Rainfall Partitioning within Juniper Communities

Final report to the Texas Water Resources Institute

M. Keith Owens
Texas Agricultural Experiment Station
Uvalde Research and Extension Center

Background: Water supply for the Edwards Aquifer is largely from rangelands where Ashe juniper (*Juniperus ashei*) has become the dominant plant. Juniper trees exert both a physiological and physical impact on local water budgets. Physiological impact is through transpirational water loss and physical impact is from rainfall interception and partitioning. Current studies indicate that juniper canopies intercept about 45% of the ambient rainfall, which is then potentially lost through evaporation. Water is also transported via stemflow directly to the base of the tree. It has been suggested that this water is funneled to the root system of the juniper trees, allowing them to survive in a semiarid environment. Recent studies with other trees, such as mesquite, demonstrate that the stemflow actually infiltrates rapidly through root channels and quickly passes through the rooting zone of the tree. The fate of stemflow water is juniper communities is unknown. Data from previous studies on Ashe juniper indicates that nearly 6 gallons of water is funneled to the base of the tree for every 1 inch of rainfall (measured on 20 ft tall trees). In a juniper community of 65% cover, nearly 38,000 gallons of rainfall water per acre is funneled to the base of the tree and is not accounted for in the hydrologic budget. In a simplistic extrapolation to the Edwards Aquifer region (assuming 65% cover over the entire 5400 mile^2 area and uniform precipitation), this could represent as much as 200,000 acre-feet of water per year. Clearly this information would be valuable in a more realistic model of water use and production from the Edwards Aquifer region.

Another basic assumption regarding the interception of rainfall is that this water is lost via evaporation and does not contribute to the local water budget. The scale-like morphology of juniper needles is very efficient in capturing rainfall and holding moisture in the needles. This retained moisture may result in decreased transpiration losses compared to trees which do not retain rainfall. The decreased transpiration may represent a water savings to the plant, leading to an exaggerated estimate of water use by juniper trees.

The overall objective was to quantify water loss due to juniper trees, and specifically to: 1) determine the significance of stemflow water, and 2) of retained canopy water (intercepted rainfall) to the water budget of juniper communities.

Methods:
Objective 1: Four trees were instrumented with heat pulse sap flow sensors at the Kerr Wildlife Management Area, the Honey Creek State Natural Area, and on the Annandale ranch near Concan, TX. Each tree had a Thermal Logic heat pulse sensor placed on the northwest side of the tree and another sensor placed on the southeast side of the tree. The sensors were monitored by a CR10x

datalogger and sap flow was estimated every 30 minutes over a 30 day period. Two of the trees at each site were equipped with a collection device to capture stemflow water and to divert it away from the tree. In this manner, 2 tress were allowed normal stemflow during natural rainfall and 2 trees were deprived of stemflow. The ecological significance of stemflow was estimated by calculating the differences in transpirational water loss between these sets of trees.

In the second trial, four trees at the Kerr site were instrumented with sap flow gauges on a DynaMax system. Two branches on each tree were instrumented and transpirational water loss was calculated on a 15 minute interval. Two of the trees received 5 gallons of water applied directly to the stem while 2 trees served as unwatered controls. A week later, 10 gallons of water was applied to the same trees. Transpirational water loss was estimated prior to any water application and immediately after application to determine the increased water loss resulting from stemflow.