

Environmental flows for riparian restoration and *Tamarix* management

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Abstract:

River scientists have increasingly advocated managing streamflow downstream of dams for ecological benefits. Flow management efforts that specifically target riparian vegetation have been relatively uncommon, however. The Bill Williams River in western Arizona, USA, has been dammed by a large flood control structure since 1968 (Alamo Dam). Dam operators and land and water managers along the river have been implementing managed flows, primarily to benefit native riparian vegetation, since the 1990's. To understand the dynamics of riparian vegetation and to evaluate the effects of flow management on the Bill Williams River system, we have analyzed historical and contemporary aerial photography and conducted various field studies over the past decade. Pulse flood releases from Alamo Dam in the early 1990's widened the river channel and resulted in the establishment of a new cohort of woody vegetation (primarily in the genera *Populus*, *Salix*, *Tamarix*). For the following nine years, low inflows did not allow for pulse flow releases, but baseflows were maintained at fairly high levels, largely to promote survival of the mid-1990's vegetation cohort. These steady low flows resulted in channel narrowing, extensive beaver pond creation, and dense vegetation growth. In 2005, extremely wet conditions and high inflows required large flow releases on the Bill Williams R., which were managed to promote establishment of a new cohort of the native *Populus fremontii* and *Salix gooddingii*, while discouraging establishment of the non-native *Tamarix ramosissima*. Whole river seedling surveys and analysis of post-flood aerial photography indicate that these flows again widened channels, destroyed beaver ponds, and created conditions suitable for new vegetation establishment. Seedlings of all three species commonly became established along the main channel and associated surfaces, but the early-dispersing *Populus* established three times more frequently on side channels and low floodplain surfaces than the later dispersing *Salix* and *Tamarix*. The mean height of the tallest *Populus* or *Salix* in sampled patches was more than twice that of the tallest *Tamarix*, potentially providing a competitive advantage of the native taxa over the alien. Our results illustrate the efficacy of this approach to influence riparian vegetation dynamics, including management of exotic species.