Abstract: The effect of groundwater fluctuation on evapotransporation of inland saltgrass

In New Mexico and Southern U.S. federal and state agencies have spent millions of dollars for decades trying to remove saltcedar (*Tamarix spp*.) and other exotic invasive species from riparian areas without much success. Some of the environmental problems caused by exotic species, particularly saltcedar, is high water consumptive use, change in the functionality of the ecosystem, and subsequent problems such as deforestation and soil erosion once the plants have been removed. Due to the extent of this problem in the Lower Rio Grande Basin in New Mexico, a method for reducing saltcedar density while replacing it with native vegetation is needed to mitigate these environmental problems. Saltgrass (*Distichlis spicata*), a halophyte riparian turf grass native to New Mexico , could be used effectively to replace riparian areas cleared from saltcedar for improving the environmental conditions.

This research is part of a larger scale project to determine if saltgrass could naturally overgrow managed saltcedar-infested areas and further inhibiting the spread of saltcedar by suppression of seed germination. The scope of the study was to measure the evapotranspiration (ET) of inland saltgrass using the energy budget method as well as measure groundwater levels and chemical properties of soil and groundwater at the site. The measurements would allow for evaluation of viability of low water consuming saltgrass as a replacement of high water consuming and invasive saltcedar in riparian regions. Based on this investigation, recommendations could be made to properly manage the land after saltcedar has been removed and to improve diversity of native vegetation and control the spread of saltcedar. The specific objectives of this study are: (1) to quantify ET of saltgrass in a riparian setting under different depths to groundwater, (2) to determine if inland saltgrass can suppress the germination of saltcedar, and (3) to measure groundwater and soil chemical attributes periodically in order to determine if there is a relationship between salinity, growth, and ET of saltgrass.

Daily ET of saltgrass was measured using the eddy covariance technique in the energy budget method. The weather and energy flux data used to determine ET was collected using a flux tower which had sensors for sensible heat, wind speed and direction, net radiation, and soil heat flux. The river (Rio Grande), groundwater, and soil samples were tested for electrical conductivity (EC), total dissolved solids (TDS), salinity, and pH using the sension™5 conductivity and sension™1 pH Meter (HACH® Company, Loveland, CO). Several surface and ground water samples were collected throughout the first half of the year totaling six measurements from January 18th to July 11th, 2013. Additionally, samples from a soil profile taken in a pentagonal manner at the site were collected on July 15th and measured for the properties mentioned above.

The water table elevations at the study site increased dramatically in both 2012 and 2013 after about early June and mid-May, respectively, due to the release of water from the Elephant Butte Reservoir, NM for crop irrigation purposes. The groundwater levels decreased from more than four feet to about three feet in 2013 and to two and a half feet in 2012 following the release of water from the Reservoir. The decrease in groundwater levels were reflected in ET measurements. The ET rates increased significantly at about half of a millimeter per day in average. Figure 1 shows the daily ET of saltgrass for the months of May and June for the 2012 and 2013 growing seasons. The arrows indicate when the depth to groundwater decreased to 3.5 ft, and the root system of saltgrass became denser.

The EC values from the soil profile showed an exponential decrease in the salt concentration in the soil as a function of depth indicating a good soil drainage at the site. As would be expected after the release of water from the Reservoir, no significant decrease in the EC of the groundwaterwas observed. Conversely, the surface water samples from the Rio Grande did show a steep decrease in the EC values around mid-May which correlates to the water release in the Elephant Butte reservoir. Higher EC levels in the river before the release of water were due to stagnant water and high evaporation rates. Once the irrigation water, with lower salt concentrations was released, the stage of the river increased thereby reducing the overall salinity of the river water.

These preliminary results indicate that ET of saltgrass is highly correlated to depth to groundwater. The effect of EC to saltgrass growth and ET was not conclusive based on the short term date collected. For optimal growth and density of saltgrass, the depth to groundwater at the site should be maintained at a maximum depth of 3.5 ft which would create an effective barrier (i.e. dense saltgrass) to prevent saltcedar germination.

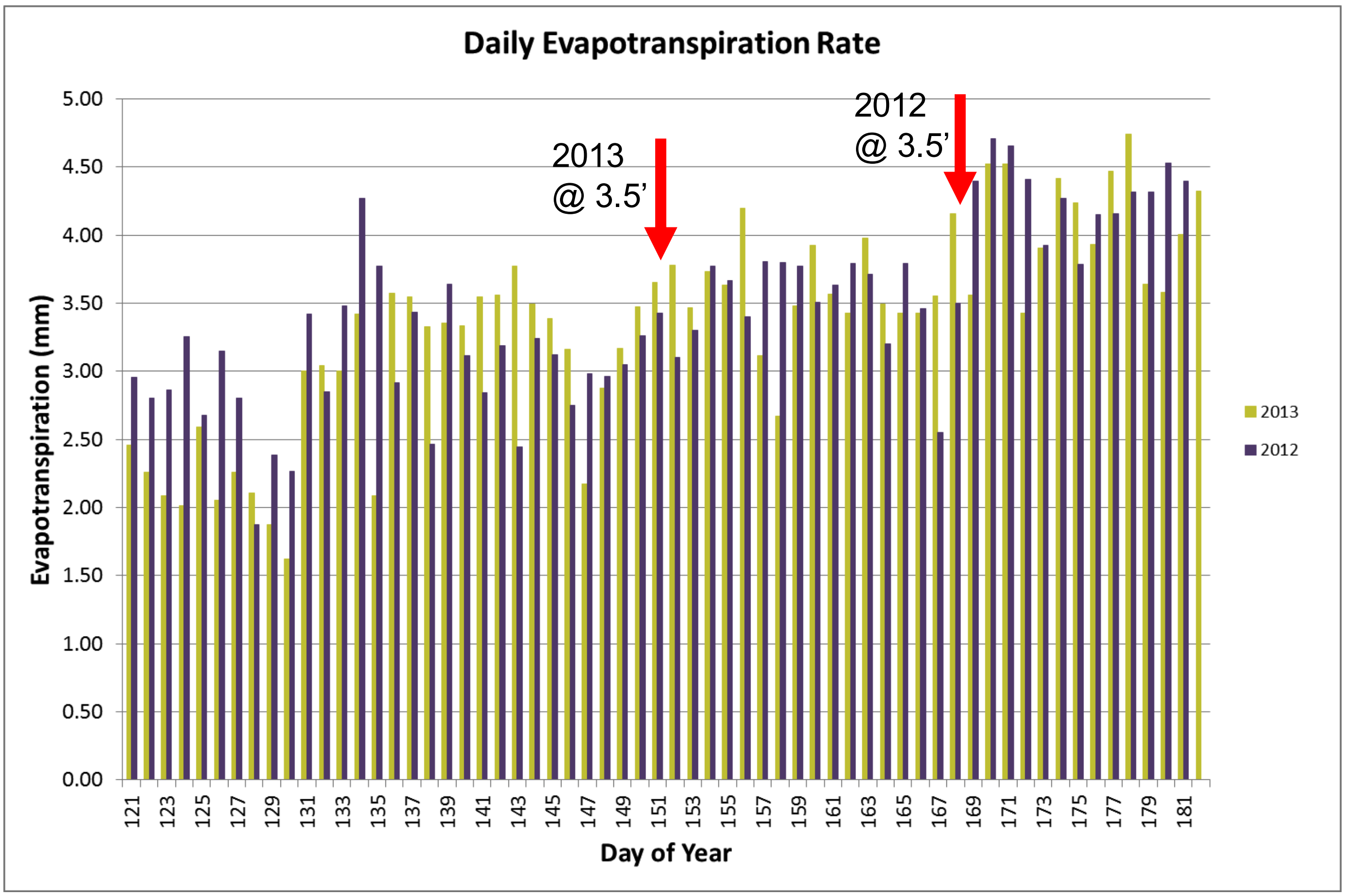

Figure 1. Daily ET of saltgrass for the months of May and June for the year 2012 and 2013 growing seasons (ET increased as depth to groundwater from ground surface decreased from over 4 ft to 3.5 ft)