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Some Ecological Observations of a South Carolina Salt Marsh

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Author Details

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Abstract

The present study was conducted on a 7,500-acre salt marsh at Georgetown, South Carolina. Salt marsh vegetation was sampled at 75 sites using the line intercept method. Distribution of vegetation was mapped along an elevation gradient using a surveyor's transit and stadia pole. The vegetation was placed in three arbitrarily determined zones: High Marsh, subdivided into the High High Marsh and Low High Marsh, Middle Marsh, and Low Marsh, divided into High Low Marsh and Low Low Marsh. Soil samples were taken from each vegetation zone and analyzed for chlorinity, salinity, conductivity, and pH. pH is not a limiting factor. Soil salinity, chlorinity, conductivity, and duration and depth of flooding effect salt marsh vascular plant species distribution. The most flood tolerant taxon and most widely distributed taxon was Sporobolus alterniflorus. We continue to monitor the effect of wrack on species composition at this salt marsh as well as climate change as it effects sea level rise and the replacement of less flood tolerant taxa by more flood tolerant taxa.

Keywords: Georgetown; South Carolina; Salt marsh vegetation; Climate; Sea level rise; Salinity; Wrack

Introduction

Salt marsh vegetation is composed of a few grasses, rushes, and succulent dicotyledons [1]. The same genera, Sporobolus (Spartina), Distichlis, Juncus, Limonium, and Salicornia are encountered in widely separated geographic regions [2]. The occurrence of salt marshes and the smaller sub communities have been explained on the basis of inundation [3-5] salinity [6] or a complex of several factors [7], of which salinity and inundation were the most important [1,8]. Accordingly, various scientists disagree on the relative importance of the aforementioned environmental factors.

The present study was conducted on a 7,500-acre salt marsh at the Bell Baruch Institute for Marine and Coastal studies, Georgetown, South Carolina 33 19' North Latitude, 79 12' West Longitude. The objective of this study was to describe the vegetation present at this salt marsh, at Clam Bank (33.33156 N. Latitude, 79.12955 W. Longitude), the composition and zonation of the salt marsh communities, and the environmental conditions under which each exists. The climate at Clam Bank salt marsh is similar to nearby Georgetown, South Carolina [9]. The average January temperature at Georgetown is 8.77°C while July temperature averages 27.1°C. Annual rainfall averages 1368mm.

Methods

The salt marsh vegetation was sampled at 75 sites using the line intercept method [10]. Transects were established at approximately 200-foot intervals beginning at the upper level of the marsh populated by High Tide Bush, Iva frutescens L. and terminated at the lowest vegetation zone of the marsh dominated by a pure tall form of Smooth Cordgrass, Sporobolus alterniflorus (Loisel) P.M.Peterson & Saarela (Spartina alterniflora) (Loisel.) (Table 1).

The distribution of vegetation was mapped along an elevation gradient by surveyor's transit and stadia pole. Elevation of salt marsh vegetation at Clam Bank was established with a tide gage linked to geodetic survey benchmarks established by Stalter with assistance of two individuals provided by Rear Admirable Bull, May 1968. This work is described in detail by Stalter [2] (Table 2).

Table 1: Tolerance of salt marsh taxa to conductivity, salinity and pH [2].

Zone	Conductivity	Salinity	pH
1. High Marsh			
a. High High Marsh			
1) Distichlis spicata	14.20 - 43.5	0.1 - 0.5	6.0 - 7.5
2) Symphyotrichum tenuifolius	– 14.2	– 0.2	6.0 - 7.5
3) Suaeda linearis	10.00 - 43.5	0.1 - 0.5	6.0 - 7.5
4) Sporobolus pumilus	10.00 - 43.5	0.1 - 0.5	6.0 - 7.5
5) Salicornia virginica	28.6 - 43.5	0.2 - 0.5	6.0 - 7.5
6) Juncus roemerianus	10.00 - 43.5	0.1 - 0.5	6.0 - 7.5
7) Borrichia frutescens	6.25 - 43.5	0.1 - 0.5	6.0 - 7.5
8) Sporobolus virginicus	6.25 - 43.5	0.1 - 0.5	6.0 - 7.5
9) Limonium carolinianum	7.69 - 43.5	0.1 - 0.5	6.0 - 7.5
10) Solidago sempervirens	7.69 - 43.5	0.1 - 0.4	6.0 - 7.5
11) Sporobolus alterniflorus	14.20 - 43.5	0.1 - 0.5	6.0 - 7.5
12) Baccharis halimifolia	3.35 - 43.5	0.1 - 0.5	6.0 - 7.5
b. Low High Marsh			
1) Distichlis spicata	14.20 - 267.0	0.1- 3.0	6.1 – 7.0
2) Borrichia frutescens	14.20 - 267.0	0.1- 3.0	6.1 – 7.0
3) Juncus roemerianus	14.20 - 204.0	0.1- 2.6	6.1 – 7.0
4) Salicornia virginica	14.20 - 267.0	0.3- 3.0	6.1 – 7.0
5) Sporobolus alterniflorus	14.20 - 267.0	0.2- 3.0	6.1 – 7.0
6) Limonium carolinianum	14.20 - 267.0	0.1- 3.0	6.1 – 7.0
7) Symphyotrichum tenuifolius	– 14.2	– 0.2	6.1 – 7.0
2. Middle Marsh			
1) Distichlis spicata	37.70 - 110.0	0.3 - 1.6	5.2 - 7.0
2) Limonium carolinianum	37.70 - 90.9	0.3 - 1.2	5.2 - 7.0
3) Salicornia virginica	37.70 - 244.0	0.3 - 3.0	5.2 - 7.0
4) Sporobolus alterniflorus	37.70 - 244.0	0.3 - 3.0	5.2 - 7.0
3. Low Marsh			
a. High Low Marsh			
1) Sporobolus alterniflorus (dwarf)	26.30 - 452.0	0.03 - 4.6	5.3 - 7.0
b. Low Low Marsh			
1) Sporobolus alterniflorus (tall)	10.00 - 322.0	0.04 - 3.2	4.8 - 7.2

The highest and lowest points above datum (mean low tide level) were recorded for each species found at this salt marsh. Using this data, the salt marsh was arbitrarily subdivided into the following vegetation zones: High Marsh (further divided into High High Marsh and Low High Marsh), Middle Marsh, and Low Marsh (further divided into High Low Marsh and Low Low Marsh) [2,11] (Table 1).

Soil samples were taken from each vegetation zone and analyzed for conductivity (total electrolytes) chlorinity, salinity, and pH (Table 1) [2]. Electrical conductivity measurements were made with conductivity cell Model BB1 to determine the total active ion population in the soil solution. A 0.01N KCl solution having an electrical conductivity of 0.0014118 mhos per cm at 25°C served to standardize the instrument. The electrical conductivity of each soil extract in mhos per cm at 25°C is obtained by the equation:

EC (Mhos per cm at 25°C) = (0.0014118 X R_std)/R_ext

Soil solutions were prepared and measured with a Coleman Metrion III pH meter standardized with a pH buffered solution [2]. Chlorinity was determined by use of the following equation:

me of Cl/liter (0/00 Cl) = 1000/(ml of sample) × (ml of $AgNO_3$-Blank)× Normality of $AgNO_3$

Chlorinity values were used to calculate salinity. Salinity values were determined following the method of Knudsen [12] who determined salinity by titrating sea water with silver nitrate. Salinity was calculated by the following equation: Salinity = 0.030 + (1.805) (Chlorinity). Classification of vegetation follows Weakley [13].

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Table 2: Relative height above datum (mean low tide level) in feet and average period of submergence (in minutes) per day for salt marsh taxa at Clam Bank [2].

Species	Height Above Datum		Average Period of Submergence Per Day
	Lower limit	Upper Limit	
Solidago sempervirens	6.54	/	Very severe storms
Iva frutescens	5.2	6.66	5
*Baccharis halimifolia	5.2	/	5
Sporobolus pumilus	4.94	6.66	20
Sporobolus virginicus	4.99	6.66	19
Borrichia frutescens	4.68	5.95	58
Symphyotrichum tenuifolius	4.68	/	58
Juncus roemerianus	4.65	6.65	60
Limonium carolinianum	4.47	5.71	64
Distichlis spicata	4.47	5.71	64
Salicornia virginica	4.29	5.42	66
Suaeda linearis	4.45	/	64
Sporobolus alterniflorus	1.3	4.93	938

Results and Discussion

pH is not a limiting factor as several taxa, S. alterniflorus; Sea Lavender, Limonium carolinianum (Walter) Britton; Saltgrass, Distichlis spicata (L.) Greene and Pickleweed, Salicornia virginica L. tolerate a wide range of pH (Table 1). Salt Meadow Cordgrass, Sporobolus pumilus (Roth) P.M. Peterson & Saarela (Spartina patens (Aiton) Muhl. Seashore Dropseed, Sporobolus virginicus (L.) Kunth; Seaside Goldenrod, Solidago sempervirens L.; Iva frutescens L. and Eastern Baccharis, Baccharis halimifolia L. tolerate low concentrations of soil solutes and populated the High Marsh where salinity values range from 0.1 to 0.5ppt. A diminutive form of Sporobolus alterniflorus was found in the High Low Marsh, the zone where salinity and conductivity values were the highest (Table 1). As soil solute concentration and soil salinity increases, species diversity decreases.

Data on relative height above datum and average daily period of inundation based on data from a surveyor's transit and stadia pole revealed overlapping ranges of elevation (Table 2). All taxa except Black Needlerush, Juncus roemerianus Scheele and Sporobolus alterniflorus occupied a zone of two feet or less (Table 2). Sporobolus alterniflorus is the most flood tolerant taxon occupied an elevation gradient of 3.6 feet and can be an ephemeral member of the High High Marsh sub community for short periods of time (Tables 1 & 2).

Wrack deposition on salt marsh vegetation has been neglected in the study of the ecology and distribution and species composition of salt marsh communities. Wrack at Clam Bank salt marsh was composed almost exclusively of culms (stems) of S. alterniflorus (Figure 1). If wrack was of sufficient thickness and covered salt marsh vegetation for a sufficient period of time it smothered and killed the plants [14].

Figure 1: Wrack cover at Clam Bank salt marsh. Wrack is composed mainly of dead culms (stems) of S. alterniflorus.

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Conclusion

Wrack deposition was a yearly perturbation at this marsh covering portions of the Georgetown, South Carolina salt marsh each year. Eventually the rafts of wrack decomposed and/or were washed away leaving bare soil, facilitating the invasion of salt marsh taxa. Taxa best suited for a specific soil solute concentration, salinity, and duration and depth of flooding will recolonize the bare soil (Table 1). Our study of wrack deposition on salt marsh vegetation was the first of two long range studies at Clam Bank Marsh where we will determine the role of wrack on community development (plant succession) and community composition. A second ongoing study involved the role climate change as it effects sea level rise and the replacement of less flood tolerant salt marsh vascular species by more flood tolerant species within the communities and sub communities at Clam Bank marsh.

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