

Comparative vegetation development in different aged brackish tidal wetlands along the lower Napa River, San Francisco Estuary, California

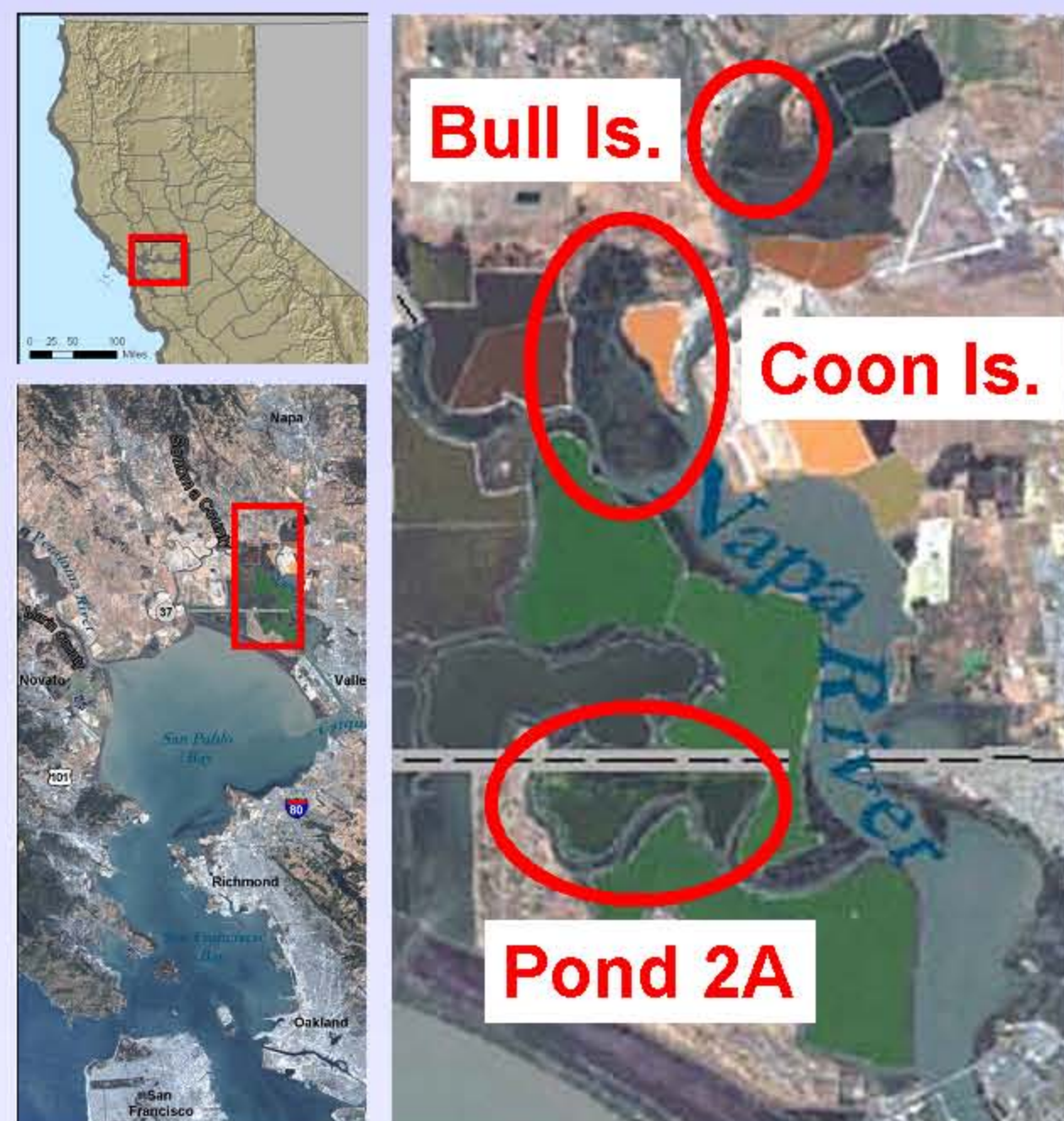
V.T. Parker¹, L. Schile¹, D. Benner¹, A. Langston¹, L. Wainer², M. Vasey¹, and J. Callaway².

¹San Francisco State University, San Francisco, CA USA ²University of San Francisco, San Francisco, CA USA

INTRODUCTION

A central goal of wetland restoration is the establishment of self-sustaining, functional ecosystems. Our research focused on one aspect of restoration success, plant community structure, in a series of different aged brackish tidal marshes in San Francisco Bay. Through multivariate analyses, comparisons of the species richness, diversity, and associations between sites were conducted to examine the differences in vegetation patterns.

METHODS



Our field sites, Bull Island, Coon Island, and Pond 2A, are located along the Napa River in Northern San Francisco Bay. Coon Island was the reference site. It has never been diked, although some farming has occurred. Bull Island is 24 years old and was once diked and farmed. Pond 2A was converted from a salt pond 8 years ago, and has many unvegetated, ponded areas.

At each site, an average of 155 stratified random points were visited and the percent cover of all plant species located within a 3m radius were recorded. Average percent cover and frequency were calculated for each species at each site. Detrended correspondence analysis (DCA) and TWINSpan were conducted to identify patterns in species association and distribution within and between marshes.

RESULTS - PERCENT COVER AND FREQUENCY

Species lists for each site

Coon Island	Bull Island	Pond 2A
Achillea millefolium	Artemisia douglasiana	Cotula coronopifolia
Artemisia douglasiana	Atriplex triangularis	Distichlis spicata
Baccharis pilularis	Baccharis pilularis	Eleocharis parvula
Beta vulgaris	Cotula coronopifolia	Grindelia stricta
Distichlis spicata	Distichlis spicata	Jaumea carnosa
Frankenia salina	Grindelia stricta	Lepidium latifolium
Grindelia stricta	Jaumea carnosa	Salicornia europaea
Jaumea carnosa	Juncus balticus	Salicornia virginica
Juncus balticus	Lepidium latifolium	Scirpus americanus
Lathyrus jepsonii jepsonii	Salicornia virginica	Scirpus maritimus
Lepidium latifolium	Scirpus acutus	Spartina foliosa
Potentilla anserina	Scirpus americanus	Typha angustifolia
Rumex crispus	Scirpus californicus	
Salicornia virginica	Scirpus maritimus	
Scirpus acutus	Sonchus oleraceus	
Scirpus americanus	Spartina foliosa	
Scirpus californicus	Triglochin maritima	
Scirpus maritimus	Typha angustifolia	
Spartina foliosa	Typha latifolia	
Triglochin maritima		
Typha angustifolia		
Typha latifolia		

Through random sampling, we documented 22 species on Coon Island, 19 on Bull Island, and 11 at Pond 2A, not including levee species. Additional species were identified outside of the sampled plots, but they occurred at very low frequency. Coon and Bull Islands had comparable species lists; however, the majority of the diversity on Bull Island was clustered in small, localized patches along levee edges, likely reflecting antecedent conditions. Pond 2A had half of the species of the other sites, but contained species commonly found in newly restored sites: *Salicornia europaea* and *Cotula coronopifolia*. *Salicornia virginica* was the dominant plant on Coon Island, Bull Island had roughly equal cover of *Typha angustifolia* and *Scirpus maritimus*, and Pond 2A was dominated by *S. maritimus*.

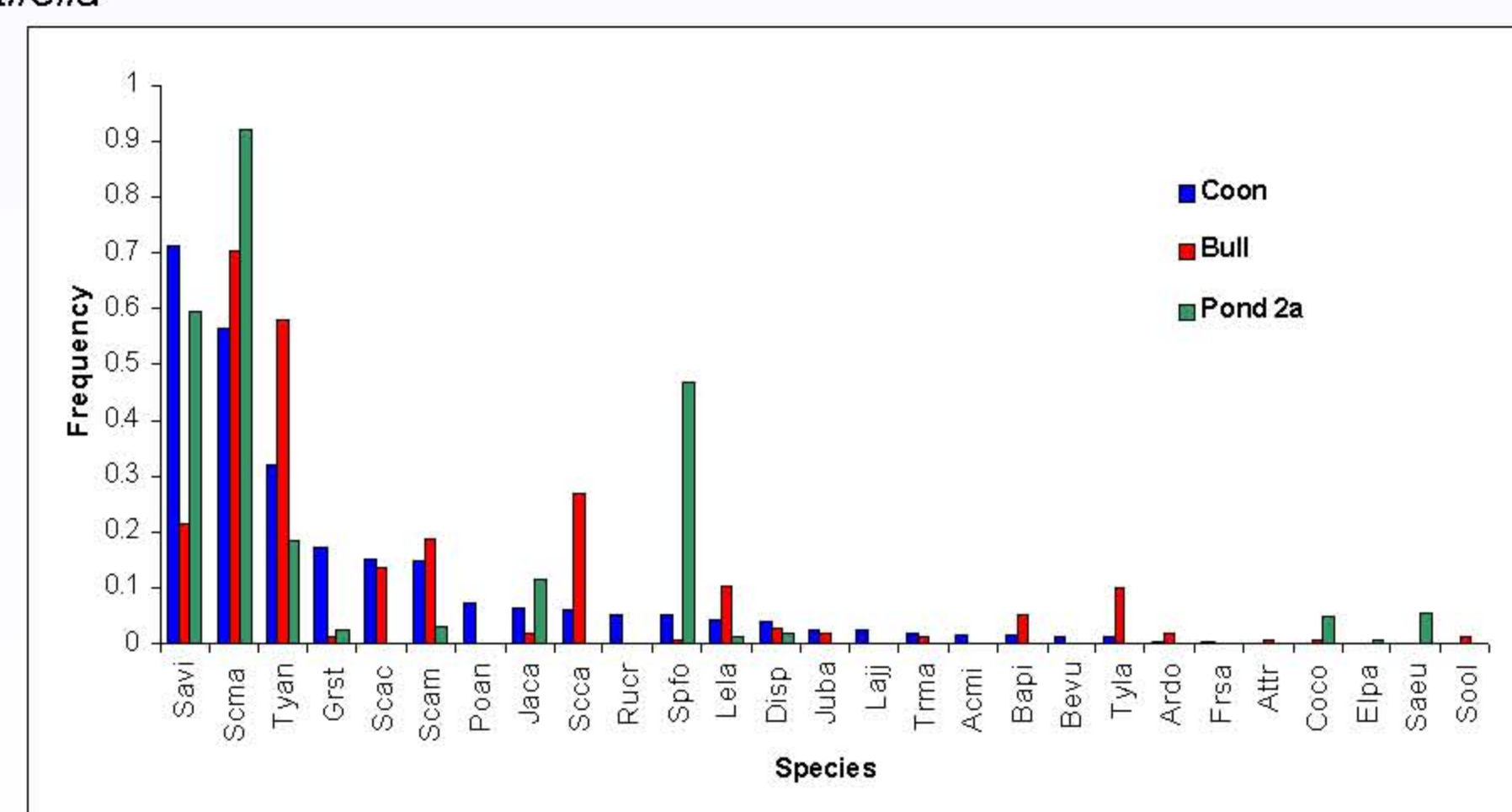


Fig 1. Relative frequency of species in all random plots at each site

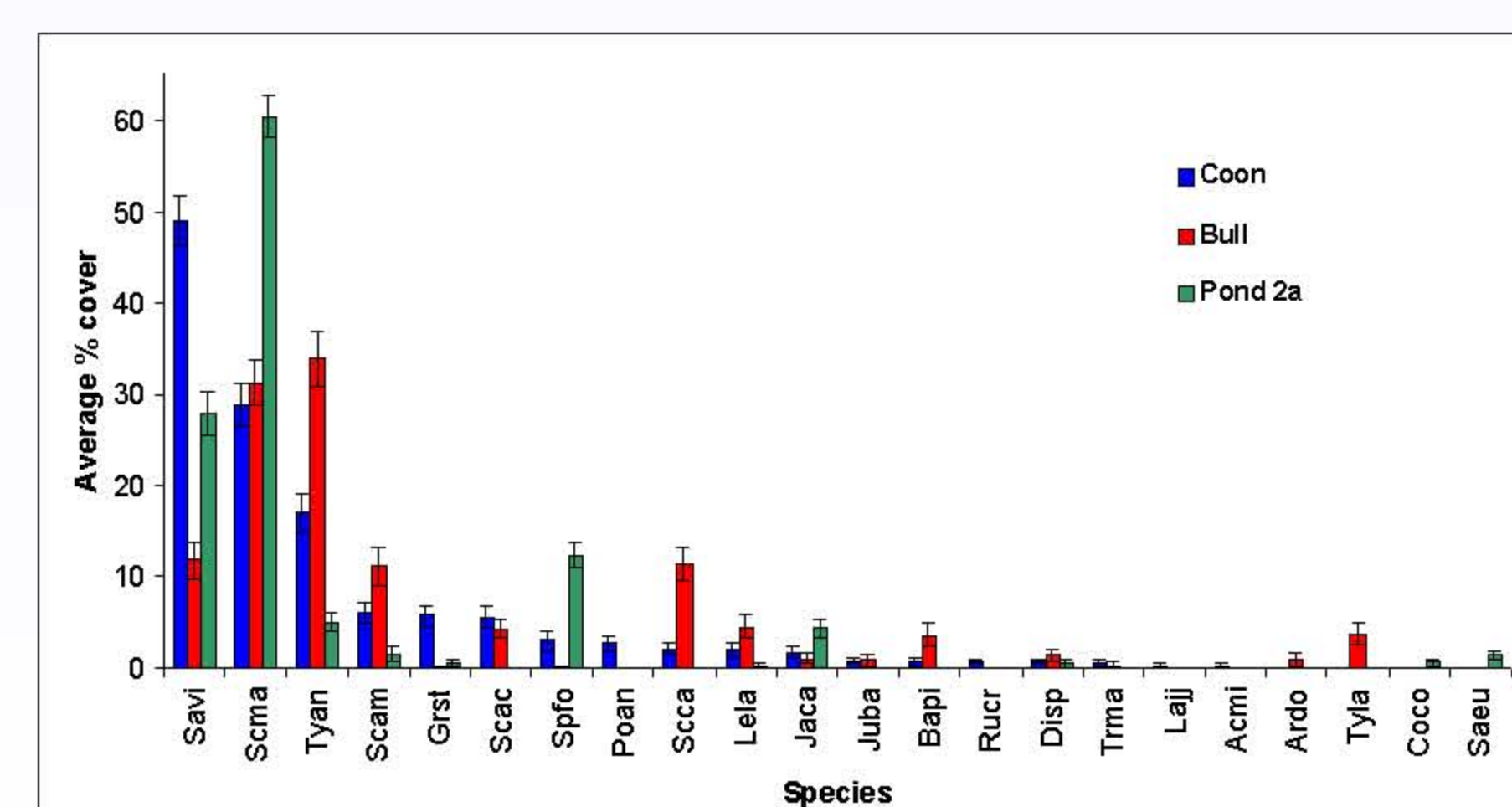


Fig 2. Average percent cover of species in all random plots at each site (species with less than 0.5% cover not shown; error bars = ± SE)

RESULTS - SPECIES ASSOCIATIONS

Coon Island



The vegetation was clustered into three main groups reflecting an elevation gradient: high marsh, mid marsh, and low marsh. *Salicornia virginica*, *Scirpus maritimus*, and *Typha angustifolia* were the dominant species in each group, respectively. The most diversity occurred in the high marsh and included a rare species, *Lathyrus jepsonii jepsonii*. Axis 1 scores correlated with an assumed elevation and salinity gradient.

Bull Island



Two main vegetation groups were identified, and stratified by elevation. One group was dominated by *Scirpus maritimus* and *Typha angustifolia*. Species distribution and associations were patchy across the site with no obvious pattern. The second group was dominated by *Salicornia virginica*. It occupied a much smaller area than the first group. Axis 1 scores correlated with an assumed elevation gradient.

Pond 2A



Species clustered into two defined groups that were characterized by proximity to the unvegetated, ponded areas. The first group was dominated by *Spartina foliosa* and was located in a 5m band around ponded areas. The other group was characterized by *Scirpus maritimus*, which covered the majority of the site and often had a dense *Salicornia virginica* understory.

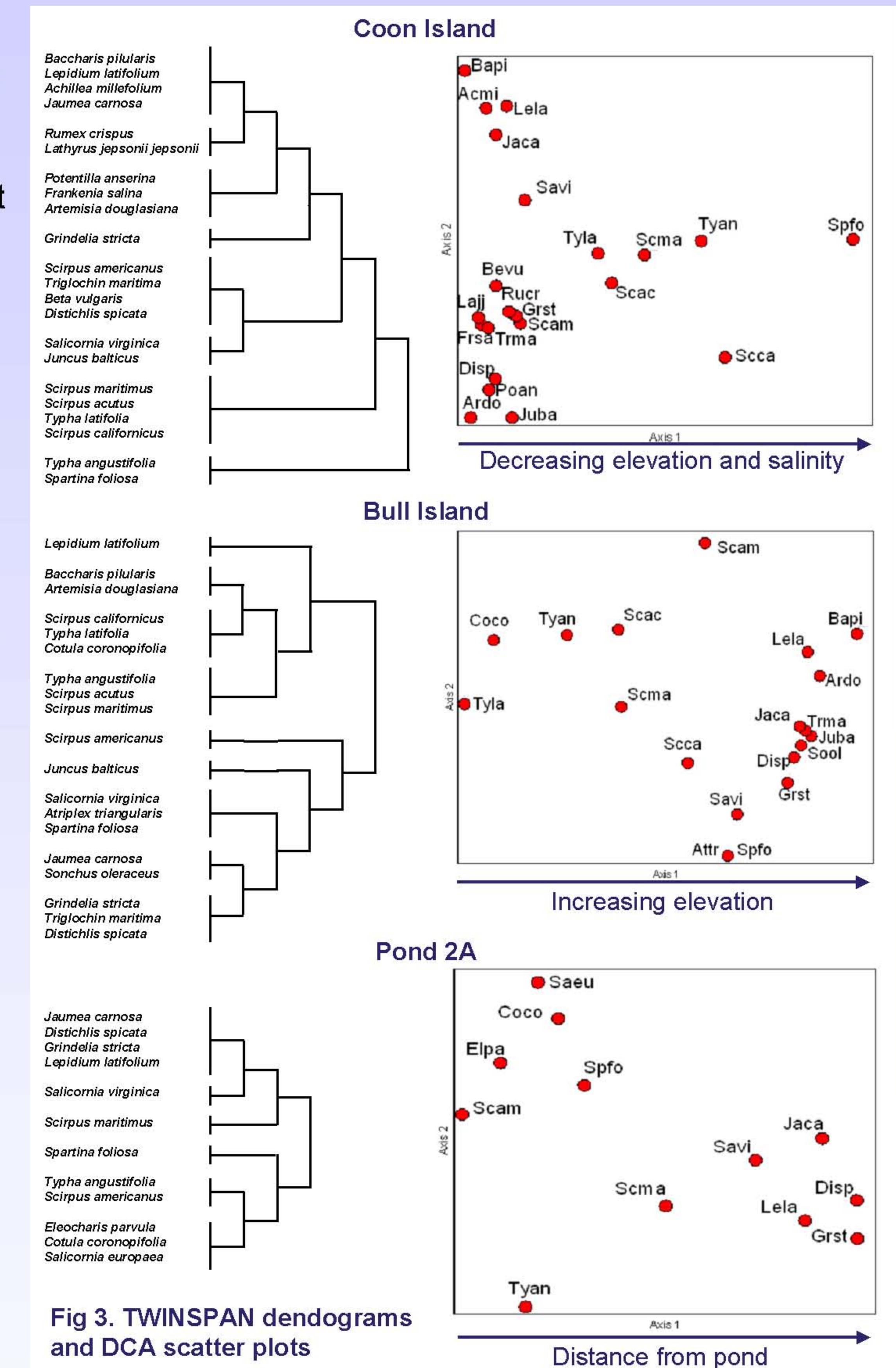


Fig 3. TWINSpan dendrograms and DCA scatter plots

DISCUSSION

All three sites displayed similar species associations; however, the driving factors behind the associations and their distribution differed between marshes. The reference site, Coon Island, had the most diversity and best defined assemblages. The high-marsh areas were the most diverse out of all communities and contained species, both common and rare, that were not found at other elevations. This suggests that elevation is a key factor driving the presence of species in these sites. Although no direct measurements of elevation have been taken, the vegetation patterns suggest that Pond 2A and Bull Island are lower in elevation than Coon Island (*i.e.* high percent cover of *Typha* species, *Spartina foliosa*, and *Scirpus maritimus*). Bull and Coon Island contained similar high-marsh species; however, their distribution at Bull Island was restricted to a small portion of the site, which is assumed to be a series of old dredge spoils. Additionally, our vegetation analyses show that Pond 2A is still actively maturing as a marsh, containing vegetation common in newly restored marshes. All together, these results suggest that future restoration plans might benefit from more strategically designed elevation gradients that encompass the full range of tidal wetland species.