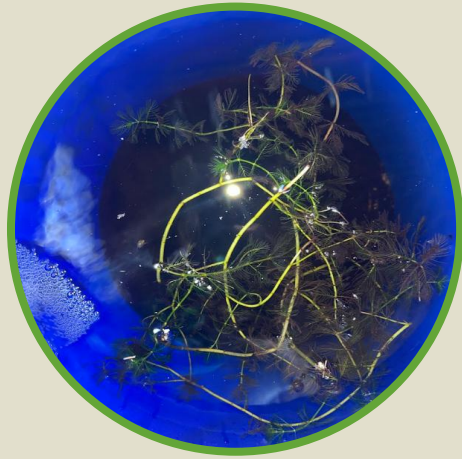


EC50 in freshwater is larger than in estuarine

How effective is 2,4-D at treating milfoil in estuarine environments?



5 ppt

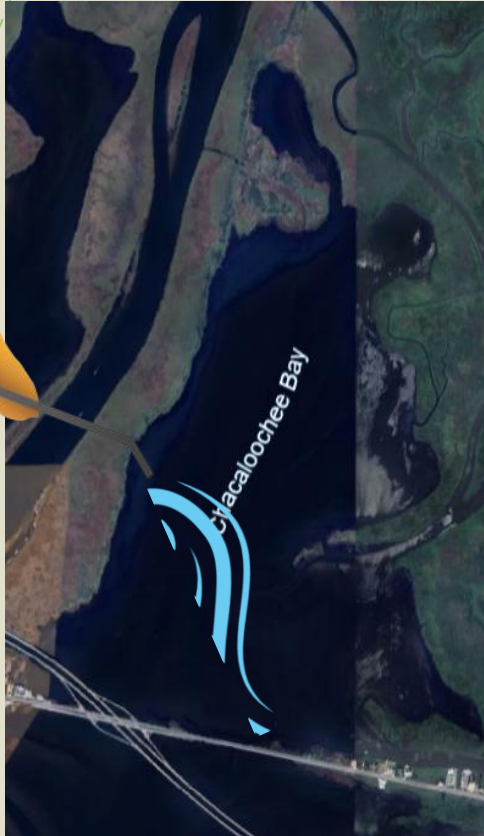


15 ppt

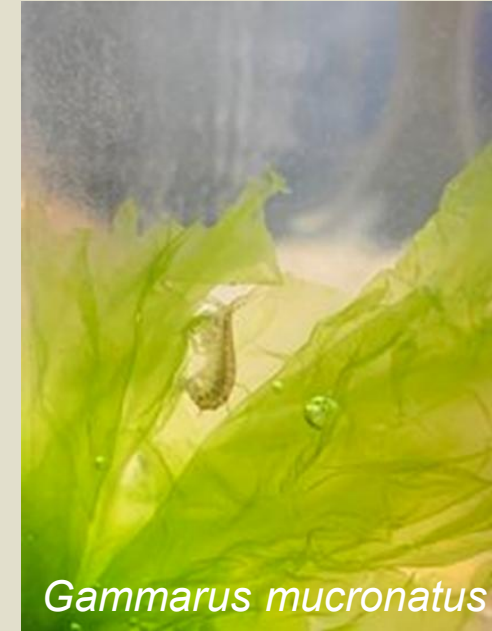


- 2,4-D reduced multiple measures of milfoil performance across tested salinities
 - Salinity altered magnitude and consistency
- The lower estimated EC50 under estuarine conditions suggests that salinity stress may increase sensitivity
 - Field validation is needed

Conclusions: Future Research for Estuarine Herbicide Management



Palaemonetes paludus



Gammarus mucronatus

- Field experiments to capture how 2,4-D would act in environment (dilution, water exchange, sediment interaction, realistic exposure duration)
- Effects on nontarget submerged vegetation
- Herbicide influence on chemical defense production
- Effects on food web dynamics



Dauphin Island Sea Lab

Acknowledgements



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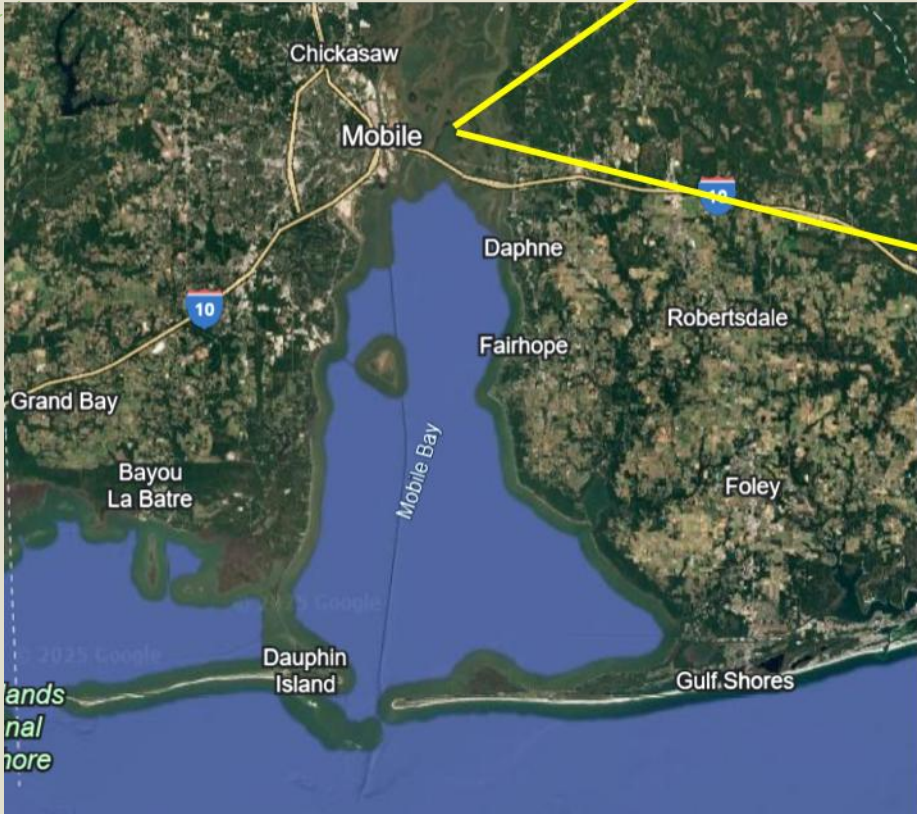
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Dauphin Island Sea Lab
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Estuarine Ecology Lab
Post Doc: Katie O'Shaughnessy
Undergraduate: Marissa Hall

Lab Instagram: @est_eco_lab
Email: areimer@disl.org

The background of the slide is a photograph of a lake. The water is a deep blue-grey color, and the bottom is covered with a dense layer of green, feathery algae or seagrass. Overlaid on the image are white dashed lines representing topographic contour lines, which are more prominent on the left side and bottom right. In the center of the image, the word "Questions?" is written in a large, bold, white sans-serif font. Directly beneath this text is a small, light blue plus sign (+).

Questions?

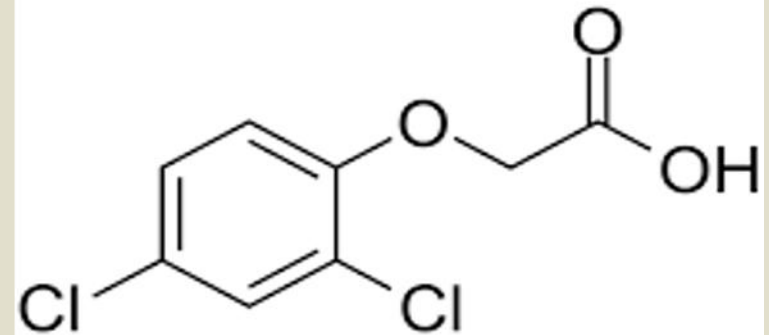
+



$$y = f(x) = C + \frac{D - C}{1 + (x/I_{50})^b}$$

$$= C + \frac{D - C}{1 + \exp[b(\log(x) - \log(I_{50}))]} \quad (\text{Eq. 1})$$

where C = lower limit, D = upper limit, b = slope, and I_{50} = dose giving 50% response.





Effect of Herbicide Concentration on Percent Change in Length

