Restoration trajectories in created tidal marsh habitat – A case study from Poplar Island, MD, USA

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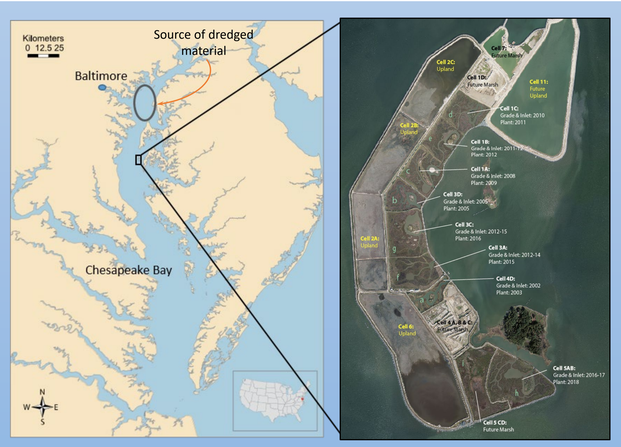
Background

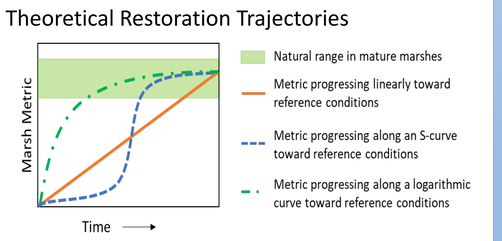
Tidal marsh loss in coastal areas of the U. S. has inspired a variety of approaches to restore habitat and associated ecosystem services, such as protection from flooding and shoreline erosion, nutrient cycling and carbon sequestration. Increasingly, material dredged during navigation channel maintenance is beneficially used to supplement declining marshes or create new ones. We present results from a large-scale marsh creation project where fine-grained dredged material is used to create 314 hectares of tidal marsh habitat in mid-Chesapeake Bay, MD, USA. In contrast to marsh projects where sand is the substrate, the Poplar Island marshes are nutrient rich, leading to the hypothesis that vegetation development trajectories could also be quite different.



Study Goals

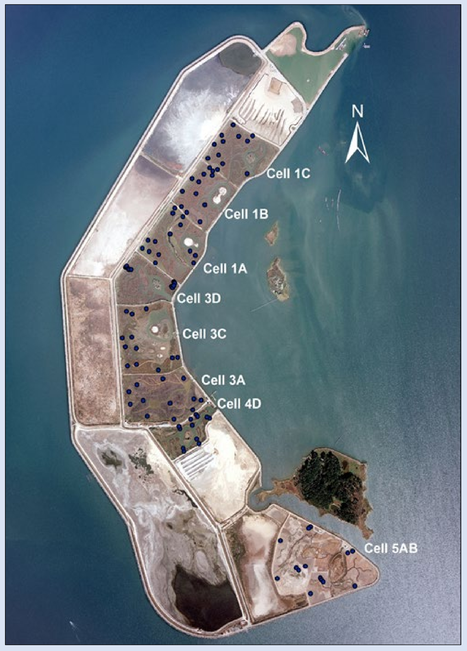
- Characterize vegetation trajectories for a tidal marsh restoration where the substrate is fine-grained, nutrient-rich dredged material and low-fertility sand
- Compare with theoretical restoration trajectories
- Compare trajectories for a variety of vegetation metrics to offer insights for future marsh monitoring designs and suggest where cost savings might be possible

Theoretical Restoration Trajectories

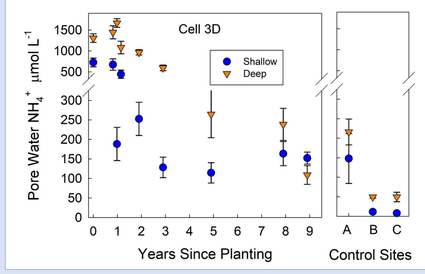


Methodology

- Analyzed trajectories in 8 cells ranging from 3-16 years of age
- Compared trajectories on 2 substrates: fine grained dredged material (n = 7); sand (n = 1)
- AG biomass: clipped plots (live)
- BG biomass: cores (live + dead)
- Percent cover: 0.25 m2 quadrats
- Analysis: RSST methodology

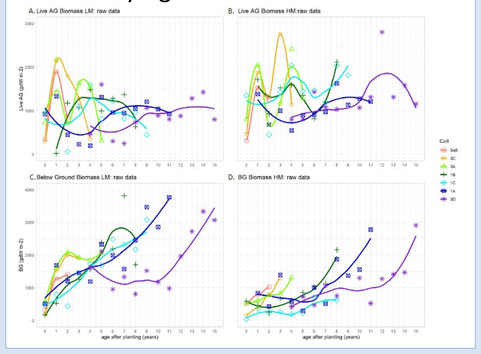


Nutrient Availability

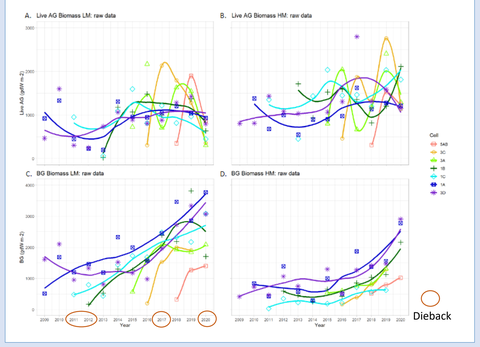


Results

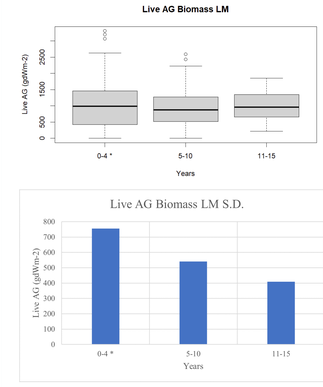
Biomass by Age



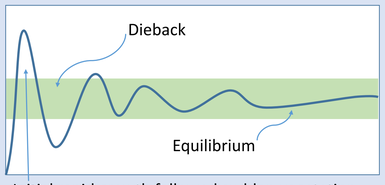
Biomass by Year



Binned means remain the same, but variability declines with age.

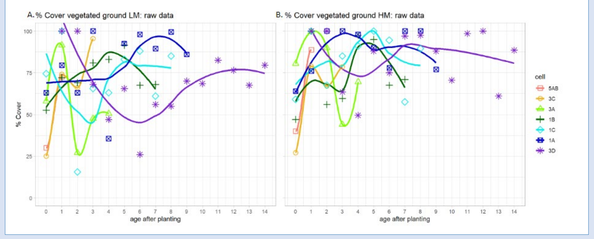


Sudden vegetation dieback (photo credit JC Stevenson)

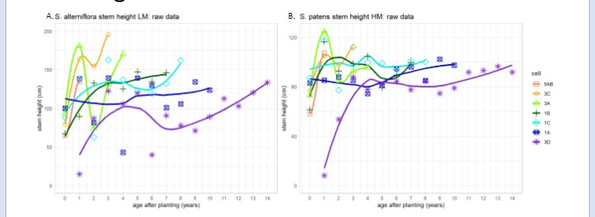


Initial rapid growth followed sudden vegetation dieback in years 2 – 5, then oscillation around a more modest level of production, similar to reference

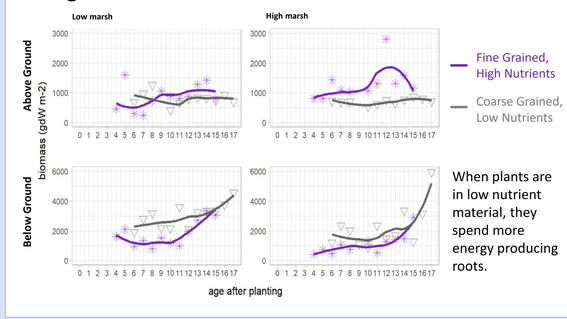
Percent Cover



Stem Height



Fine-grained vs. Sand



When plants are in low nutrient material, they spend more energy producing roots.

Conclusions

- Trajectories on fine-grained dredged material demonstrate rapid plant establishment and growth and lower initial root:shoot ratio compared with a low fertility substrate (sand)
- Aboveground biomass (live) initially increases rapidly, is highly variable in the first five years, then settles around a lower production level, similar to reference. ***Dieback in years 2 - 5 is normal. Sites rebound without adaptive management.***
- Belowground biomass (total) starts low and builds over time as partially decomposed roots and rhizomes accumulate
- AG biomass, percent cover and stem height have similar trajectories
- Synthesizing data across the phases of wetland development creates science-based trajectories of ecological outcomes that differ from classical theoretical trajectory shapes.