Characterization of Mangrove Peat from Southwest Florida

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INTRODUCTION

The restoration of mangrove forests is an increasingly important management issue in Southwest Florida because of rapid urban development. Restoration of these mangroves is important for estuary health. Rookery Bay National Estuarine Research Reserve (RBNERR) has been the pioneer of mangrove restoration in the area. This study is the preliminary approach to examining mangrove peat as a factor of restoration function of these forests. Peat is partly decayed unconsolidated plant matter with high moisture content. The overall objective of this study is to characterize the peat in restored forests and to compare it to that in natural areas. Variables examined will be bulk density, organic content, and water content all with respect to depth, as the influence of substrate on restoration.

METHODS

Cores were taken at Windstar, Henderson Creek, and Faka-Union Canal. The forests were characterized by mapping and measuring diameter at breast height (DBH) of trees in that area. Approximately 5cc samples were taken every 5cm from each core. Samples were at 60 degrees C for 24 hours. Organic content was calculated by loss on ignition.

STUDY SITES

Henderson Creek: This site was located within the RBNERR along Henderson Creek. In 1972, the area was destroyed when a pond was excavated and dredged material was deposited. In 1992, the area was cleared, flushing cuts were dug, fill was removed, and trees were planted. Immediately adjacent to the restored site is a natural, undisturbed mixed mangrove forest, which has been used as a control for the monitoring of the mitigation project. Based on historical aerial photographs

Windstar: This golf course and multi-family community is located in South Naples on the east shore of Naples Bay. In August 1982, restoration began on land that was covered with fill as a result of dredging the channel in the bay. A reference site of estimated age >50 years, was established in a natural mangrove forest adjacent to the restored site. The area is thought to have been undisturbed for at least 60 years.

Faka-Union: Two other sites were examined as references. The first was an old-growth forest of more than 50 years and the second was termed "transgressive" as it had developed from salt marsh to white mangrove forest about 10 years ago.

FIELD OBSERVATIONS

Henderson Creek-Natural Site (A): The site was a mature, mixed forest of black, red, and white mangroves. There was approximately a 17 m canopy. The density of trees in the area was not very high. DBH ranged from 1.27-28.66 with an average of 6.71 cm. The largest trees were white mangroves.

Henderson-Creek Restored Site (B): One core was taken above the fill and one was taken in a flushing cut, in order to access the material below the fill. The ground was very wet, black organic material with very little peat. The trees were much denser here than the control site and dominated by whites. The few reds were either small or medium. The canopy was 12 m.

Windstar-Natural Site (C): This area was less dense than Site A. The dominant species was red then black, and then white. Based on size, the blacks were older than the reds. The canopy was approximately 6 m.

Windstar-Restored Site (D): The area was so dense it was impossible to count the trees individually. There were an estimated 75 percent white, 22 percent red, and 3 percent black. The canopy was 2.44 m.

Faka-Union Old Growth Site (E): The trees were large and scattered. The area was not as open as Site C. The trees were whites with red seedlings scattered throughout. The canopy was 10 m high.

Faka-Union Transgressive Site (F): This area was very open with no trees within a 1m radius of the core. There were fewer red seedlings and the whites were not as large as Site E. The canopy was 6.7m.

LAB RESULTS AND DISCUSSION (Figure 2)

Organic Content: My original hypothesis was that organic content would increase with depth because roots are the principal contributors of organic material. Also, since these wetlands produce a reducing environment, the deepest material would be less susceptible to decomposition because it has very little interaction with the air. This was the case with Sites A, C, and D. Sites B, E, and F showed a decrease with depth. A decrease could indicate that the deepest material is the oldest and would have the longest time to decompose.

Bulk Density: It was expected that bulk density would increase with depth since the deepest material is subject to the most compaction, particularly with respect to the restored areas where fill is placed on top of the peat. Site D was expected to exhibit a higher bulk density, because of the dredged material on top of peat. However, a general decline in bulk density begins at about 15 cm and continues to the end of the core. This is not consistent with field observations, which found the last 50 cm to be very compacted peat. Sites D, E, and F showed a decrease in bulk density, while Sites A, B, C showed an increase with depth.

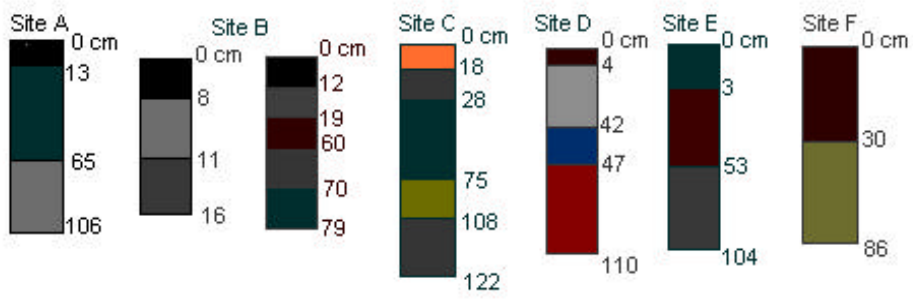
Water Content: All sites but Site C showed a decrease in water content with depth. Site C showed an increase right near the bottom of the core. This decrease in pore water was expected since as the peat gets deeper and more compacted, there is less room for water.

IMPLICATIONS OF RESTORATION SITE RESULTS

Site C behaves quite differently from the other sites in all measurements. It had a much lower canopy than Site B (2.44 m v 12 m), and Site C is 10 years older than Site B. It appears that the restoration at Windstar has affected tree growth and peat characteristics. Conversely, Site B behaved consistently with my original hypotheses and with respect to its reference forest.

It is not possible to make definitive conclusions, but preliminary ones can be made. Restoration can affect the natural properties of the forest, like Site C, but does not have to, like Site B. Another conclusion is that substrate does influence growth. Previous experimental results have shown that substrate is not the limiting factor for effective restoration. However, the core from Site B showed the roots were growing across the fill rather than penetrating it. Site C was also subject to dredged material and it showed very different characteristics than the reference forests, possibly because of the dredged material.

Figure 1: Representations of cores with descriptions



Core Descriptions

Site A: 106 cm long with 0 cm of compaction.

0-13 cm: moist and very dark black with fibrous root hairs and rootlets, leaf at 10 cm.

13-65 cm: dark gray with reddish tint characterized by root hairs and roots; large roots at 20 cm, 30 cm, 40 cm and 60 cm.

65-106 cm: black to very dark gray with root hairs and smaller roots; living root at 70 cm

**There are two Site Bs because there two cores were taken as it was impossible to core through fill. The cores were added together in order to simulate approximately one meter of core

Site B: 16 cm long with 1.5 cm of compaction.

0-8 cm: very black, "sludgy,"wet soil with root hairs, leaf litter, and pieces of shell

8-11 cm: dark gray transitional section between organic layer on top and sandier fill layer; articulated clam and root holes with black haloes

11-16 cm: dark gray fill layer with hard, cement like chunks; clasts as large as 3 cm; very few rootlets and one dead root.

Site B: 79.75 cm long with 0 cm of compaction.

0-12: pneumatophores, mussels, live roots, and root hairs; roots were growing sideways on top of the fill; black in color on top grading to a lighter black or dark gray with the transition to fill.

12-19 cm: gray-brown sand with small shell pieces and very few roots; distinctive top and bottom boundaries for this package.

19-60: reddish-black section with rootlets, root hairs, and a few large dead roots as well as a few medium dead roots; linear, compacted sand-filled burrow at 50 cm.

60-70: dark gray with red tints; sandier than the section above; three burrows and four or five dead roots.

70-79**:** very dark gray and sandy with no roots or rootlets; mottled, swirly appearance of dark brown and gray.

From 19 cm to the end of the core the organic rich material is very firm in comparison to the first 12 cm and to core 9906-3. In this more compacted peat there is a visible planar fabric.

Site C: 122 cm long and had 4 cm of compaction.

0-18 cm: good root fiber at the top with many live roots, rootlets, and root hairs; vertical roots in this section

18-28 cm: grayish black, silty sediment layer with only root hairs and no roots or rootlets.

28-75 cm: similar to the first 18 cm of core; black, fibrous, and organic rich with live roots, rootlets, and root hairs.

75-108 cm: less organic material than everything above; much sandier and mottled gray and black; some live roots but not as many as in the sections above.

108-122 cm: dark gray, sandy with sparse root fiber and a small amount of organic material.

Site D: 110 cm in length with 7 cm of compaction.

0-4 cm: organic rich, black peat with some live roots and leaves.

4-42 cm: light gray and sandy with a decrease in organic material with depth; thin 1mm thick shell layers, at 20 cm, 28 cm, 30 cm, 35 cm, 40 cm, and 41 cm; minimal roots, root hairs, and rootlets. some darker organic patches and the roots were ringed with dark halos at 29 cm.

42-47 cm: thin varve-like laminations of white, black, gray mud alternating with silty clay.

47-110 cm: very compacted peat, similar to Henderson Creek-Restored; thick root hair mat at 50 cm; reddish brown to black getting increasing darker towards the bottom of the core; roots, rootlets, and root hairs

Site E: 104 cm long with 7 cm of compaction.

0-3 cm: black and mushy, organic sludge with decaying leaves.

3-53 cm: very soft, dark reddish brown with rootlets, root hairs, and roots; roots were not very large about 1-2 cm.

53-104 cm: moist, but not as wet as the upper sections; dark and light sand lenses throughout; mottled with sand and organics; few roots and some rootlets. Towards the bottom of the core there from 70 cm to the end, there were no roots present.

Site F: 86 cm with 13 cm of compaction.

0-30 cm: brownish black, very moist with many roots and root hairs.

30-86 cm: mostly sand mottled with organics to bottom; roots and darker mottles decrease with depth; no more roots after 52 cm.

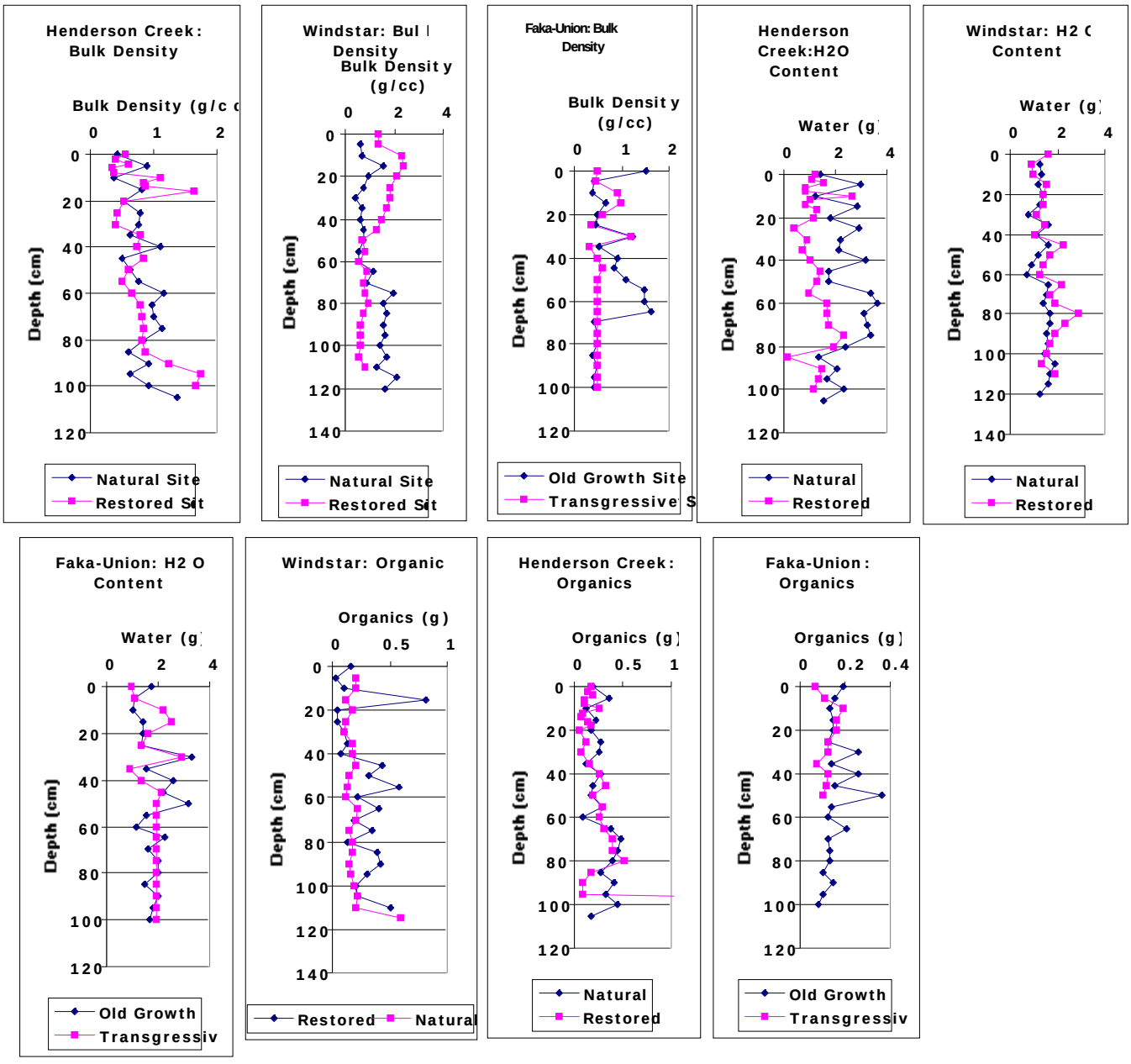


Figure 2: Graphs for all sites depth versus bulk density, water content, and organics.