Plant diversity of Texas and Georgia salt marshes

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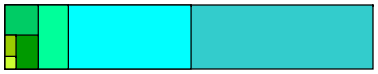
Introduction

Experimental studies of biodiversity often fail to capture patterns observed at large scales. To address this problem we used an alternative, natural experimental approach to examine the effects of tidal regime on marsh plant diversity patterns in two regions, Texas and Georgia. Both systems share similar climate, rainfall, and common plant species. While the tides of the Texas coast are of low amplitude and irregular frequency, those of Georgia are of a much larger amplitude and occur with diurnal frequency. In Georgia, these conditions result in strict vegetation zones. Marshes of Texas are relatively unstudied and appear not to have discrete zones. We hypothesized that the diversity of Texas marshes is greater than that of Georgia because the irregular flooding events in Texas result in less discrete microhabitats.

Methods

We measured 3 indicators of diversity in 7 vegetation zones in 4 sites in each region;



1. Species-Area Curve

Species presence was recorded in 7 sub-plots of increasing area (n=6 reps/zone). Cumulative richness and area values were log transformed to determine the slope of the relationship.

2. Diversity-Biomass Relationship

Vegetation height was measured as a non-destructive indicator of biomass.

3. Diversity Indices

We calculated evenness and the Shannon-Weiner diversity index from percent cover data.

	Slope			Actual Pool		Zone Richness			Shannon-Weiner			Evenness			Height		
Zone	TX	GA	P-value	TX	GA	TX	GA	P-value	TX	GA	P-value	TX	GA	P-value	TX	GA	P-value
Shrubs	0.13	0.13	0.1	28 (19)	18 (16)	4.61	4.11	0.31							96.21	87.09	0.2
Juncus	0.1	0.09	0.87	6	6	2.35	1.25	0.4	0.4	0.02	0.35	0.78	0.82	0.84	111.27	98.06	0.14
High Meadow	0.1	0.09	0.62	15	11	4.16	3.69	0.39	1.15	0.83	**0.01**	0.83	0.86	0.59	42.51	61.91	0.05
Mid Meadow	0.13	0.06	**0.04**	11	7	2.85	2.99	0.77	0.88	0.66	**0.01**	0.85	0.77	0.43	38.41	13.96	**0.0003**
Low Meadow	0.1	0.05	0.16	10	5	3.26	3.64	0.42	0.91	0.93	0.84	0.87	0.8	0.31	54.3	20.42	**0.0019**
Spartina	0.06	0.01	0.26	4	1	1.825	1	0.07*	0.25	0	0.07*	0.76	1	0.07*	105.88	93.22	0.34
Combined	0.11	0.07	**0.001**	28 (19)	18 (16)	3.25	2.54	0.06	0.75	0.42	**0.01**	0.82	0.87	0.26	71.45	57.67	0.16

Table 1. Species-area slopes, 4 measures of diversity, and vegetation heights in major marsh zones in Texas and Georgia.

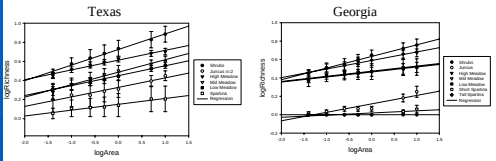


Fig. 1. Relationship between area and species diversity in comparable zones of Texas and Georgia salt marshes.

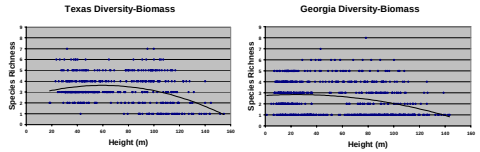


Fig. 2. Relationship between height (as an indicator or biomass) and richness throughout entire marsh.

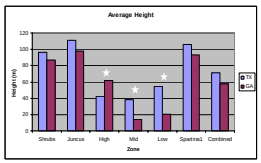


Fig. 3 Height (as an indicator of biomass) in 6 common zones. Stars indicate significant p-values.

Georgia Species	Shared Species	Texas Species
Baccharis halimifolia	*Aster tenuifolius*	*Cuscuta sp.*
*Cyanchum sp.**	*Batis maritima*	*Heliotropium sp.**
Hydrocotyl sp.	*Borrichia frutescens*	*Lepidium sp.**
*Ipomoea sp.**	*Distichlis spicata*	*Lycium carolinianum*
*3 unknowns**	*Fimbristylis sp.*	*Monanthocloe littorallis*
	Iva frutescens	*Plantago sp.**
	Juncus roemerianus	*Scirpus maritimus*
	Limonium carolinianum	*Spartina spartinae*
	Salicornia bigelovii	*Suaeda linearis*
	Salicornia virginica	*8 unknowns**
	Spartina alterniflora	
	Spartina patens	
	Sporobolus virginicus	




* Indicates annual and rare species found only along the terrestrial border.

Results and Conclusions

1. Species-Area Curve

Richness was greater in Texas at all spatial scales (Fig. 1). In addition, Texas species-area slopes were steeper than those of comparable Georgia zones. In general, plants in Georgia were confined to fewer marsh zones, whereas plants in Texas occurred across more marsh zones.

2. Diversity-Biomass Relationship

Diversity was greater in Texas at all levels of biomass. Biomass and height were greater in Texas overall (Fig. 3). Thus, higher diversity in Texas was not caused by lower biomass.

3. Diversity Indices

Evenness did not differ between regions (Table 1). Because richness was greater in Texas than Georgia, Shannon-Weiner diversity was also greater. Thus, diversity differences between Texas and Georgia marshes are driven primarily by richness, not evenness.

4. Total species pool

The total species pool found in each marsh was greater in Texas than Georgia, but most of this difference was due to annual and rare species found in the terrestrial border (shrub zone) in Texas. When these were eliminated, the resultant species pool (Table 1, numbers in parentheses) was similar between regions. Similarly, if the shrub zone was omitted, the species pool for all other zones was similar between regions.

5. Future work

Future work will look at richness patterns across all marsh zones in a larger number of sites. We will test the hypothesis that species in Texas occur across a wider portion of the marsh than Georgia conspecifics.

Acknowledgements

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