

Quantifying Ground-Water Savings Achieved by Tamarisk Control: A Demonstration Project in the Riparian Zone of the Cimarron River, Kansas

Gerard J. Kluitenberg¹, J.J. Butler, Jr.², D.O. Whittemore², and D. Arnold³

¹Department of Agronomy, Kansas State University, Manhattan, KS 66506. gjk@ksu.edu

²Kansas Geological Survey, University of Kansas, Lawrence, KS 66047. jbutler@kgs.ku.edu, donwhitt@kgs.ku.edu

³Arnold Ranch, Ashland, KS 67831. darnold@ucom.net

Abstract

Low streamflows are an increasing problem in Kansas and other areas of the U.S. One factor thought to be responsible for stream-flow reductions in western Kansas is the consumption of ground water by phreatophytes in riparian corridors. Extensive control measures, primarily focusing on invasive species such as salt cedar and Russian olive, are being considered in response to concerns about the impact of phreatophytes on water resources. At present, there is no generally accepted means of quantifying the ground-water savings that might be achieved through these measures. Recently, an approach based on diurnal fluctuations in the water table has been shown to have potential for quantifying ground-water consumption by phreatophytes. A demonstration project is underway to evaluate this method for assessing ground-water savings achieved through phreatophyte-control measures.

The site for the demonstration project is on the Arnold Ranch near Ashland in an area of salt-cedar infestation along the Cimarron River in southwestern Kansas. Four plots, each approximately four hectares in size, have been established at the site. Different salt-cedar control measures are being applied in three of the plots and one plot (background monitoring plot) is being used to collect data unaffected by control measures. Wells have been installed at the site to monitor water-table responses at the site; each is equipped with an integrated pressure-transducer and datalogger unit programmed to take a pressure head readings at 15-minute intervals. Water content in the vadose zone is monitored biweekly during the summer months using a neutron probe in access tubes located adjacent to each well. A weather station has been installed to collect the meteorological data required to estimate potential evapotranspiration. Salt-cedar control measures were initiated in March of 2005. At that time, three of the four plots were clear cut except for circles ranging from 20-30 m in radius, centered at each well. The radii of those circles of vegetation were progressively reduced through repeated cuttings in the summer of 2005. Only the invasive phreatophytes (salt cedar and Russian olive) were cut at the site; grasses, forbs, and low-lying bushes were largely unaffected. A chemical treatment (Remedy and diesel-fuel mix) was applied to the salt-cedar regrowth in one plot following the cutting. Water levels, soil moisture, and meteorological parameters were monitored during these activities.

Water levels from wells in the background-monitoring plot were compared with water levels from wells in the other plots prior to cutting. A similar comparison following cutting and chemical treatment shows a reversal in the relative magnitude of the fluctuations. The changes in the relationships between water levels in the background-monitoring plot and those in the cutting and chemical treatment plot enabled initial estimation of the reduction of ground-water

consumption resulting from control measures. The reduction appears to be on the order of 30-40%. Apparently, the shallow depth to water at this site allows substantial ground-water consumption by other mechanisms, such as transpiration by shallow-rooted vegetation and direct evaporation from the water table. Work has been initiated to assess the relative importance of ground-water consumption by these other mechanisms. Unless the impact of these mechanisms is better understood, it will be difficult to reliably estimate the potential water savings to be achieved through control of invasive phreatophytes.