Category I - Hydrology, Climatology and Hydraulics

Plant water use in Owens Valley, California: Understanding the influence of climate and depth to groundwater

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EXECUTIVE SUMMARY:

Owens Valley, California is a closed hydrological basin at the base of the Sierra Nevada Mountains, about 250 miles away from Los Angeles. Since 1913 the Los Angeles Department of Water and Power (LADWP) has been diverting water from the valley, which now provides about 30% of the Los Angeles municipal water supply. Although Owens Valley consists of semi-arid vegetation from the Great Basin and Mojave Deserts, water table depths are generally shallow and are likely to be within reach of plants in many locations. Yet despite a potentially large groundwater source for transpiration, plant growth and leaf area have shown a dependence on interannual variability in climate that may be indicative of limited soil water supplies, nutrient interactions, or effects of atmospheric conditions and humidity on plant gas exchange. While linkages between water table depth and riparian vegetation have been fairly well-studied, there remains a paucity of data on rooting depths, groundwater use, and climate sensitivity of vegetation in semi-arid grasslands and shrublands. This information is critical in order to quantify spatial and temporal patterns in the transpiration component of the local hydrologic budget.

In this study, groundwater use by common plant species in Owens Valley will be evaluated with measurements of the stable isotope composition of groundwater, soil water, and plant stem water at sites of varying water table depth. Groundwater and soil water each have a unique isotopic signature: by measuring the isotopic composition of plant stem water, plant water sources can be quantified. Plant transpiration, gas exchange, and responses to atmospheric vapor pressure deficit will also be measured, as well as plant water potential - a measure of plant water stress. Particular attention will be paid to differences in groundwater access and water stress in grass versus shrub species, as previous studies in Owens Valley have documented a shift in community composition from grasslands to shrublands. Local residents are concerned that groundwater withdrawals for municipal use have lowered water tables and contributed to vegetation change; however, shifts from grasslands to shrublands may be due to a variety of causes including changes in groundwater depth, grazing, past agricultural land use, and climate. Additional data on groundwater use, transpiration, and drought sensitivity of grass versus shrub species are needed to evaluate the possible relationships between water table depth, plant water use, and plant community composition. The results of this study will benefit water and natural resource managers who must balance municipal water needs with California's ecological resources.