

Evapotranspiration by tamarisk from three 1-km² sites at Cibola NWR on the lower Colorado River

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Abstract:

Saltcedar (*Tamarix ramosissima*) has become the dominant plant species on the Lower Colorado River. Over 90% of the riparian corridor is classified as saltcedar habitat, growing in monocultures or in association with other salt tolerant shrubs such as arrowweed (*Pluchea sericea*) or saltbushes (*Atriplex* spp.). There is concern that saltcedar uses large amounts of water that could otherwise be used for agriculture or municipal water needs. Foliage density, leaf area index and evapotranspiration rates of saltcedar have been measured at the plant or small-plot scale, but little information is available for these parameters at the landscape level of measurement from which water budgets can be constructed. We used remote sensing methods and ground surveys to characterize the stand structure and evapotranspiration (ET) of three large (1 km²), densely vegetated stands of saltcedar in the Cibola National Wildlife Refuge on the Lower Colorado River near Blythe, California. The centers of the plots were 200 m (Plot 1), 800 m (Plot 2) and 1600 m (Plot 3) from the river channel. Depth to groundwater varied from 3.0 m for Plot 1 to 3.7 m for Plots 2 and 3, and salinities of the groundwater varied from approximately 2,000 ppm for Plot 1 and 10,000 ppm and 5,000 ppm for Plots 2 and 3, respectively. All plots were virtual monocultures of saltcedar and were selected as typical of the large, dense stands of saltcedar that grow along the river within this wildlife refuge. Percent vegetation cover, determined by aerial photography, was 56%, 71% and 85%. LAIs for individual plants averaged 5.0 for all plots, and global LAIs for plots ranged from 2.8 to 4.3, as determined by % cover times LAI of individual plants. Plants in Plot 1 exuded copious amounts of water from leaves each summer morning, and appeared to moisten the soil in the vadose zone at 1-3 m depth through hydraulic lift. These phenomena were not as pronounced in the other two plots, which had deeper and more saline water tables. ET was estimated by an algorithm developed for saltcedar and other riparian plants on southwest rivers, which regressed moisture flux tower data against MODIS Enhanced Vegetation Index values from the Terra satellite and ground-level air temperature measurements. Applied to these stands, peak ET rates ranged from 7-9 mm d.⁻¹ among sites. Projected annual rates were 1.6 m, 1.9 m, and 1.8 m for Plots 1-3, respectively. Annual ET_o is about 2.0 m at this location. These rates compare to annual rates of 0.8 m to 1.2 m measured for dense stands on the Middle Rio Grande (LAI 3.0-3.5), and 0.8 m to 1.0 m for mixed arrowweed/saltcedar stands at the Havasu National Wildlife Refuge on the Lower Colorado River near Needles, CA. For whole river stretches, rates projected from MODIS imagery are approximately 0.8 m yr⁻¹, as they incorporate areas of sparse vegetation as well as saltcedar stands.

