Surficial Geology of the Big Cypress National Preserve

Currently, there is a permit pending to conduct 3-D seismic surveying in the Big Cypress National Preserve (BCNP) utilizing vibroseis machines. Recently, comments have been made that the vibroseis machines used in this surveying process could potentially crack or fracture the karst limestone leading to changes in the perched hydrology and impacting wetland hydroperiods in the BCNP.

Vibroseis

To better understand how vibroseis machines affect the surrounding environment, specifically the karst terrain found in the BCNP, a review of the vibroseis technology and surficial geology of the BCNP is essential. Seismic surveying, utilizing a vibroseis energy source, is a non-intrusive technique that consists of vibrating a steel pad (approximately 4.5 feet by 7.5 feet) that is maintained in contact with land surface from a buggy-type vehicle with a total weight of approximately 62,000 pounds, thereby, generating a series of ground vibrations. Modern vibrator electronics provide force control on the metal pad resulting in consistent ground contact and minimizing surface disturbance and compaction. Duration and frequency of buggy vibrations range from a few seconds to several minutes and up to 120 hertz, respectively.

Geology

First, it is important to note that the BCNP is one of the lowest, youngest, and most geologically stable geologic platforms in North America, and it has been repeatedly submerged and exposed by the rising and falling sea level over the past 50,000 years. Beneath the surface of the BCNP are roughly thousands of feet of horizontal layers of rock that are all rich in carbonate minerals that have been exposed to terrestrial weathering since the last significant interglacial flooding 130,000 years ago. Compared to the Everglades, the BCNP is slightly higher in elevation, because this area is primarily underlain by the Pliocene Tamiami Formation, a coral-rich limestone that is exposed in large areas of the preserve. The primary geologic units that are exposed at land surface within the preserve include the Tamiami Formation (consisting of carbonate and siliciclastic layers) and the Miami Limestone (consisting of oolitic and bryozoan facies).

Carbonate minerals dissolve easily in rainwater and groundwater made acidic by decaying natural organic materials, which is made easier in the dry season when water levels are lower and physical, chemical and biological processes increase the rate of decomposition of organic matter, and thus increases the concentrations of organic matter within the remaining surface waters. Once the carbonate minerals have

Geologic Features of the BCNP

Sloughs are extensive, meandering marshy areas that form where the surface of the ground coincides with a shallow water table.

Strands are elongated bands of cypress trees that form where high water level and sufficient flow result in a channel along a depression.

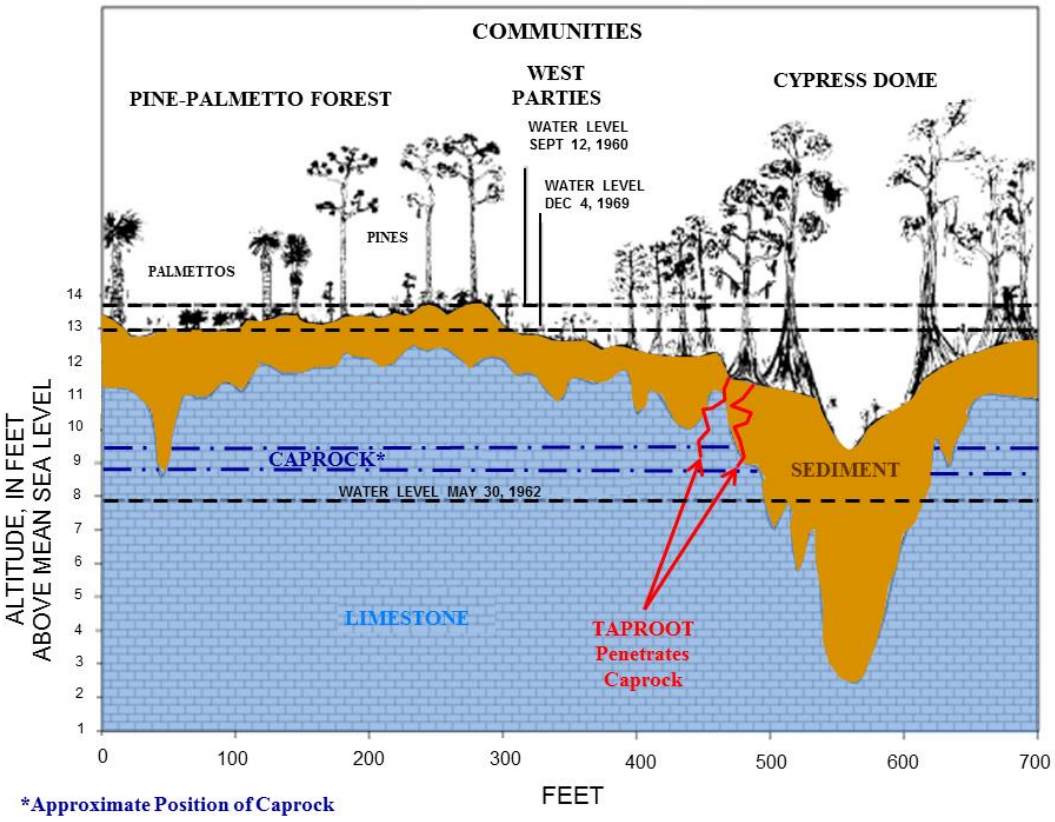
Domes are relatively small areas of swamp dominated by bald cypress trees, characterized by having configurations that consist of larger trees growing in the center of the area with progressively shorter trees growing towards the edges. Domes tend to coincide with dissolution and collapse of near-surface limestone caprock, creating the subsurface karst landscape.

dissolved, gaps and spaces are left behind in the subsurface, resulting in a karst landscape defined by sinkholes, solution holes, disappearing streams and springs.

In some areas of the preserve, a cap rock overlies the near-surface limestone, thereby controlling surface water flow and infiltration into the groundwater. Instead of the occurrence of typical alluvial flow patterns, surface water in the preserve flows around cypress tree strands, domes, and through extensive meandering sloughs. Within the NGA, bald cypress domes are ubiquitous in association with water-filled depressions where the caprock is absent. Sloughs, swamps, and marshes are ubiquitous in the BCNP because of the minimal relief in the BCNP (approximately 2 inches/mile). Soils in the BCNP are usually sand or marl and thinner than in the Everglades. In the Noble Glades, the soils are also poorly developed and characterized as caprock, marl soil, organic soil or peat, and sandy soils.

At least three aquifers, separated by aquitards, underlie the BCNP. The hydrogeology of the BCNP is typical of Southwest Florida and generally characterized by permeable soils and fine sediments in depressions. The water table is generally at or near land surface throughout the NGA. The upper three aquifers consist of shells, sand, and limestone with high hydraulic conductivities. These aquifers separated by aquitards include the water table aquifer and the Tamiami, Sandstone and Hawthorn aquifers. The underlying 500-foot sedimentary sequence consisting of alternating shelly sand, shell beds, and shelly limestone is unconsolidated to moderately indurated. These aquifers are predominantly recharged by the surface waters within the preserve.

Summary



Now, how does all of this relate to concerns that 3-D seismic surveying will be harmful to the perched hydrological environment of the BCNP? The surface flow of water through the BCNP, which is evident throughout the rainy season, is developed in part through the recharging of the groundwater aquifer, having been replenished by rainfall and offsite flows, rising to the surface and gradually flowing south. The fact that, for long periods during the year, the water level is above ground level in much of the swamp areas and the abundant presence of sloughs in the BCNP indicates that the water table intersects with the ground surface. The hydrogeology of the BCNP does not include low permeability units within the water

table aquifer, with the exception of the cap rock, which is not a continuous feature. Due to the high permeability of soils and discontinuity of the cap rock, rapid infiltration of water from the surface occurs. In addition, the water table is typically at or very near land surface minimizing the potential existence of a perched water table. If a perched water table exists in this environment, it will be an uncommon and localized condition.

Hence, we can conclude that because the sediments in the BCNP are unconsolidated to moderately indurated and the surface exhibits extensive dissolution features, vibroseis machines will not cause additional surface drainage to occur or affect the wetland hydroperiod within BCNP.

Past vibroseis seismic survey studies indicate that the major environmental impacts are associated with land surface rutting caused by the buggy's tires, which can potentially lead to erosion. This is typically overcome by avoiding areas of saturated soils during the wet season. Shrubs and grasses can be potentially disturbed under the weight of the vehicles; however, root masses are not permanently damaged and re-growth can be expected. **Because the vibroseis seismic surveying technique is not intrusive beyond temporarily affecting near-surface features and soils, it should not adversely affect the associated hydrology and flow system of the BCNP.**

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