Sustainability in the Created Marshes at the Poplar Island Restoration Project in Mid-Chesapeake Bay

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Background

- 694 hectares (1715 acres)
- 50/50 upland/wetland
- ~73 hectares (180 acres) completed
- Capacity 68 mcy
- Cost $1.4 billion
-Completion 2029
Construction

Inflow

Crust management

Tidal opening
Source

- Fine-grained
- Nutrient rich
- Mesohaline
- Pyrite rich
Planting

- 80% Low marsh: *Spartina alterniflora*
- 20% High marsh: *Spartina patens*
- Flood dominated design to maximize deposition
Main Concern: Sea Level Rise

Annual Mean Sea Level in Chesapeake and Delaware Bays

- Baltimore -- 3.2 mm/yr
- Lewes -- 3.3 mm/yr
- Solomons -- 3.5 mm/yr
- Cambridge -- 3.6 mm/yr
Unanticipated - Extreme Fertility

- $\text{NH}_4^+$ decreasing over time in both surface (<12 cm) and deep (>20 cm)
- SRP increasing over time in both surface and deep
- Result of coastal eutrophication
2006

Planting

Lush growth

Die-back

Re-colonization
Inter-annual variability in aboveground biomass production

![Graph showing aboveground biomass production from 2006 to 2012 (Cell 3D)]
2012 Biomass vs. Wetland Age

- Declining AG following early maximum
- Increasing BG
Marsh characteristics associated with high fertility sediments:

- Lodging
- Low root:shoot ratio
- Fungal infection
- Leaf speckling
- Grazing pressure
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Adapted from Darby and Turner 2008

Marschner 1995

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*Fusarium* infections on *S. alterniflora* stems (left), Poplar Island.
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Reference Marsh  Dredged Material
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Common factor:
Reduced potential for sediment oxygenation

Muskrat grazing in Cell 3D
Elevation Change 2009-2013

Upper Chesapeake Bay
sea level rise = 3-4 mm y\(^{-1}\)

**Cell 3D**
- Mean Rate = 0.96 cm y\(^{-1}\)
- \(R^2 = 0.9424\)

**Cell 4D**
- Mean Rate = 0.88 cm y\(^{-1}\)
- \(R^2 = 0.9756\)

**Cell 1A**
- Mean Rate (High Marsh) = 1.13 cm y\(^{-1}\)
- Mean Rate (Low Marsh) = 0.46 cm y\(^{-1}\)
- \(R^2 = 0.9911\)
- \(R^2 = 0.9944\)

Upper Chesapeake Bay
Conclusions

• High fertility substrate leads to pulsed macrophyte production

• Oscillations decline over time as the N supply declines

• Silicon amendments may help prevent die-back

• Sustainability – sea-level rise and eutrophication are both important factors
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