Evaluation of Marsh Restoration Progress at Blackwater National Wildlife Reserve

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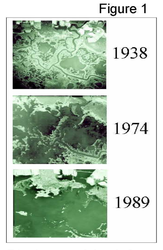
Problem

- Blackwater Refuge has lost nearly 8,000 acres of tidal wetlands since 1933.
- The USFWS and the Army Corps of Engineers are developing a large project to use dredged material from Baltimore Harbor to restore 11,000 acres of tidal marsh at Blackwater.
- This study was designed to evaluate the progress and potential for success of these restored areas by comparing a plot restored in 2003 to a non-restored reference site.

Figure 1



Blackwater Marsh Loss
(credit: USFWS)

Four variables control marsh elevation:

Sedimentation ↑ Organic accumulation

Compaction ↓ Sea-level rise

- Local Sea-level rise = 3mm/year (Hoffman et al., 1998)
- Compaction only significant over long periods of time

Sedimentation and Organic accumulation pivotal to the sustainability of marshes

Hypotheses

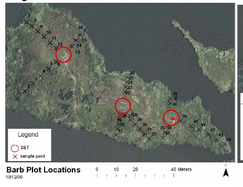
- Blackwater marsh accumulation rates have dropped below sea-level rise rates due to both low net biomass accumulation and low sedimentation rates.
- Restored sites have higher plant productivity and more efficient trapping of sediment than non-restored sites.

Approach

Core samples were taken at both plots and analyzed for bulk density and organic carbon, by depth. Recent accumulation and erosion was estimated by the use of marker beds; a feldspar bed was laid down at all of the sample points and was used to measure recent accumulation, and the layer of sediment deposited during the restoration event in 2003 was used as a longer period indicator at the restored site.

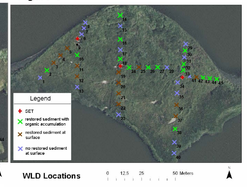
Study Sites

Figure 2



Natural Marsh

Figure 3



2003 Restored Marsh

Methods

- A peat auger was used to take 1m cores at 83 different points throughout the two sites (figure 2 and 3). Each core was divided in to horizons.
- Bulk Density and organic carbon (by high temperature combustion) were found for each horizon.
- A rectangular plot of feldspar was placed at each sample point 3 months before sampling.
- The layer of restoration sediment was identified by bulk density in cores from the restored marsh, and used as a known time (May 2003) to estimate accumulation rates.

Figure 4

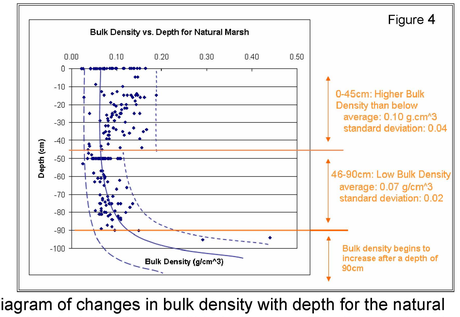


Diagram of changes in bulk density with depth for the natural marsh, which has been split in to 3 zones. The time scale is too short for compaction to explain these anomalies, which implies a flux in sedimentation.

Figure 5

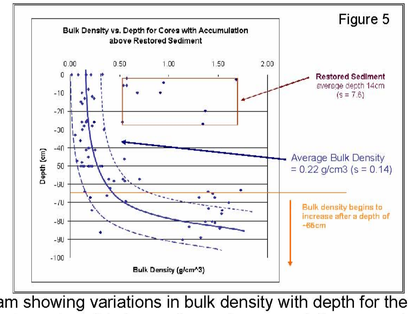


Diagram showing variations in bulk density with depth for the restored marsh. A thin layer of organic accumulation present atop higher density restoration materials. Average bulk density higher than that of the natural marsh and increases after 65cm.

- Turbidity maximum is the point in an estuary at which the sediment concentration and turbidity is greatest and thus points further seaward have much less sediment fallout.
- Turbidity maximum moves up-stream as sea-level rises
- Past events of higher sedimentation could be due to the location of turbidity maximum once being closer to Blackwater.
- If sedimentation is the main control of marsh elevation at Blackwater, restorations can never be successful.

Figure 7

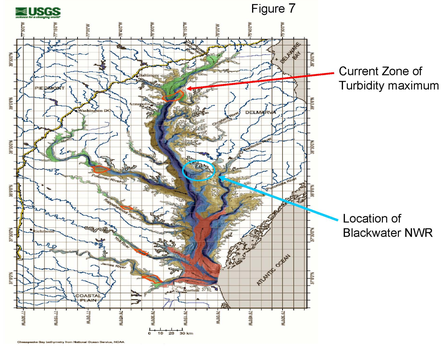
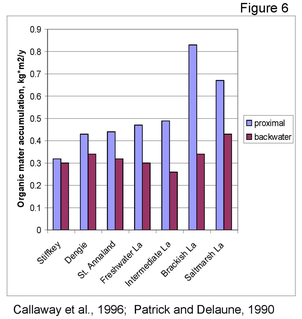


Figure 6

Previous studies show higher accumulation rates in proximal sites. At Blackwater, interior sites tend to have higher accumulation whereas proximal site tend to have no accumulation and indications of large non-deposition of erosion events (see figure 3)



Callaway et al., 1996; Patrick and Delaune, 1990

Conclusions

- Data suggests Blackwater marsh accumulation rates have dropped below sea-level rise rates due to recent low sedimentation rates.
- Data suggests restored sites do not have higher plant productivity and is no more efficient at trapping of sediment than non-restored sites.