Seed dispersal in the Eden Landing salt ponds complex: the influence of landscape, site and time on seed arrival

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Introduction

Passive arrival of seeds via tide and wind is the most common means of re-vegetation in tidal marsh restoration projects. Research in the north SF Bay found similar seed composition in restored and reference sites[1], however research from Southern California demonstrated that restoration sites had significantly fewer seeds than reference sites[2]. Evidence from San Francisco Bay restoration projects indicates that distance to seed source may play a role in a restoration project's species composition[3]. To assess seed dynamics in the South Bay Salt Pond Restoration Project, we will address the following questions:

Research Questions

Question 1: Is the frequency and composition of seeds arriving to a tidal marsh dependent on local vegetation density and species richness?

Hypothesis 1: Developed marshes will exhibit higher seed frequency and diversity than restoration projects, where seed frequency and diversity will be proportional to age and vegetation.

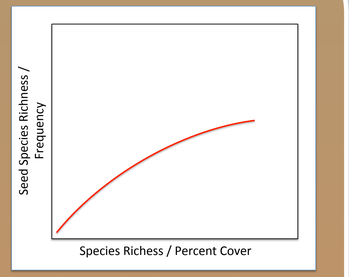

Figure 1: Question 1 Hypothetical Results

Question 2: Is there evidence of distance decay in seeds arriving to tidal marshes?

Hypothesis 2: Seed diversity will be positively correlated with standing vegetation, with increasing dissimilarity over geographic distance.

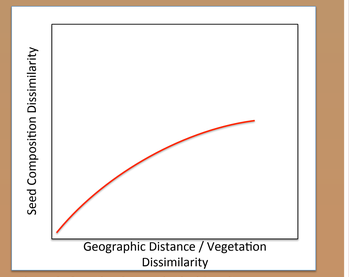

Figure 2: Question 2 Hypothetical Results

Question 3: Do local factors influence the seeds arriving to an area within a marsh?
Hypothesis 3a: Areas with higher elevation and greater sedimentation rates will accumulate more seeds.
Hypothesis 3b: Areas closer to channels will accumulate more seeds.

Study Areas

Figure 3: Study locations at Eden Landing Ecological Reserve

Site Descriptions

(Sites 1-4 represent an age gradient and will be used to test Question 1)

1: Whale's Tail Marsh: ~100 year old naturally developed tidal salt marsh. Reference site for restored areas

2: North Creek Marsh: Restoration site breached in 2006.

3: Mount Eden Creek Marsh: Restoration site breached in 2008.

4: Pond E8A: Restoration site breached in 2011.

(Site 5 encompasses a salinity gradient and will be used to test Question 2)

5: Old Alameda Creek: Tidal creek with substantial freshwater inflow, transition from salt-intolerant Schoenoplectus dominated community to salt-tolerant Salicicornia dominated community.

Methods & Materials

Seeds will be collected using 3-layer seed collection mats[1]. Following installation in September 2013, mats will be collected and replaced in November for final collection in January.

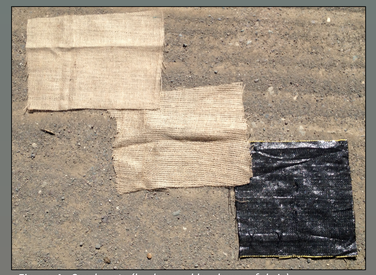

Figure 4: Seed mats (burlap and landscape fabric)

Question 1:
16 seed mats will be arranged in a grid and laid out in sites 1-4 (total n=64). Grid spacing will correspond to the size and accessibility of each marsh.

Question 2:
A linear transect with 10 points will be laid out with 5 points in the brackish area and 5 points in the salt marsh area. Each point will contain 3 mats spaced a set intervals from the closest channel (total n=30).

Environmental variables:

Plant species composition
Percent vegetation cover
Elevation
Sedimentation over time
Cumulative distance from channel
Soil salinity

Figure 5: Seed mat in mudflat

Conclusions

Question 1:
If species richness and percent cover of standing vegetation are positively related to seed composition, restoration efforts may benefit from the direct application of seedlings to provide local seeds for marsh development.

Question 2:
If distance decay of similarity (communities becoming less similar over space) is evident, the geographic distance between a restoration site and a potential seed source may be a factor in the development of restoration projects.

Questions 3:
If elevation, sedimentation and cumulative distance to channel influence the arrival of seeds, dispersal limitations as well as abiotic filtering may play a role in structuring tidal marsh plant communities.

Broader Implications:
To help generalize our findings, question 1 will also be tested in the north bay by comparing the vegetation and seed dynamics of the historic Heerdt Marsh to the adjacent Muzzi Marsh restoration project. Question 2 will also be tested in brackish marshes in Suisun marsh, where lower salinity allows greater species diversity and vegetation heterogeneity. Testing these questions in other systems will help generate results that could be applied Bay-wide. These results will help identify and prioritize areas where planting of seedlings may be needed to encourage marsh development towards reference system conditions and improve understanding of the factors influencing re-vegetation trajectories.

References

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