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# Evaluation of vegetation sampling methods for brackish tidal wetlands

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## INTRODUCTION AND OBJECTIVES

Fig 1. Vegetation along channels on Coon Island, a brackish tidal marsh

Brackish tidal wetlands pose problems for rapid vegetation sampling owing to the patchy distribution of vegetation responding to subtle changes in salinity or inundation (Fig 1). This contrasts with either tidal salt or freshwater marshes, which usually present a simpler zonal structure in the high marsh driven by inundation associated with channels. The objective of this study was to implement three sampling techniques for vegetation to compare their relative accuracy and efficiency in describing these complex systems. As part of another study of vegetation mapping, we sampled almost 200 randomly chosen plots, stratified by preliminary vegetation classes. We assumed that the high intensity random sampling represented a relatively accurate assessment of the marsh vegetation and we used these data to compare to other sampling techniques. Since wetland vegetation in tidal systems, including brackish/freshwater marshes, is structured by tidal hydrology and correlated processes, we tested two additional sampling techniques that focused on the influence of tidal channels on species distribution and abundance. Our specific questions were:

1) For a heterogeneous tidal wetland, how do the three techniques compare in relative cover, frequency, species area curves, and total species richness?

2) How much comparative effort is required to reach a given level of accuracy for the three techniques?

## METHODS

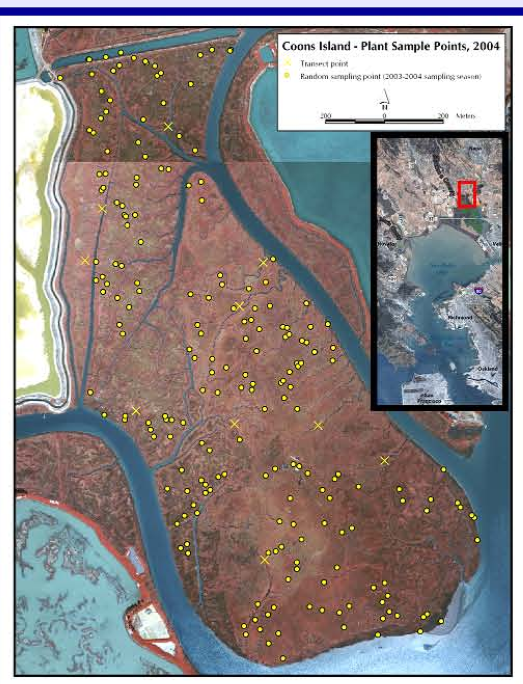


Fig 2. Coon Island map with transect and random point locations

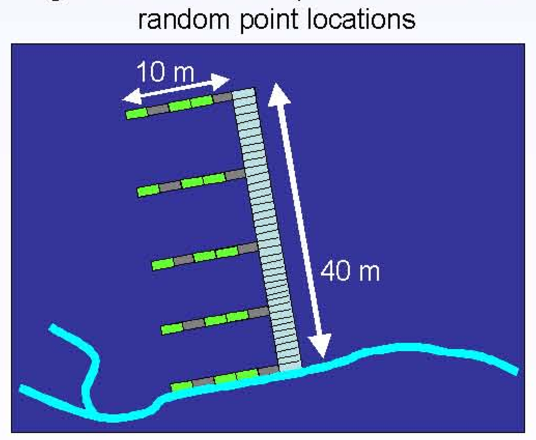
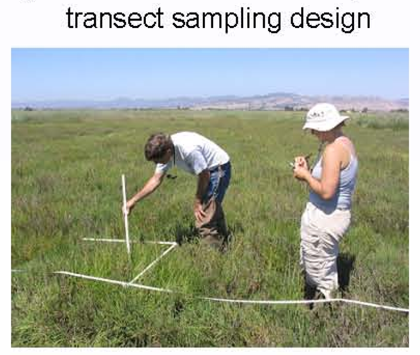



Fig 3. Schematic of belt and parallel transect sampling design



The vegetation sampling was conducted on Coon Island, a large and complex brackish tidal marsh located along the Napa River, north of San Pablo Bay, in April – June, 2004. The first sampling method utilized 198 random points stratified according to a preliminary vegetation map (Fig 2). The percent cover class of each plant species was recorded within a 3m diameter relevé plot. The other methods involved sampling along channel edges at ten randomly generated points throughout the marsh (Fig 2). Two variations of transect sampling were then implemented (Fig 3):

- A 2 x 40m continuous belt transect sampled every meter, beginning at the channel edge
- Five 10m transects parallel to the channel edge and placed 0, 10, 20, 30 and 40m from channel edge and three plots sampled per transect.

For all plots, percent cover of each plant species was estimated using cover classes. The amount of time required to sample transects and quadrats was recorded.

Percent similarity values were computed for each combination of sampling methods. Species-area curves were then generated and average percent cover and frequency were calculated for each species. To test for differences in sampling effort, we created percent cover variance plots for each method, which involved the cumulative addition of random points/transects plotted against the average percent cover. Sampling effort for capturing a given species richness was calculated, along with the corresponding work hours required.

## RESULTS

Table 1. Different measures of sampling effort calculated for each sampling method

| | Species richness | # of sampling days | Total effort (min) | Ave. # points/ transects per day | Ave. time per point/transect (min) |
|---|---|---|---|---|---|
| **Random Points** | 22 | 4 | 1995 | 49.5 | 10.1 |
| **Belt Transect** | 20 | 2 | 379 | 5 | 37.9 |
| **Parallel Transect** | 18 | 2 | 320 | 5 | 32 |

Table 2. Comparison of the percent similarity in species presence and relative cover among the different sampling methods.

| | Point | Belt |
|---|---|---|
| **Belt** | 0.7851 | |
| **Parallel** | 0.7871 | 0.9188 |

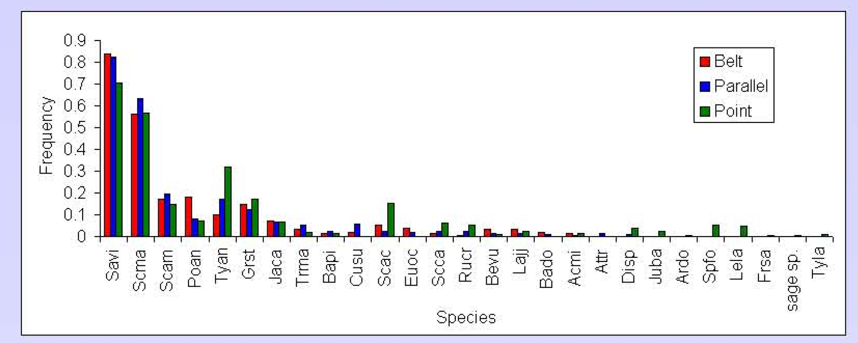



Fig 4. Relative frequency of species in each sampling method.

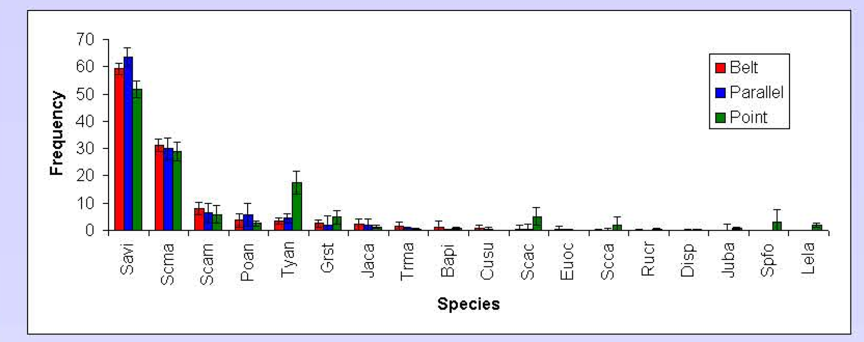



Fig 5. Percent cover of species averaged within each sampling method (species with less than 0.5% cover not shown; error bars = ± SE)

The three sampling methods were comparable for species richness; however, the effort involved differed between methods (Table 1). The transect sampling methods were more similar in species composition than they were to point sampling (Table 2). The average percent cover and relative frequency of species were comparable among sampling methods, but two species, *Scirpus acutus* and *Typha angustifolia*, had greater cover and frequency in the random point sampling (Figs. 4 & 5). The species-area curves represented similar trends; however, the variance for both transect methods was greater (Fig 6).

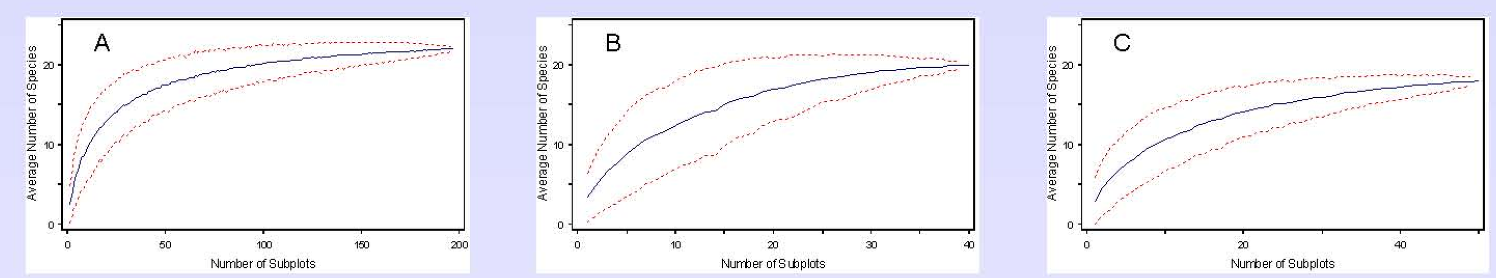



Fig 6. Species-area curves calculated from (a) random point, (b) belt transect, and (c) parallel transect sampling

Table 3. The estimated effort, represented by the number of points/transects sampled, that is required to obtain a specified level of species richness

| | Number of Species | | | |
|---|---|---|---|---|
| **Sampling Method** | *5* | *10* | *15* | *20* |
| *Random Points* | 3 | 11 | 28 | 96 |
| *Belt Transect* | 1 | 3 | 5 | 10 |
| *Parallel Transect* | 1 | 3 | 6 | 10 (18 sp) |

Table 4. The average time in minutes needed to sample a certain level of species richness based on the values from Table 3.

| | Number of Species | | | |
|---|---|---|---|---|
| **Sampling Method** | *5* | *10* | *15* | *20* |
| *Random Points* | 30.2 | 111 | 282 | 967 |
| *Belt Transect* | 37.9 | 114 | 190 | 379 |
| *Parallel Transect* | 32 | 96 | 192 | 320 |

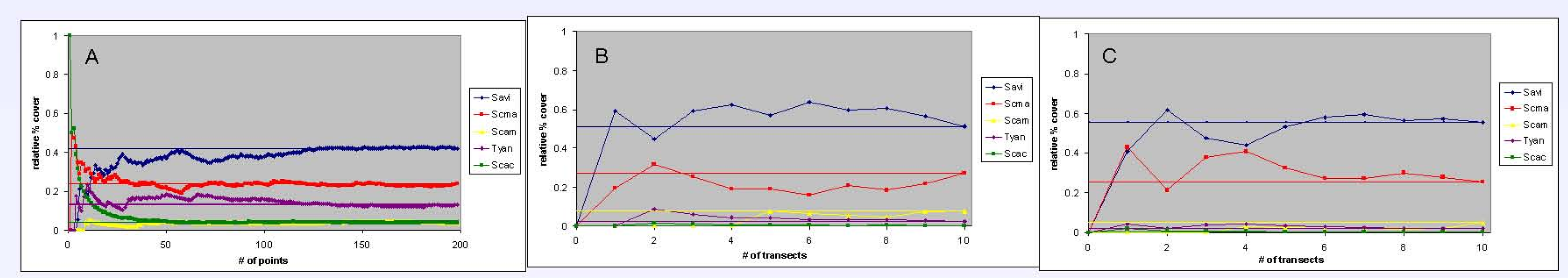



Fig 7. Species cover variance with the cumulative addition of points or transects for (a) random point, (b) belt transect, and (c) parallel transect sampling. Plots/transects were randomly chosen and a cumulative average of percent cover was calculated. The color-coded solid lines represent the overall average percent cover for a given species.

The three sampling methods were comparable in sampling effort at low numbers of species richness; however, the sampling effort and time to obtain the total species richness increased for the random point sampling as compared to the transect sampling (Tables 3 & 4). Relative percent cover leveled at approximately 100 points for the point sampling, 5 transects for the belt transect sampling, and 6 transects for the parallel transect sampling (Fig 7), yet the sampling effort differed greatly between point and transect sampling (1010, 190, and 192 minutes, respectively).

## DISCUSSION AND CONCLUSIONS

This research established that rapid, structured sampling is as effective as intensive random sampling at representing vegetation in one brackish tidal marsh, Coon Island. On average, the 2 transect sampling methods more efficiently described vegetation patterns, shown through reduced effort, and demonstrated that the majority of species richness was found within 40m of a channel. Out of the three methods, the belt transect appeared to be the most successful in capturing species richness and also provides the most environmental structure with which to test factors governing species distribution and abundance in a marsh. Although our effort and efficiency estimates tend to support the use of the belt transect, inherently there will be species that are not represented in the sampling due to the patchy nature of these systems. Certain species were underestimated using transect sampling, specifically *Scirpus acutus* and *Typha angustifolia*. This could be due to their location in the marsh (i.e., farther inland than the transects extended) or that the random point sampling was inherently biased towards the initial vegetation classifications from which they were generated. Consequently, we conclude that a belt transect method is the most efficient method for accurately characterizing brackish tidal wetlands. This conclusion is dependent on using random locations to initiate the transects, and depending on the size of the marsh, increasing the transect length to incorporate species located away from channels.