Assessing the Periodic Groundwater Flow Conditions of a Perched Aquifer System in the Daniel Boone National Forest

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Natural ephemeral wetlands situated among the ridgetops in the Daniel Boone National Forest serve as reservoirs that recharge a shallow groundwater system. Unique interactions between surface and groundwater in these isolated systems provide substantial support for the native ecosystem, serving as a breeding ground for amphibians and as source water for vegetation—especially in periods of drought. Currently it is not understood how groundwater could provide regional biodiversity, a drought buffer, or a crucial role in biogeochemical cycling. It was the goal of this research project to define the seasonal controls of groundwater levels within the aquifer system. This was accomplished by:

1.) Monitoring groundwater and surface water in a representative wetland in the Daniel Boone National Forest, Kentucky.
2.) Quantifying the physical properties of the aquifer and groundwater evapotranspiration rate.
3.) Numerically modeling the groundwater recharge rate required to sustain groundwater levels by analytic element method.

Monitoring and aquifer tests were conducted in the summer of 2016 and 2017. All data gathered in the field was introduced into a computer model to simulate the groundwater processes. The results of our research indicate that groundwater stored within hillslopes acts as a reserve for the surface water during the winter months and contributes further support for the ecosystem. In the dynamic transition from winter to summer months, vegetative water use intensifies during leaf-out (~0.002-0.005 m/d) and eventually overcomes the groundwater recharge rate (0.0017-0.003 m/d), which can completely desiccate the system. Periodic storm events inundate the wetland, recharging both the surface and groundwater. These sub-seasonal storm events maintain groundwater levels for up to 20 days, before vegetation depletes the stored water.