Does ecotypic-based genetic diversity improve productivity? A mesocosm study with *Spartina alterniflora*

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Introduction

Plant species diversity often positively affects ecosystem characteristics (e.g., Tilman 1999).

In habitats dominated by single species, genetic diversity may play a role similar to species diversity and enhance plant productivity, increase fauna diversity, and increase ecosystem stability (e.g., Hughes and Stachowicz 2004, Crutsinger et al. 2006).

Salt marshes are highly productive ecosystems but are often dominated by a single species. High genetic diversity might influence the function of these productive, monospecific stands.

Spartina alterniflora often dominates marshes on the East and Gulf coasts and is commonly used for marsh restoration. Utilizing different ecotypes, genetically distinct populations of a single species, is a method to increase genetic diversity of a restored marsh.

Question

Does genetic diversity of *Spartina alterniflora* increase productivity of these plant stands?

Objectives

1. Quantify plant morphology differences between monocultures and polycultures
2. Understand monoculture and polyculture response to a stressful condition, drought

Methods

•*Spartina alterniflora* sprigs (Fig. 1) were collected from 3 sites (Fig. 2): Texas Point, Bolivar, and Port O'Connor, TX in March 2012.

•Sprigs were planted in separate monoculture (one ecotype) and polyculture (two or three ecotypes) treatments. All seven treatments were kept in separate mesocosms (Figure 3) at 10 and 20 ppt as ambient conditions and 30 ppt as the stressful condition. (n=5 per culture at each salinity type)

•Mesocosm, drought experiment was run from June-October 2012

•Response variables were stem density, stem height, stem growth, plant cover, number of leaves, new leaf production, inflorescence density, and root biomass. (Day 0, 20, 40, 68, and 130)

•We performed 2-way ANOVA: salinity (3 levels), culture (2 types); multivariate analysis: 6 groups, 11 variables; repeated measures ANOVA (SPSS Software)

Figure 1: *Spartina alterniflora* sprig used for planting

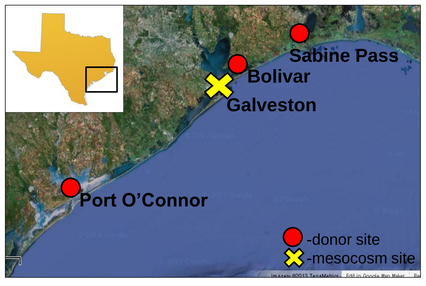


Figure 2: Map of collection sites and common garden

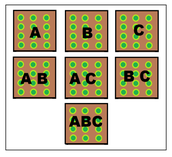
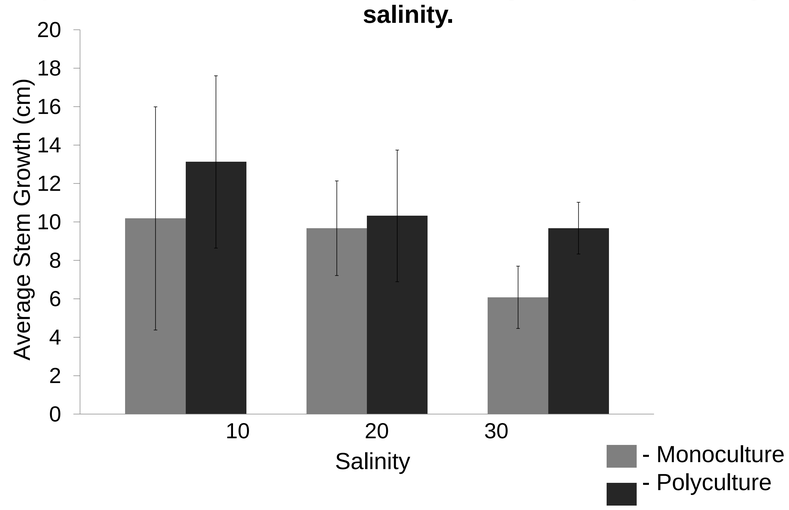


Figure 3: Monoculture and polyculture combinations in a single mesocosm

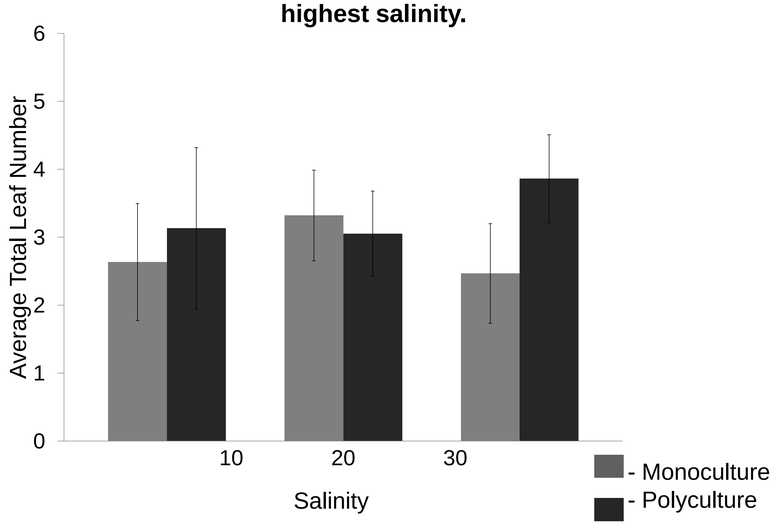
Results

Some individual plant metrics responded to diversity treatments, but:
-only at highest stress (30 ppt)
-responses to diversity were generally weak (nonsignficant)

Polyculture treatment had increased stem growth only at the highest salinity.

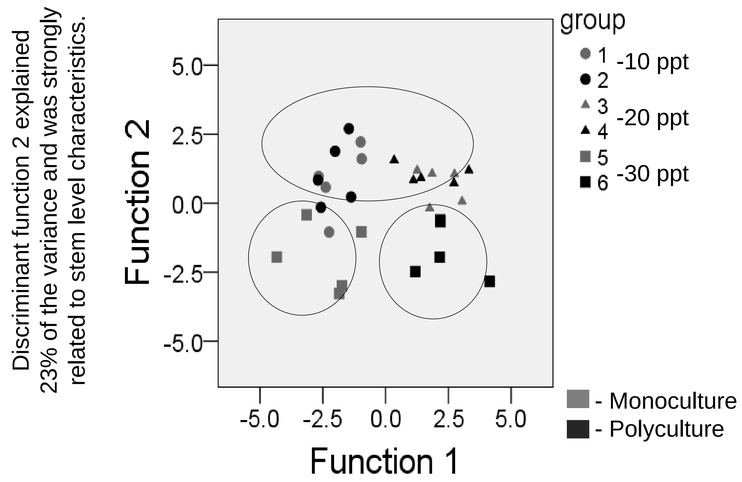


Polyculture treatment had increased leaf production only at the highest salinity.



Results (Continued)

Genetic diversity important in stressful conditions



Discriminant function 1 explained 61% of the variance and was strongly related to leaf level characteristics.

Conclusions

- The effects of genetic diversity were best reflected in the polyculture at the highest salinity when all metrics were considered.
  - Increased genetic diversity might increase productivity of monospecific plant stands in stressful conditions.
- Current marsh restoration practices often do not consider genetic diversity in the design or assessment of restoration success (Williams 2001).
- Restoration practices that incorporate genetic diversity of *Spartina alterniflora* by creating marshes with multiple ecotypes might be a efficient, economical way to improve the health of the restored marsh even with increasing prevalence and intensity of stressful conditions.

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References

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