THE JONES CENTER AT ICHAUWAY

Publication Brief

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Excluding Prescribed Fire Affects the Water Budget of Longleaf Pine Stands

Measuring forest evapotranspiration (ET) is important because it informs us of how much water forests use and gives us insight into other forest processes, such as productivity. It also tells us how much water from rainfall will be left over to feed streams or recharge groundwater, an important consideration for watershed managers. Forest thinning and prescribed fire have been used in some areas as management tools to reduce ET and increase water yield, but the results of these actions have been mixed. We knew that prescribed fire changes forest structure, but we didn't know precisely how these structural changes affected transpiration and evaporation from different forest canopy layers, and how those changes added up to affect total forest ET.

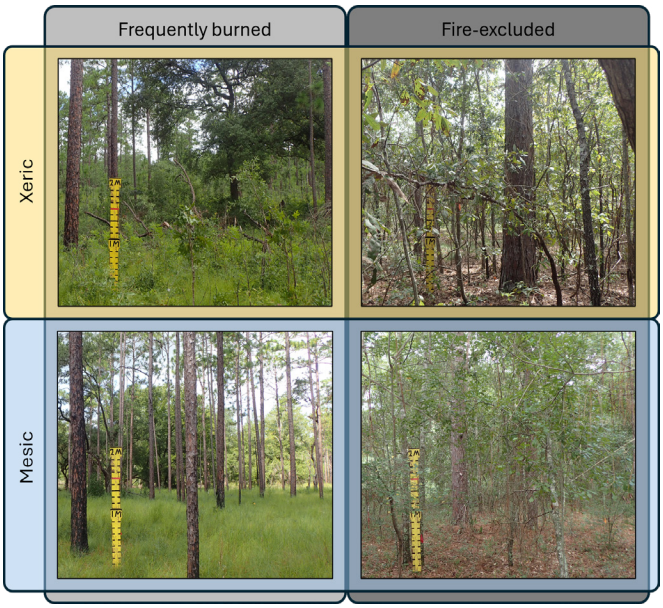

Photo points collected in different sites (mesic, xeric) and different fire regimes show distinct differences in forest structure and composition. Frequently burned plots were burned every 1-2 years for several decades, while fire-excluded plots were excluded from fire for 15-20 years.

To measure ET under different fire regimes, the Ecohydrology Lab at The Jones Center at Ichauway compared stands of longleaf pine which were burned every two years with stands where fire was excluded for 15-20 years. These fire regime treatments were repeated at two sites: one with sandy, dry soils and lower productivity (xeric), and one with finer, more moist soils and higher productivity (mesic). We calculated forest ET for each fire regime and site by breaking the water budget down into its components: transpiration of the overstory, midstory, and groundcover layers, and interception of rainfall by the forest canopy, groundcover, and leaf litter layers.

In fire-excluded stands, midstory leaf area and leaf litter increased, and groundcover vegetation density declined. Compared to frequently burned stands, fire-excluded stands used more water for midstory transpiration and lost more water through rainfall interception by the canopy and litter layers. At the same time, fire-excluded stands lost less water to groundcover interception and transpiration compared to frequently burned stands. At the xeric site, the net balance between these conflicting changes in water use led to lower ET in frequently burned stands. But at the mesic site, the frequently burned stands used more water due to high ET from the dense groundcover layer.

By calculating each component of the forest's water budget, this study provides a better understanding of how prescribed fire affects forest ET in open-canopy pine ecosystems. The study also highlights how important groundcover is in this system. We hope it also serves as a model for other researchers and land managers considering forest management choices that may affect forest structure, ET, and water yield.

MORE INFORMATION

Brantley, S.T., O.S. Stuber, D.L. Holder, R.S. Taylor. 2024. Fire exclusion alters forest evapotranspiration: A comprehensive water budget analysis in longleaf pine woodlands. *Ecological Monographs*. https://doi.org/10.1002/ecm.1623

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KEY POINTS

Excluding fire from stands of longleaf pine for 15-20 years changes forest structure and species composition.

Forest structure and composition changes led to both increases and decreases in water use across different forest canopy layers.

Soil moisture and site productivity can affect whether fire exclusion reduces or increases the water use of a stand.

Groundcover vegetation, though often overlooked in water budget studies, is an important contributor to water use in longleaf pine.