

ET Estimation by Remote Sensing and GIS Approaches

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For effective system-wide management of tamarisk, a crucial and often overlooked first step is to assess the current state of the river, to evaluate processes and treatments already undertaken, and to project potential cost/benefits and risks to the system. The Pecos River in New Mexico has undergone extensive multi-year, helicopter-based herbicide spraying in an attempt to control tamarisk from its banks and along several tributaries. This study was undertaken to provide an estimate of water salvaged by tamarisk control to provide the basis for conducting a cost/benefit analysis. An estimate of salvage was made as the residual between evapotranspiration (ET) estimated for the year prior to commencement of herbicide spraying (summer 2002) and for the year following final treatments (summer 2005). Accurate estimation of ET quantifies the potential salvage through the decrease of ET in the system. Rather than going to tamarisk use, the salvaged water becomes available to provide increased supply for native vegetation, increased soil water storage, and as the agencies that funded, planned and undertook the herbicide spraying hoped, discharge of the salvaged water to the river.

Color aerial photography was used as a visual reference of the phreatophyte vegetation and LANDSAT TM7 satellite imagery were used to assess water use by riparian vegetation. Image processing techniques expanded the accuracy and precision of Normalized Difference Vegetation Index (NDVI) by conversion to NDVI* that controls non-systematic variation in the data. NDVI* was calibrated to annual totals of precipitation and reference ET (ET_0) to yield an estimate of annual ET consumption that was applied to the imagery through the entire study reach from Sumner Dam northeast of Fort Sumner to Brantley Dam north of Carlsbad (about 230 km). The calculations of ET before and after herbicide application were made within a GIS using 30-m pixels. The areal coverage of the analyses was defined by GPS logs taken by helicopter during aerial application on the main stem (areas that were sprayed outside of our study area--above Sumner Dam, below Brantley Dam and on tributaries were not analyzed).

From the before-after comparison, an estimated savings of 3.1 AF/acre were realized on the approximately 6,000 treated acres (annual salvage of 18,600 AF). Projection of these results to the herbicide treated areas outside our study area increased estimated water salvage by another 16,700 AF/yr. The water in the Pecos system has an actual value between \$13 and \$30/AF. Thus, were all of the salvaged water realized in river flow (only a portion would be expected) the value of total salvage of 35,300 AF/yr would be between \$460,000 and \$1,060,000. The amount of salvage is expected to decline each year as regrowth by tamarisk or other species occurs. The value of "realized" salvage and its dollar value on the Pecos River must be balanced against risks for bank erosion and reservoir sedimentation: in combination these may exceed a billion dollars.