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ABSTRACT TITLE: Hydrological response of an upland oak/pine forest on the Atlantic Coastal Plain to drought and disturbance

ABSTRACT: During 2005-2011, sap flux measurements were used to quantify transpiration, eddy covariance was used to quantify evapotranspiration, and a local water balance was derived though stream discharge data from the USGS. The forest experienced defoliation by Gypsy moth (*Lymantria dispar* L.) in 2007, a partial defoliation in 2008 and drought conditions in 2006 and more severely in 2010.

From 2005-2011, annual canopy tree transpiration (E_C) averaged 201 mm $a^{-1} \pm 47$ mm a^{-1}. In this forest, E_C was reduced by 20% in 2007 when a defoliation event occurred compared to the seven-year mean from 2005-2011. Likewise during drought years in 2006 and 2010, stand transpiration was reduced by 8% in the month of July in 2006 and by 18% in 2010 compared to the seven-year mean for July. During the month of July in 2007 after the defoliation and subsequent re-flushing of leaves, E_C was reduced by 25%, even though only half of the leaf area re-flushed. Therefore, prolonged drought had a lesser effect on E_C as reduced foliage or episodic defoliation suggesting access to deeper soil moisture. Alternatively, this stand may experience higher sensitivity to drought because of the history of prior defoliation as seen in the higher reduction of E_C in 2010 compared to 2006.

Stream water discharge scaled to the watershed area showed greatest correlation with transpiration in a 24-day and a 219-day time lag, signifying hydrological connectivity on the watershed scale. The stream and transpiration undergo similar fluctuations coinciding with leaf on and leaf off conditions accounting for the capacity of the system. Thus, any changes in transpiration or precipitation will also alter stream water discharge and therefore water availability. Under future climate change, frequency and intensity of precipitation and episodic defoliation events may alter local water balance components in this upland oak/pine forest.