Drought, restoration, and evapotranspiration n the Middle Rio Grande riparian corridor, New Mexico.

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Abstract:
The purpose of this research is to investigate ecosystem water budgets and tamarisk invasion in the Middle Rio Grande corridor of New Mexico. Specifically, this study compares water use patterns across a multi-year severe drought in native (cottonwood), non-native (tamarisk and Russian olive), and restored forests. To measure water use by each of these forests, three-dimensional eddy covariance (3SEC) systems were mounted upon towers above the canopy. This is the only method available for directly measuring fluxes of water, energy, and carbon dioxide between terrestrial ecosystems and the atmosphere. Four towers were erected in 1999, located at Bosque del Apache National Wildlife Refuge (NWR) (monospecific tamarisk), Sevilleta NWR (tamarisk-saltgrass mosaic), near the towns of Belen and Rio Communities (native cottonwood forest), and in Albuquerque's south valley (cottonwood forest with tamarisk and Russian olive understory). The non-native understory in Albuquerque's south valley was removed during the winter of 2003-2004. A fifth tower was installed in 2003 over a Russian olive and coyote willow stand at the La Joya State Game Refuge. Drought struck this region in September 2001 and persisted into the winter of 2005, when record snowfall generated three months of spring and summer flooding. Vapor pressure deficit, or the leaf-to-air moisture gradient, increased with drought from 2.35 to 2.55 kPa over the tamarisk stands and from 1.95 to 2.25 kPa over the cottonwood forests. Ecosystem water use was highest in the invaded cottonwood forest (128 +/- 2 cm/yr), intermediate at the monospecific tamarisk, native cottonwood, and Russian olive sites (110 +/- 6), and lowest at the site dominated by tamarisk and saltgrass (79 +/- 4 cm). Crown dieback in cottonwood was observed at a location where the water table was deeper than 3-m, while tamarisk and Russian olive showed no chlorosis. At the site where the non-native understory was removed, a first-year 26% reduction in ET during the following year was measured, but water salvage relative to the unrestored sites was negligible during the second year. Regrowth of cut tamarisk stumps accounted for the transience in ET reduction, implying that efficacy of removal is a crucial factor in applying restoration of tamarisk forests. Attention to post-removal control is especially important during drought, when native species are more vulnerable to deepening groundwater than tamarisk and Russian olive.