Perched groundwater-wetland systems on ridge tops of the Appalachian Plateau, Daniel Boone National Forest, Kentucky
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Introduction
Ephemeral wetlands on Appalachian ridge tops in the Daniel Boone National Forest, Kentucky are hydrologically connected to shallow perched groundwater. Although these perched groundwater-wetland systems have been shown to support native vegetation and amphibians, the physical controls and hydrologic connectivity are rarely studied due to geographic isolation and sparse occurrence. In this research we determined the hydrologic connectivity of a perched groundwater-wetland system in Daniel Boone National Forest by (1) Mapping wetland morphology, (2) Monitoring groundwater and surface water, and (3) Quantifying groundwater inputs and outputs.

Groundwater Surface Water Interaction

Water Budget

Conclusions and Future Research

Acknowledgements

References

Figure 1: Ephemeral wetland (97°FN) in June 2016. By the time of year many of the ridge top wetlands dry.

Figure 2: Map of Kentucky with ridge top wetlands from this study marked as stars.

Figure 3: Ephemeral wetland (HEW) in January 2017. By this time heavy rains recharge the area and standing water returns.

Figure 4: Schematic of Darcy’s Law.

Figure 5: (A) 30 minute interval water level measurements taken with pressure transducers from standing water and groundwater for the DC2 wetland. Time period is May-October 2016. (B) Elevation map of the DC2 wetland. Blue contour lines indicate the standing water area for water levels 368.16 m and 368 m. Wells are located as black dots in Figure 5B. Well 1 is located in the wetland depression and Well 2 is developed upslope. Surface water has a higher head than groundwater indicating flow from wetland to groundwater (Figure 5A). • Surface water has a higher head than groundwater indicating flow from wetland to groundwater (Figure 5A). • Rainstorms recharge wetland quickly, with a short head reversal during heavy rain (Figure 5A). • Wetland initially dries out during a drought in June. Heavy July-August rain recharge the wetland before drought in October (Figure 5A). • Rate of head decline during drought increases as wetland dries to 368 m (Figure 5B).

Methods

Mapping wetland watersheds:
The surface geomorphology of wetland watersheds were mapped using an accurate GPS and optical transit (Figure Below). Points were imported into GIS software and interpolated to create a surface (Figure Right).

Water Level Monitoring and Measuring Physical Characteristics:
Wells were installed within wetland pools and in watershed uplands (Figure left). Water levels were measured with a water sounder or pressure transducers. Hydraulic conductivity was calculated with the Bouwer-Rice slug test method.

Water Budget for Groundwater:
Surface maps, monitoring data, and lab analyses were brought together in order to quantify groundwater inputs and outputs. During times of drought the main groundwater input was due to infiltration from wetland basins, while the main groundwater outputs were due to leakage and evapotranspiration.

Water Budget Inputs:
Groundwater inputs were determined using Darcy’s Law. Where Q = the volume of groundwater flow, K = hydraulic conductivity, dh/dt = the hydraulic gradient, and A = the standing water area of the wetland (Figure 4).

Water Budget Outputs:
- ETg = Evapotranspiration.
- Leakage = the volume of water lost from the wetland through leakage.
- Infiltration = the volume of water recharged from pool to groundwater.

Q = -KAΔh/dt

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Water Budget:

Figures 6-8 show the main groundwater input and output areas for the DC2 wetland. The main groundwater output was due to evapotranspiration (ETg). ETg was measured using the White (1932) method. Where Sy = the specific yield of the soil, Δs = change in groundwater storage, and Δt = time, and R = the recharge.

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