Abstracts — Session 2: Sedimentation and Geomorphic Processes

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Climate, tamarisk, and river regulation on the Upper Green River of Dinosaur National Monument: hydrologic scenarios for floodplain sedimentation

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Hydrogeomorphic factors influencing the establishment and distribution of *Tamarix* in Grand Canyon National Park

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Abstract:

Geomorphology and hydrology influence the establishment, persistence, and spread of invasive riparian plants. In turn, riparian plant invasions affect hydrogeomorphology by stabilizing river banks and narrowing river channels. We are interested in the present establishment and distribution patterns of *Tamarix* and the hydrogeomorphic factors that favor *Tamarix* over native riparian woody species in Grand Canyon National Park (GCNP). Following the completion of Glen Canyon Dam in 1963, *Tamarix* colonized the newly available habitat adjacent to the river that was now protected from annual floods. However, new germination surfaces have been limited due to decreased flooding and sedimentation. Current conditions appear to favor new *Tamarix* establishment on cobble bars and silty-sand beaches.

In order to elucidate the influence of geomorphology on *Tamarix* distribution patterns, we estimated *Tamarix* density on random 100 m "floating transects" from Lee's Ferry to Diamond Creek (364 km). The average *Tamarix* density was 0.29 m-2. The maximum (1.65 m-2) and minimum (0 m-2) *Tamarix* densities were sampled in the Upper Granite Gorge geomorphic reach which has the lowest mean reach width of the sampled reaches. We analyzed the influences of distance to nearest upstream tributary, channel sinuosity, geomorphic reach, substrate resistivity, and channel width on *Tamarix* density using multiple linear regression models. In a previous study we found higher cover of *Tamarix* in geomorphic reaches of moderate resistivity. Additionally, straighter channels are more likely to have higher relative *Tamarix* cover due to this shrub's unique ability to colonize cliffs and rocky channel margins. We hypothesized that transects located closer to tributary mouths would have a higher density of *Tamarix* as a consequence of added sediments. However, initial analyses (scatterplots) reveal no significant effect of distance to major upstream tributary on *Tamarix* density (p=0.39). These findings corroborate earlier research finding no significant difference in vegetation cover one mile above and one mile below the Little Colorado River tributary.

Importance of understanding sedimentation for tamarisk control efforts

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Abstract:

Non-native phreatophytes, such as tamarisk, are an invasive tree species infesting and seriously impacting millions of acres of land in the American West. These species have no natural enemies in the United States, and are swiftly replacing native vegetation thus impacting livestock/wildlife habitat, increasing wildfire intensity, decreasing recreational activities, and most notably, consuming significantly more water than native species.

Although the motives for tamarisk control are born from a desire to promote healthy ecosystems and watersheds, it is vital to recognize that tamarisk provides important value, at a minimum for; a) stabilizing the banks of Western rivers prone to avulsion and erosion and, b) endangered species habitat (although often considered poor-is better than no habitat). Destroying these trees without rational planning may produce negative impacts such as inducing severe, costly erosion and displacing endangered species. All western states have begun or completed strategic management plans to control non-native phreatophytes. Difficulties in tamarisk management lie in formulating and implementing effective/efficient tactical control plans (built from the foundations provided by strategic plans) suited for any given riparian environment or watershed, while minimizing negative risk or creating new problems.

If tamarisk removal successfully frees water that would otherwise be lost to evapotranspiration, a portion of this extra water must flow into the river and be stored in reservoirs to be available for beneficial use. Recently, salt cedar control efforts along the Pecos River have been conducted through application of herbicides by aerial spraying. This has resulted in defoliation and presumably killing of thousands of acres (14,000-16,000) of salt cedar in this area. Brantley Reservoir is the primary repository of salvaged water of current tamarisk control efforts. There are approximately 160 river miles between Brantley and the next upstream reservoir, Ft. Sumner. The Bureau of Reclamation cleared the flood plain of saltcedar on most of this 160 mile reach thirty years ago. However, the Bureau of Reclamation left a 50 foot buffer of salt cedar growing on each river bank for wildlife cover and stream bank stabilization. Once this saltcedar is removed from the river banks, so too will be the root system that has stabilized the banks for many years. This will leave the banks of the river susceptible to mobilization during subsequent significant flood flows until native plants and trees can be restored. With over 320 miles of banks (accounting for both sides of the river) and many significant bends and lots of potential high flows due to thunderstorm runoff, these bank sediments threaten to be eroded into the river and transport to and accumulate in Brantley reservoir. Sediments are not the only concern. Dead tamarisk biomass left on the rivers edge could be washed downstream during large flow events and accumulate at river crossings, significantly increasing chances for over bank flooding.

In this study, erosion has been assessed in a variety of ways, including field measurements and aerial/satellite imagery. Stream bank erosion in the forms of lateral migration (channel widening/narrowing) and bank slope degradation were assessed. Field measurements included repeated, detailed bathymetric surveys at several locations across the river channel as well as repeated GPS measurements used to map large sections of river at the top and bottom of a stream bank to assess lateral migration and bank slope patterns. Measurements of texture and observations of plant types (dead and new growth) were also made. Aerial photography for the entire state of New Mexico was taken between 1996 and 1998. Since then only scattered aerial images existed, until now. In 2005 the entire state was flown again, which has enabled investigation of pre-saltcedar control images (1996-1998) in comparison to post-saltcedar control images (2005).

Predictions of sediment stability and transport are made using a combined hydrodynamic and sediment transport model recently developed at Sandia (called SNL-EFDC). The Adjustable Shear Stress Erosion and Transport (ASSET) Flume is a unique Sandia developed device for measuring erosion and transport of sediments at depth, under high flow conditions, and because the device is mobile, in the field for ex-situ measurements. The data from the ASSET Flume is

directly input into the SNL-EFDC model and the monitoring data described above will help to calibrate model results. The model is used to predict under what conditions the Pecos River bed and bank sediments become mobile as well as where and how far sediments are transported downstream.

Hydrogeomorphic effects of a controlled flood release on Tamarisk and *Salix*, Bill Williams River, AZ

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Abstract:

We examined geomorphic and vegetation responses to a controlled flood releases on the Bill Williams River (BWR) in western Arizona. In March 2005, a controlled flood release resulted in the widespread establishment of woody riparian seedlings, including many seedling patches codominated by *Tamarix* spp. and *Salix gooddingii*. In March 2006, a controlled flood of 56 m3/s for two days, followed by a gradual daily drawdown of approximately 1 m3/s, was released from Alamo Dam on the BWR. We investigated whether this relatively small flood release (1.1–1.2 year event compared to pre-dam peak flows) would result in greater damage to and mortality of *Tamarix* versus *Salix*, and affect geomorphic changes associated with vegetation responses. Physical data collection included pre-and post-flood topographic surveys, bed sediment sampling, and deployment of scour chains and velocity and stage measurements during the flood at two field sites. Biological data collection included pre-and post-flood density, diameter, and height of 1 year-old *Tamarix* and *Salix* seedlings growing on channel bars at the sites. At the upstream site, approximately 18 km downstream from Alamo Dam, the flood caused scour of *Tamarix* seedlings and their substrates from mid-channel bars, lateral shifting of bars, and coarsening of bed sediment. In the downstream reach, approximately 48 km downstream from Alamo Dam, we observed burial of *Tamarix* seedlings as a result of aggradation, but no significant change in bed sediment sizes. In both cases, *Tamarix* suffered greater reductions in density than *Salix*. Our results suggest that this is largely due to the substantially greater first-year height and diameter growth of *Salix* relative to *Tamarix*. Although boundary shear stresses during the flood were lower in the downstream reach than in the upstream reach, total suspended sediment concentrations were approximately half as large in the latter reach, perhaps as a result of downstream decreases in the effect of dam-induced reductions in sediment supply. Our observations suggest that in a dynamic, sand-bed river such as the Bill Williams, even relatively small floods can generate sufficient forces and/or geomorphic changes to cause higher mortality of first-year *Tamarix* than *Salix*. These results also illustrate how the effect of floods or other components of hydrologic regimes on riparian vegetation are mediated by geomorphic processes on both a reach scale, where local bed gradients and geomorphic characteristics influence shear stress dynamics, and on a basin scale, where sediment supply dynamics may have important influences on morphologic and vegetation responses.