# USING HYDROSTRATIGRAPHIC CORRELATION OF SOIL CORES TO UNDERSTAND EPHEMERAL HYDROLOGY OF RIDGETOP WETLANDS

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Daniel Boone National Forest spans more than 635,000 acres in the Appalachian foothills of eastern Kentucky, yet it contains only 33 known natural ephemeral ridgetop wetlands. These remote ridgetop wetlands are important ecosystems that provide spawning grounds for a variety of amphibians and water for surrounding vegetation. These wetland systems can hold a very large amount of water in both an above ground pool and an underground aquifer. However, little is known about how they form, how water moves through the system, or why they dry out during the summer time.

In this research, we mapped the subsurface using a backpack drill and percussion coring methods to understand the geometry of the groundwater body and to examine geologic factors that control these wetlands. Soil cores were taken along a transect of the wetland in order to track how the soil layers changed throughout the transect. Soil layers were determined both from examining the cores as well as counting the hammer blows as we drilled the core. In order to count the hammer blows, we counted how many strikes powered by the consistent force of gravity it took for the drill to be driven four inches into the ground. Thus the number of hammer blows can be used as a measurement of the density of the soil. Each core was surveyed in order to find its exact position and elevation, then the depth of the boundaries for each soil layer were found and plotted on the datum. Both the bedrock topography and the impermeable clay layer geometry were then examined to see its effect on the interaction between the groundwater and the surface water throughout the system.

The cores exhibited gradual boundaries due to the fact that the density of the soil increased incrementally and because the layers moved from silt loam, to clay, and to saprolitic soil without a sharp change. Because the soil appears to be derived from the bedrock and not material from an outside location we consider this a residual soil meaning it formed in place. The presence of residual soil points to these wetlands occurring when the residual soils derive from fine-grained silty-mudrocks (shale or mudstone) that have weathered into an impermeable clay layer capping the ridges in particular locations. The locations of these wetlands appear to be associated with a bedrock depression that is overlain by a low-permeable shale that has weathered into clay which is not common among most Appalachian ridges. Most ridges have a very thin soil layer derived from sandstone. In fact, the soil in the wetlands is on average twice as deep as the soil on the ridges without wetlands. The ridges without a wetland on them also have much more rocky soil without a clay layer. All of this points to a geologic origin of these wetlands as opposed to anthropogenic or surficial processes like tree fall.

Groundwater and surface water accumulate in the more permeable silt loam that developed above the weathered clay material found in the wetlands. Water level data and cross-sections show that summer rainfall recharges the groundwater and surface water differently depending on antecedent conditions. Given slow rainfall and saturated soil, the groundwater will recharge with negligible changes to the surface water. However during long droughts or high rainfall, the surface water will rise with negligible changes to the groundwater. All of this water likely leaks to the lowlands to recharge groundwater springs and streams during the springtime. The system becomes more localized during the summer time allowing the trees to drain the groundwater through transpiration during the summer droughts which causes the ephemeral crash that defines these wetlands.