# Ecotypic Variability in Salt Tolerance

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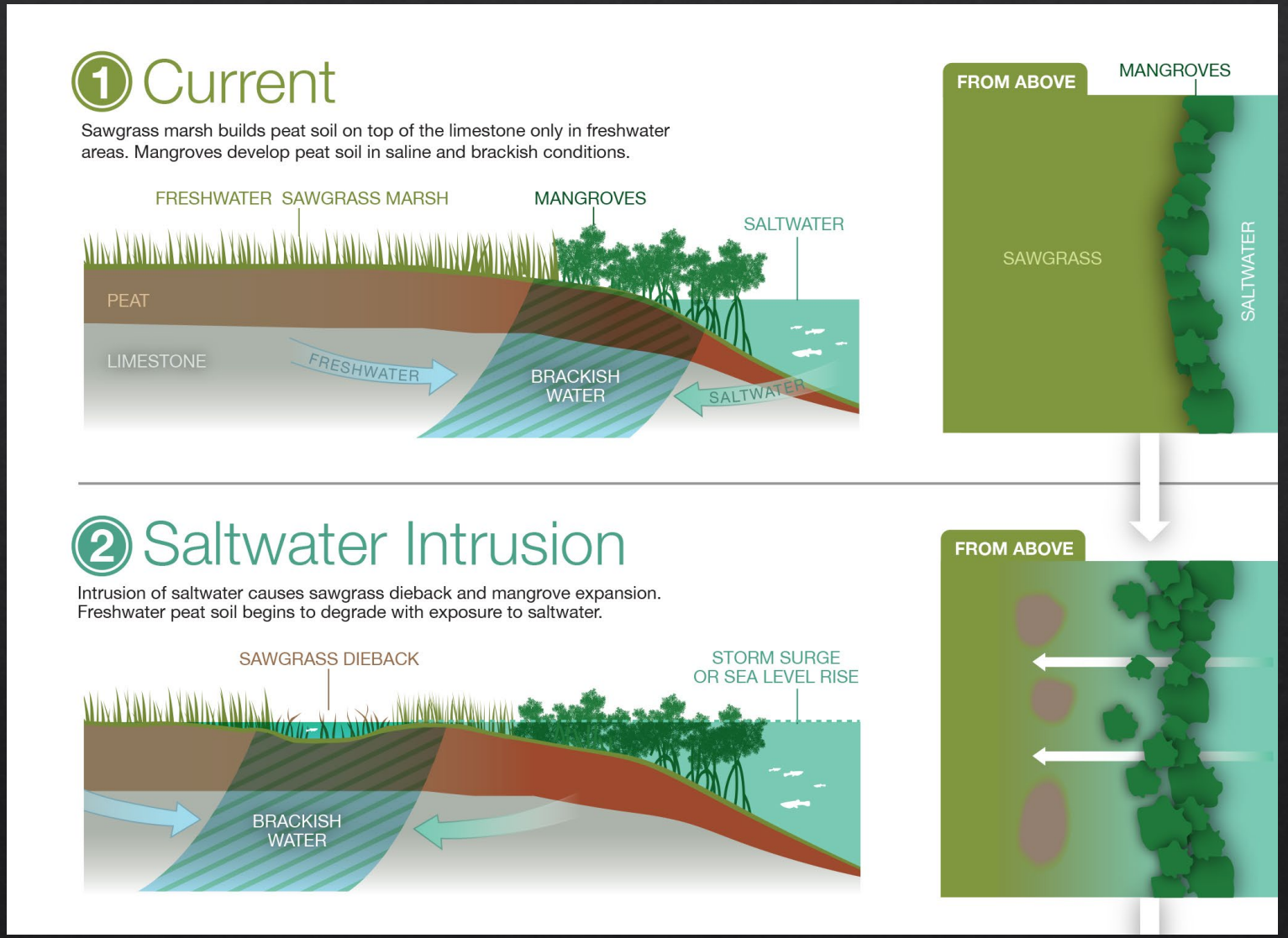
# Sea level rise and saltwater intrusion



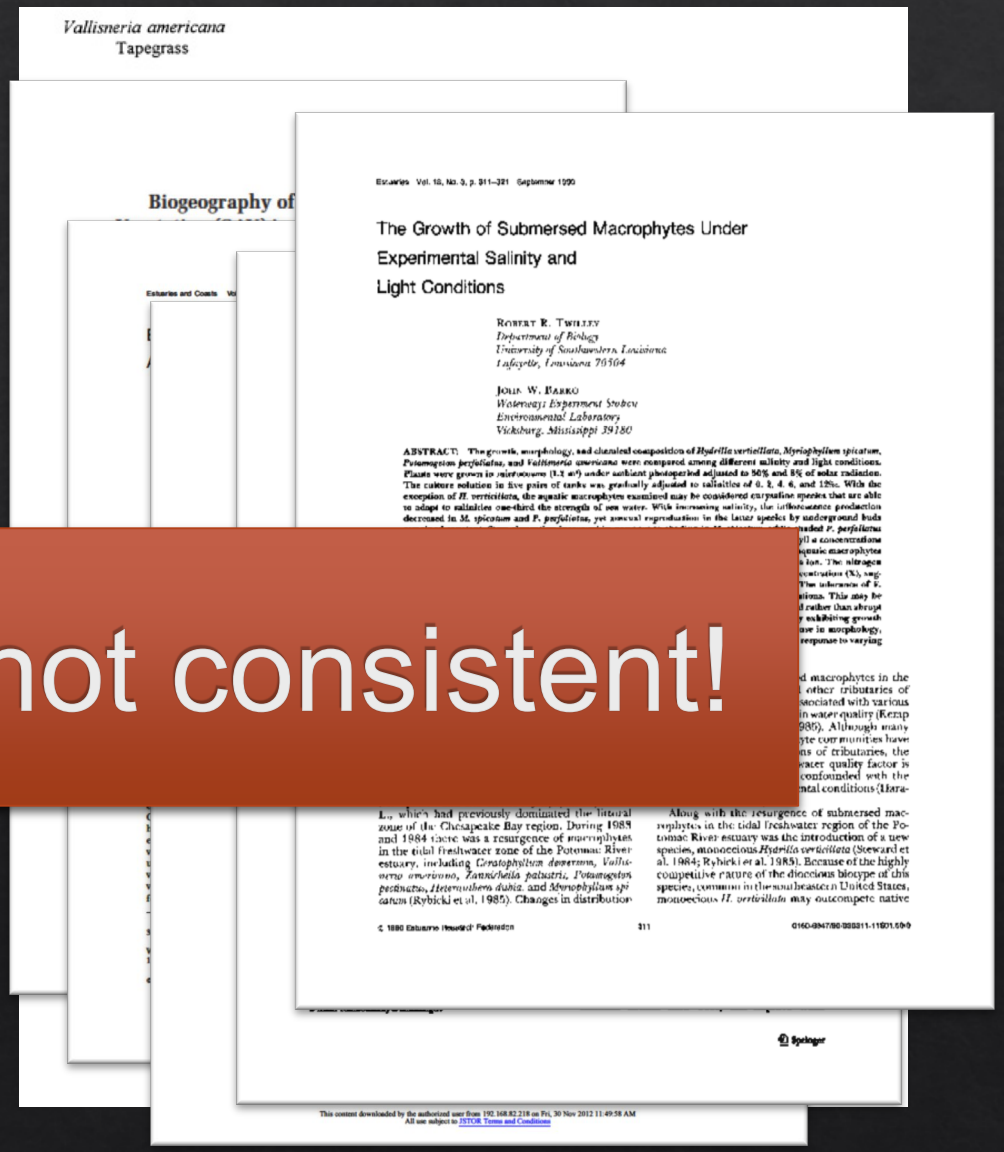

Sklar, F.H., Meeder, J.F., Troxler, T.G., Dreschel, T., Davis, S.E. and Ruiz, P.L., 2019. The Everglades: At the Forefront of Transition. In Coasts and Estuaries (pp. 277-292). Elsevier.

# Salt stress

- Salt stress can cause:
  - Mature plant death
  - Reduced plant size
  - Decreased growth rates
  - Suppressed sexual and asexual reproduction

- Example: *Vallisneria americana* can tolerate:
  - 5.0 ppt or less
  - 6.6 ppt
  - 8.0 ppt
  - 12.0 ppt

**Reports are not consistent!**


*Vallisneria americana*
Tapegrass

Biogeography of

The Growth of Submersed Macrophytes Under Experimental Salinity and Light Conditions

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ABSTRACT: The growth, morphology, and chemical composition of *Hydrilla verticillata*, *Myriophyllum spicatum*, *Potamogeton perfoliatus*, and *Vallisneria americana* were compared among different salinity and light conditions. Plants were grown in microcosms (3.1 m²) under ambient photoperiod adjusted to 50% and 8% of solar radiation. The culture solution in five pairs of tanks was gradually adjusted to salinities of 0, 2, 4, 6, and 12‰. With the exception of *H. verticillata*, the aquatic macrophytes examined may be considered euryhaline species that are able to adapt to salinities one-third the strength of sea water. With increasing salinity, the inflorescence production decreased in *M. spicatum* and *P. perfoliatus*, yet asexual reproduction in the latter species by underground buds

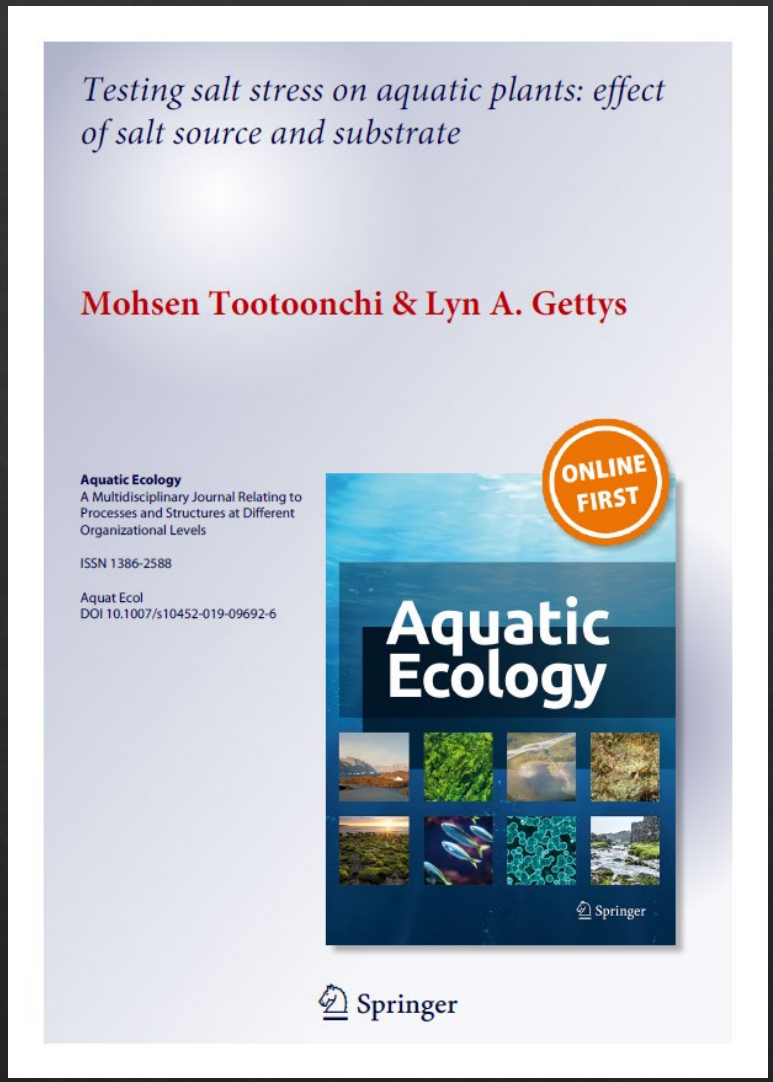
Springer

# What factors impact plant salt-tolerance

- Increasing salinity (gradual vs abrupt)
  - Salt used for increasing salinity level

# Salt source matters!

- Plant response to saline conditions is significantly affected by the salt source.
- This effect is due to differences in elemental composition of salts (More Na and Less S, Mg, Ca, B).
- In this study, effects of salinity induced by Instant Ocean was similar to seawater.

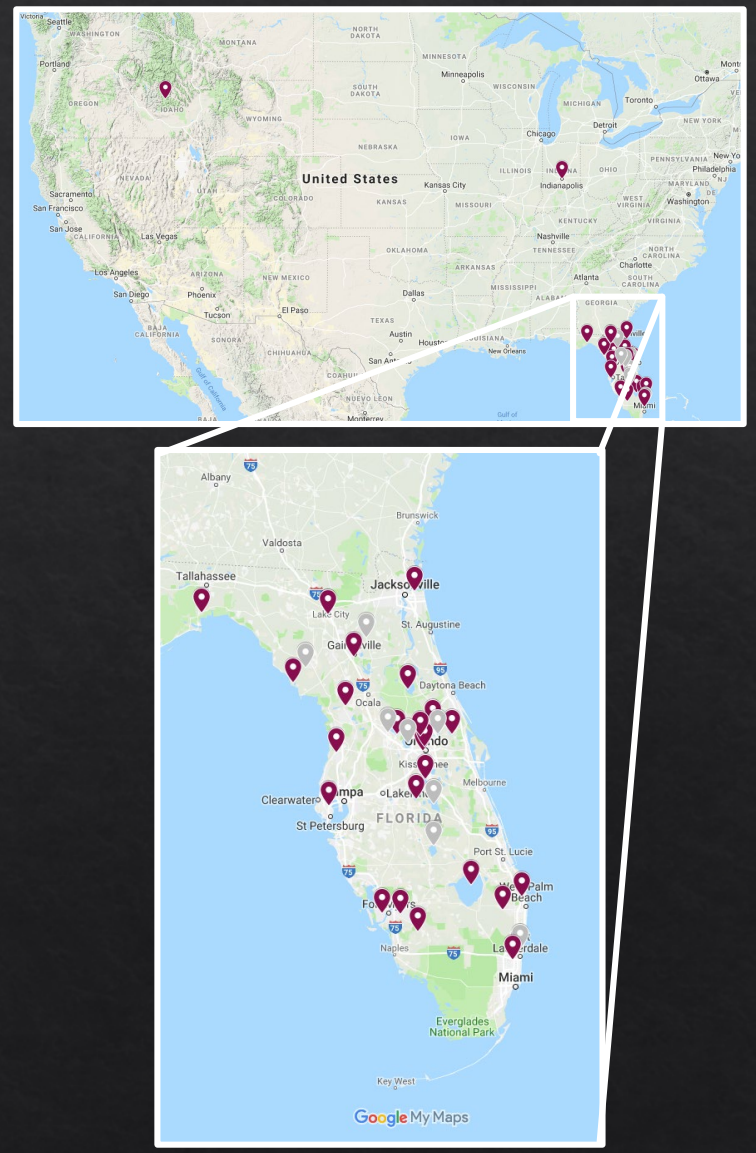


# What factors impact plant salt-tolerance

- Increasing salinity (gradual vs abrupt)
  - Salt used for increasing salinity level
    - **Variability among ecotypes**

# Variability among ecotypes

- *Vallisneria americana*
- 26 different ecotypes from FL
- Except 2 from Indiana and Idaho



# Variability among ecotypes

1- What is the salt tolerance threshold of *V. americana*?

2- Is there a difference in salt sensitivity among ecotypes?

# Salinity experiment

- Plants were grown in 14 oz pots
- 4 Replication
- Plants were allowed to grow in freshwater for 4 weeks
- Saline solutions were produced using Instant Ocean aquarium mix
- Salinity levels: 0.2, 2, 4, 10, 15 and 20 ppt
- Plants were exposed to 6 weeks of increased salinity

# Plant evaluation

**Visual evaluation**: plant health was rated a number between 0 and 10

0= Dead; 10= No visible damage

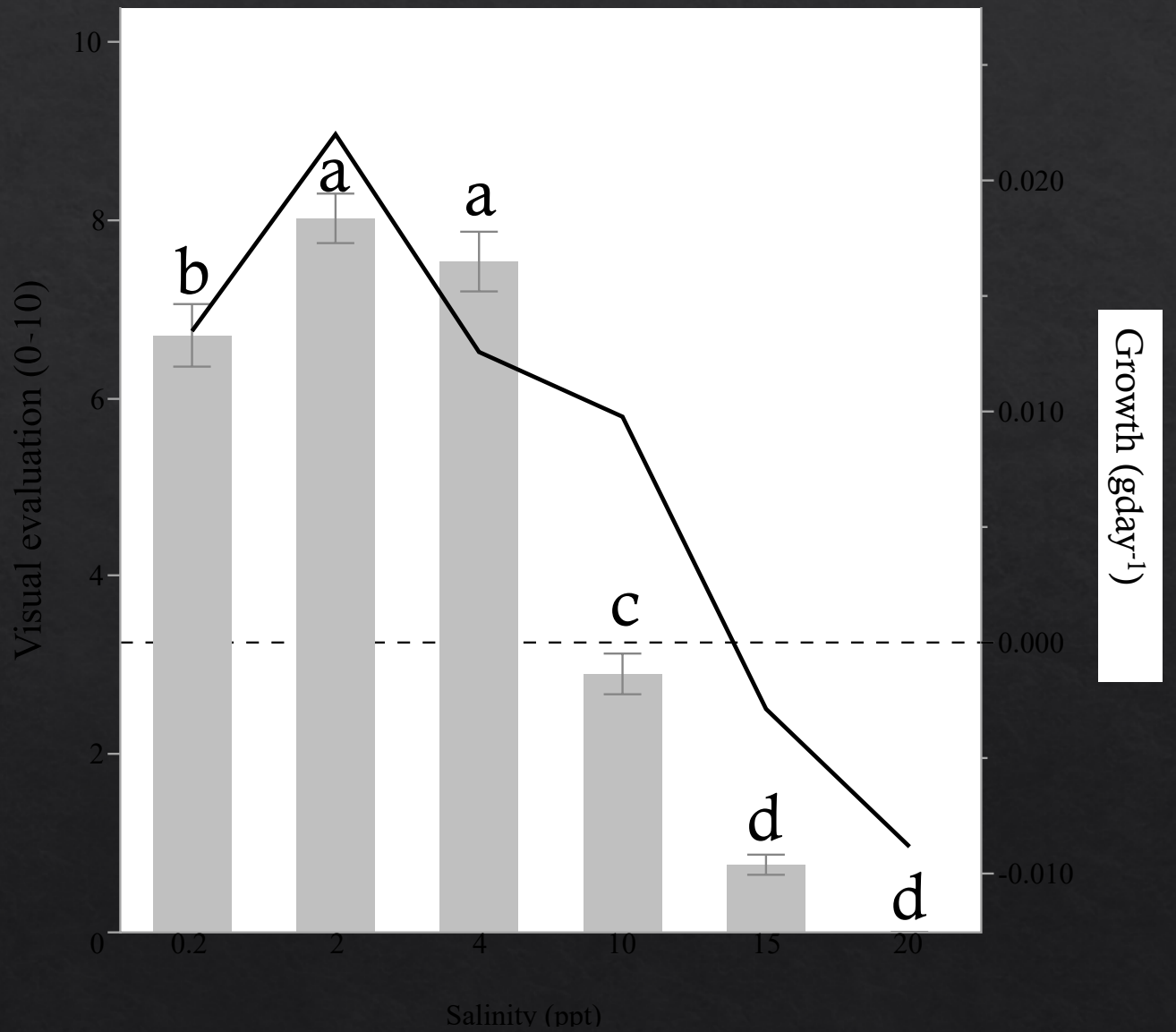
**Shoot biomass**: aboveground biomass was destructively harvested and dried for two weeks (65 °c)

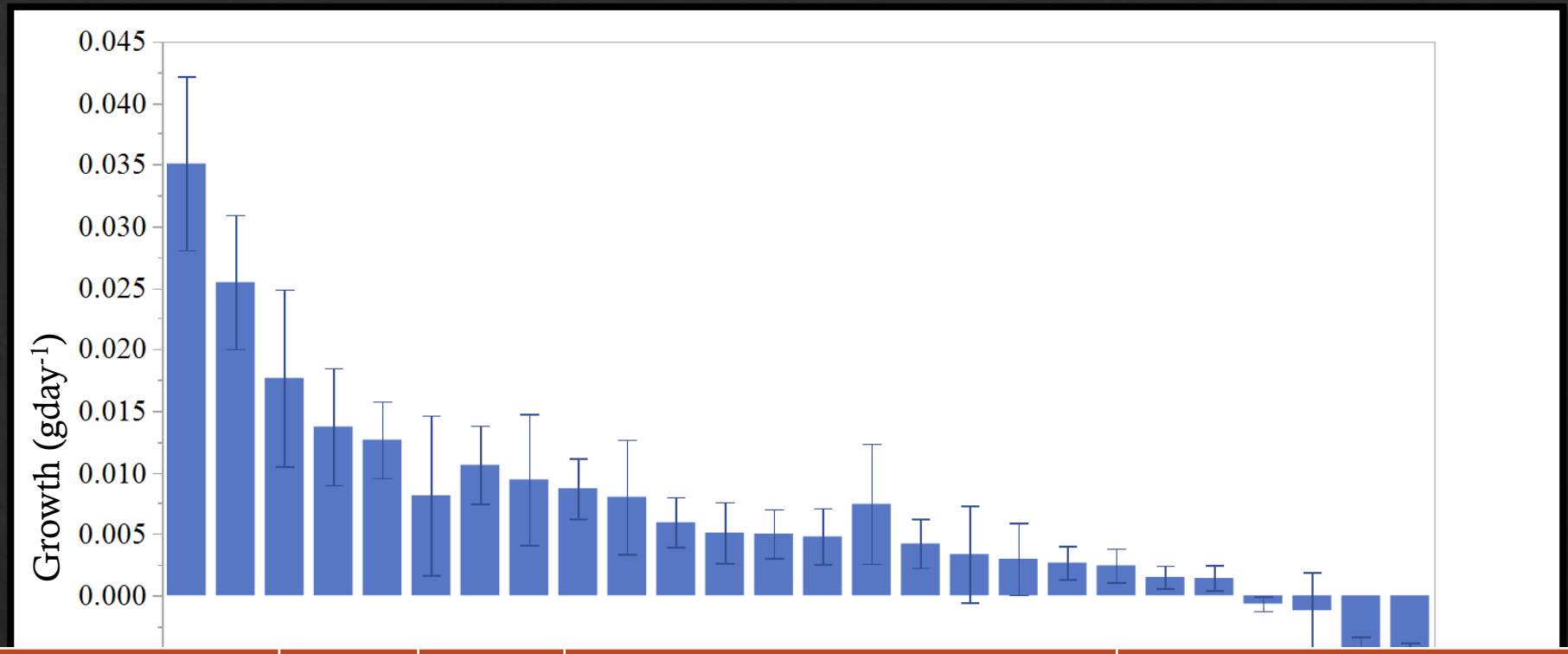
$$\text{Relative growth rate} = \frac{W_2 - W_1}{T_2 - T_1}$$

# Salt tolerance threshold

All 26 ecotypes in the same pool

- Lower growth in 0.2 than 2 ppt
- Reduced growth at 10 and 15ppt
- All ecotypes died at 20 ppt

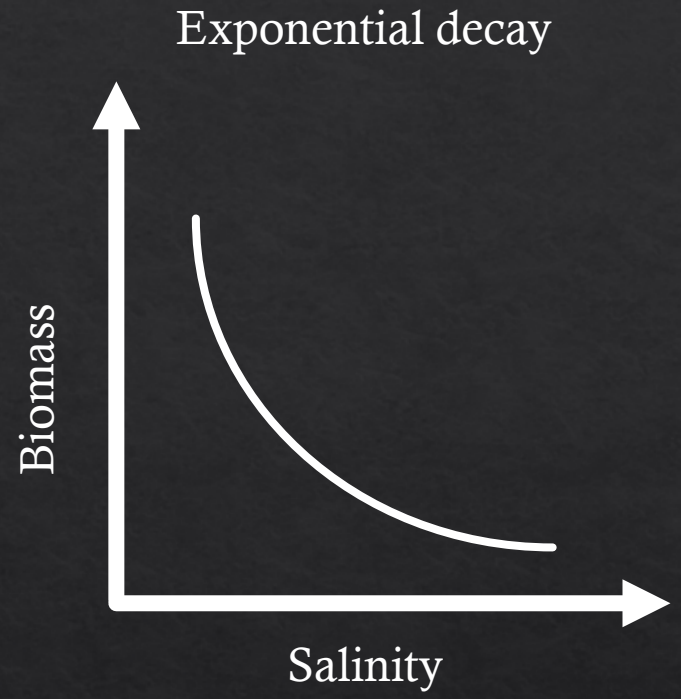





| | | | Growth rate $R^2$=0.70 | | Visual evaluation $R^2$=0.82 | |
|---|---|---|---|---|---|---|
| Source | N | DF | F | P | F | P |
| Ecotype | 25 | 25 | 12.1 | <.0001 | 9.4 | <.0001 |
| Salinity | 5 | 5 | 76.9 | <.0001 | 316.7 | <.0001 |
| Ecotype*Salinity | 125 | 125 | 2.9 | <.0001 | 1.8 | <.0001 |

# EC calculation

- Effective concentration (EC) that can reduce a percent of plant population/biomass




$$U = \frac{d}{1 + \exp[\, b(\log(concentration) - \log(EC_{50}))]}$$

U: plant response; d: upper limits of the plant response (control treatment); $EC_{50}$: concentration required to reduce the biomass by half b: proportional to the slope of the curve around $EC_{50}$.

# $EC_{50}$ values

- $EC_{50}$ for three ecotypes with the highest and lowest growth rates

| Ecotype | $EC_{50}$ (ppt) |
|---|---|
| 1 | 12.1 |
| 2 | 10.3 |
| 3 | 7.2 |
| 21 | 10.7 |
| 22 | 9.7 |
| 23 | 6.9 |

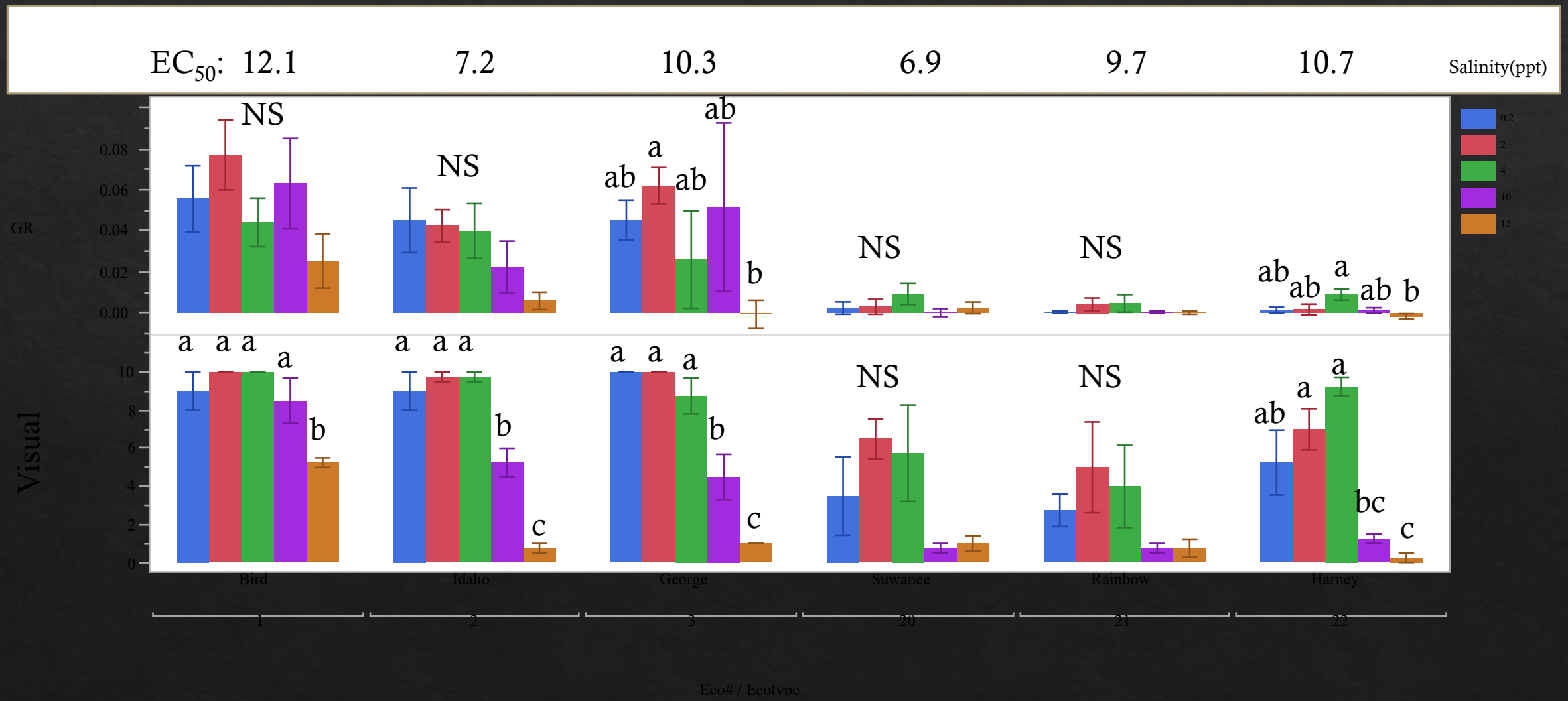
# Summary

- Salt tolerance could differ among ecotypes.
- Most ecotypes stopped their growth at 10 ppt and decayed at 15 ppt.
- Average $EC_{50}$ across *V. americana* ecotypes was 8.9 ppt.

- The most salt tolerant ecotype had positive growth even at 15 ppt!

# Thank you

# 6 ecotypes


EC50: 12.1 7.2 10.3 6.9 9.7 10.7
Salinity(ppt)
0.2
2
4
10
15
GR
Visual
NS
a
ab
b
c
bc
Bird
Idaho
George
Suwanee
Rainbow
Harney
1
2
3
20
21
22
Eco# / Ecotype