Comparing Chemical Properties of Subaqueous Soil Samples from Barnegat Bay, NJ: An Analysis of Carbon, Nitrogen, and Phosphorus

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Introduction

Subaqueous soil science is considered the new subfield of Pedology. This recently developed idea defines subaqueous soils as sediments in shallow water environments (<2.5m) that undergo soil-forming processes, are capable of supporting rooted plants, and exhibit pedogenic formation.[1] With the assistance of soil scientists from the USDA-NRCS, soil cores were extracted for a subaqueous soil survey in Barnegat Bay (Figure 1) and split open for description. Soil cores were taken via the Vibracore method (Figure 2) for each soils series present in the bay. Soil series are similar to families of soil with common profile properties and horizons. The soil series used from this survey in Barnegat Bay (Table 1) were distinguished by changes in landform type and water depth (Figure 3). Subsamples from each horizon from each core were collected and analyzed for total carbon, total nitrogen, and available phosphorus. This study aims to determine if there is a significant difference in chemical properties among soil series found in Barnegat Bay.

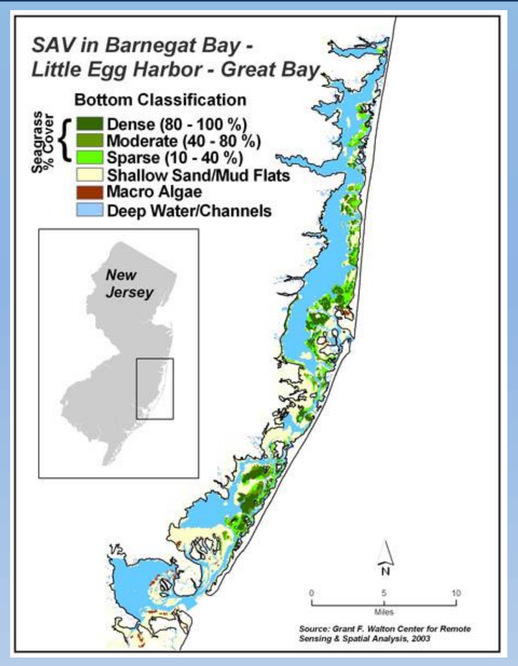

Figure 1. Barnegat Bay location.

Figure 2. Vibracoring setup.

Methods

- Sampling – Vibracore method (cement mixer vibrating 3 inch diameter aluminum pipes)
- Carbon and Nitrogen – Dumas Method, CHNS Elemental Analyzer
- Phosphorus Extraction – Bray I Method, Extracting solution: 1N ammonium fluoride with 0.5N hydrochloric acid, Color reagent: Ascorbic acid-molybdate solution, UV Vis λ = 882 nm
- Statistical Analysis – One way ANOVA in Minitab, Tukey mean separation at 95% CI

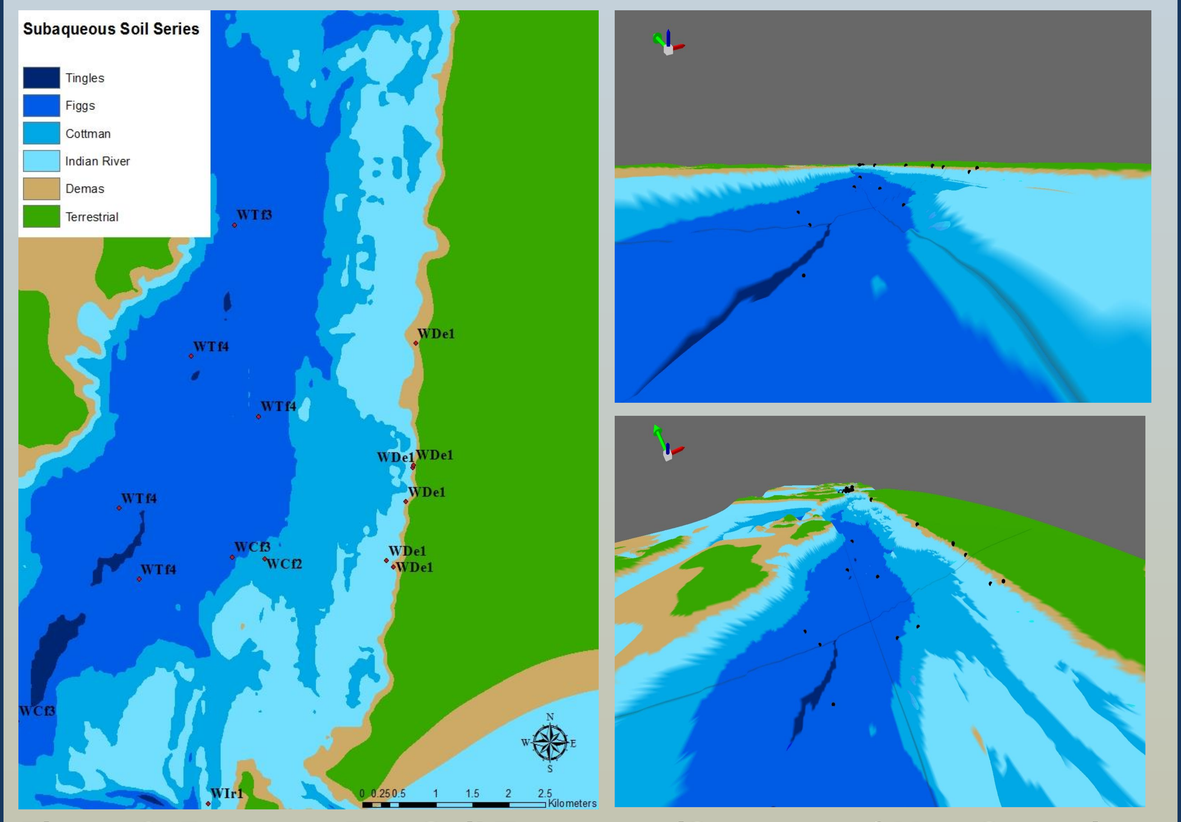

Figure 3. Barnegat Bay Soil Transects (Courtesy of Matt Cowen).

Table 1. Soil series identified in Barnegat Bay soil survey

Series	Landform Type
Cottman	Lagoon bottom (barrier side)
Demas	Washover-fan flats
Figgs	Lagoon bottoms, mainland coves
Indian River	Flood-tidal delta flats

Significance

Due to the economic importance of Barnegat Bay and other similar ecosystems, strategizing management options could be the key to improving the health of the bay. By surveying the subaqueous soils, soil scientists can provide insight for the management of submerged aquatic vegetation restoration and estuarine protection.

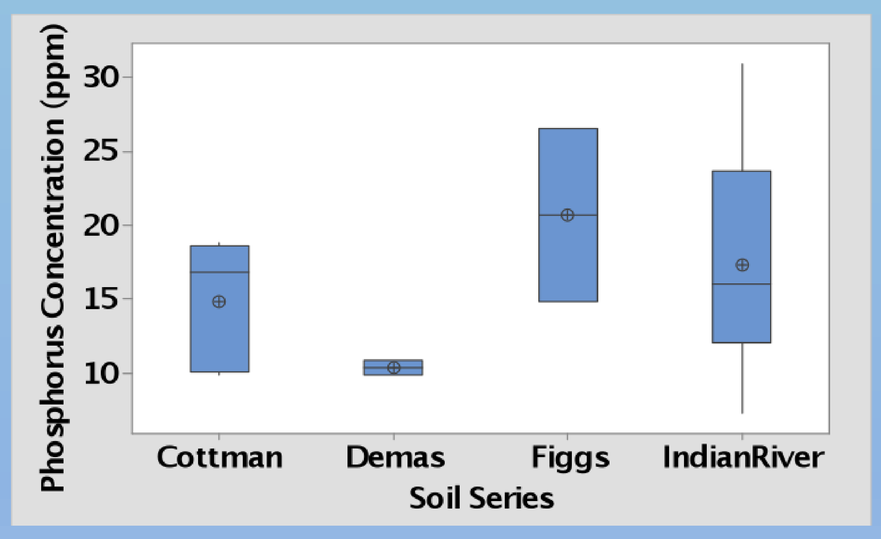

Figure 4. Extractable P for each soil series (p=0.332).

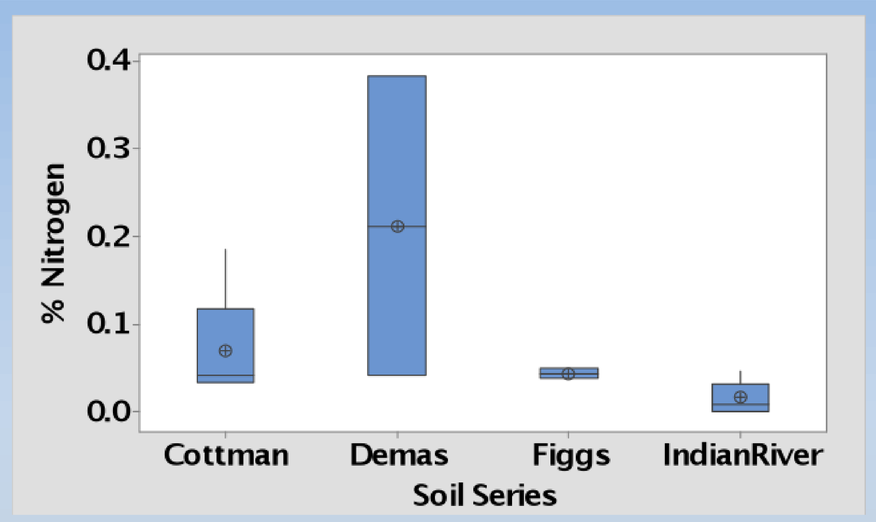

Figure 5. Total N for each soil series (p=0.002).

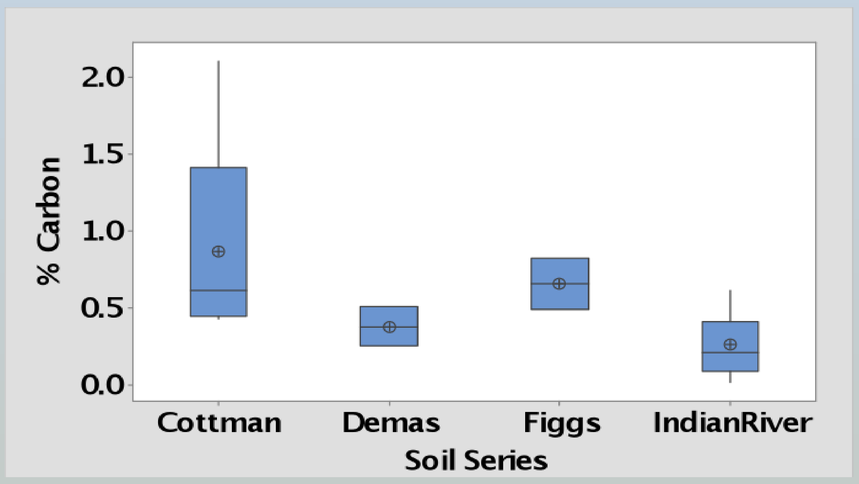

Figure 6. Total C for each soil series (p=0.015).

Conclusions.

- The soil series were not significantly different with respect to phosphorus concentration.
  - Extractable phosphorus seemed to follow trends in amount of clay present
  - The Demas cores consisted of almost exclusively sandy horizons
  - The Figgs cores had many more loam horizons
- The Demas series had significantly higher nitrogen levels (0.212 ± 0.242% N), whereas the Indian River series had significantly lower nitrogen levels (0.01616% ± .01698% N) compared to the other series.
  - Most samples were too close to the IDL. If run again, different results would be expected.
- The Cottman series had significantly higher carbon levels (0.869% ± .702% C), whereas the Indian River series had significantly lower carbon levels (0.2593% ± .1883% C)
  - Former subaqueous soils and cores extracted in deeper water depths/portions of Barnegat Bay have exhibited potentials for higher carbon and clay contents
- Future studies should be continued, collecting additional cores for maximized representation and distribution of sample data.

References

[1]Demas, G.P. and M.C. Rabenhorst. 1999. Subaqueous soils: Pedogenesis in a submersed environment. Soil Science Society of America Journal. 63(5):1250-1257.
[2]Demas, G.P. and M.C. Rabenhorst. 2001. Factors of subaqueous soil formation: a system of quantitative pedology for submersed environments. Geoderma. 102(2001):189-204.
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