United States Department of Agriculture
Agricultural Research Service

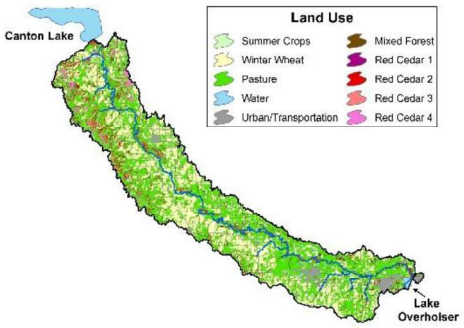
Impact of Eastern Redcedar on Water Resources

Grazinglands Research Laboratory, El Reno, Oklahoma May 2017

Rationale: Eastern redcedar (*Juniperus virginiana*, L.) is an aggressive native woody shrub/tree that has encroached upon millions of acres of grassland in the central and southern Great Plains. It decreases rangeland forage production, and has been implicated in reducing stream flow and groundwater recharge. Little is known concerning the impacts of increasing redcedar density and areal coverage on local and regional water budgets through transpiration (Tr) and canopy interception (CI) of precipitation.

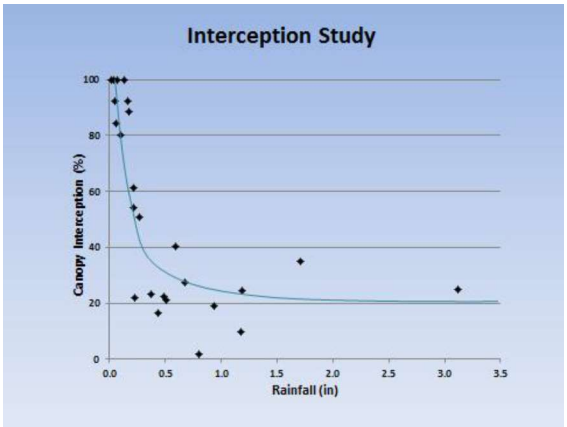
Objective: We had two objectives: 1) measure canopy interception and evapotranspiration of two size classes of redcedars, and 2) use this information along with other data to assess the impact of increasing density and aerial expansion of redcedars on surface runoff.

What we did: We measured both CI and Tr at two locations, for two large and two small redcedars. CI is calculated as: CI = GP – TF – SF. Gross precipitation (GP) is the total amount of precipitation that falls within the vertically projected canopy area of a given redcedar, and was calculated from precipitation measurements and vertically projected canopy area. Tr was measured using sap flux sensors. Both CI and Tr were measured over a two-year period.

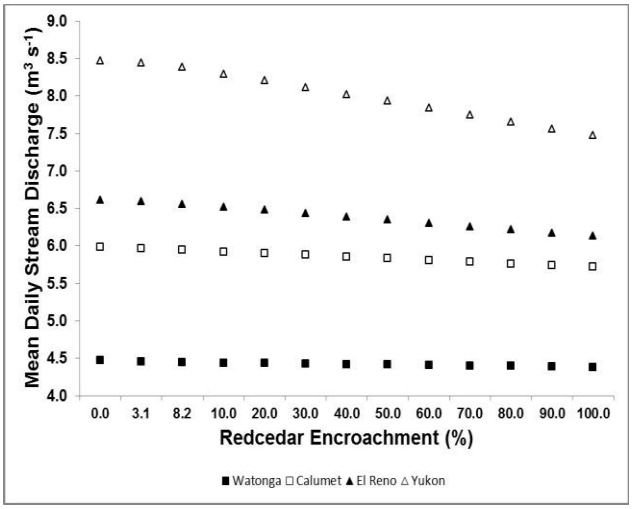


Our measurements of CI and Tr were used in combination with other measurements in the Soil and Water Assessment Tool (SWAT). In this study, we modeled the effects of increasing redcedar coverage and density on the central reach of the North Canadian River basin between Lake Canton and Lake Overholser, located in central Oklahoma. (The North Canadian River supplies about 25% of Oklahoma City's water supply.)

What we found: Redcedar canopies were found to intercept 100% of precipitation for events ≤ 0.09 in (2.4 mm) and 50% of precipitation under about 0.25 in (6.4 mm). Redcedar canopies reduce annual precipitation received at the surface by about 33%, and as much as 39% in the western portion of the state. The amount of water transpired by a given redcedar will be a function of tree size, atmospheric demand, and available soil water. One of the large redcedars in our study transpired 87 gal d^{-1} (331 L d^{-1}) for one day in May 2012, but averaged 35 gal d^{-1} (132 L d^{-1}) over the study period. The smaller redcedars transpired from 0.2 to 0.6 gal d^{-1} (0.8 to 2.2 L d^{-1}). These data imply that CI, coupled with Tr rates as large as or larger than native grasses and with year-round Tr, increases in redcedar density and areal coverage could affect local water resources (e.g. reducing infiltration, runoff, and ground water recharge rates).



To the right you can see the modeled reductions in runoff at four USGS stream gages as a function of increasing redcedar density encroachment. Our simulations suggested that if all grasslands in the central reach of the North Canadian River were replaced by redcedar, the simulated reduction in stream discharge would equal 112% of current municipal water demand and 89% of the projected 2060 demand. However, a more realistic conversion of 20% of grassland to redcedar would, according to our simulations, reduce stream discharge by an amount of water equivalent to ≈ 27% of the current water demand, or ≈ 21% of the projected 2060 demand. Our model simulations suggest that encroachment of redcedar into grasslands could have a detrimental effect on stream discharge, which could impact water availability on populations further downstream.



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