

**MESC Research**

Riparian Restoration Using Hydrologic Manipulation and Physical Disturbance

KEYWORDS

streamflow, water management, exotic species, geomorphology, hydrology, instream flow, cottonwood, willow, bottomland, saltcedar, Russian-olive, plant distribution, aquatic, desert and arid lands, ecosystem science, forests, human impacts, invasive species, lakes/reservoirs, landscape, National Wildlife Refuges, National Parks, plants, populations, public lands, riparian, river systems, terrestrial, wetlands

GEOGRAPHIC DISTRIBUTION

Bill Williams River, Agua Fria River, Arizona

Synopsis

Riparian ecosystems in the semi-arid regions of the western US have important habitat and aesthetic values because they are structurally distinct from the surrounding drier landscape. The character of these systems and their responses to management actions have been heavily influenced by invasion of non-native plant species such as saltcedar (*Tamarix ramosissima*) and Russian-olive (*Elaeagnus angustifolia*). This study encompasses basic research at multiple spatial and temporal scales aimed at defining the environmental determinants of the distribution of non-native trees in western riparian ecosystems. This study, in combination with a complementary study focused on case studies addressing site-specific Department of the Interior riparian management questions, describes activities of an interdisciplinary team whose overall goal is to better inform riparian management decisions by better integrating hydrology, plant ecology, and fluvial geomorphology. This study has three basic components:

1. continuation of a series of small scale manipulative experiments aimed at quantifying life history characteristics relevant to replacement of native with non-native trees;
2. watershed scale studies aimed at the temporal sequence of invasion as related to management actions and changes in environmental conditions;
3. a regional scale study correlating distribution of the important native and non-native trees to a suite of climatic and hydrologic environmental determinants.

The small scale manipulative studies extend the group's previous experiments comparing characteristics of seedling germination and survival among native cottonwood (*Populus* spp.) and non-native salt cedar and Russian-olive by conducting a seedling establishment comparison of Russian-olive (a large-seeded, shade tolerant invader) to cottonwood (small-seeded, pioneer natives) using manipulated paired field plots. At the watershed scale, current seedling establishment rates and retrospective analyses of processes producing existing tree composition are being measured above and below dams on two Arizona rivers (Bill Williams and Agua Fria) that have large non-native tree populations and substantial flow alterations from dam operations. The regional scale work is based on measurements of

vegetation, channel geometry, climate, and hydrology at 350 randomly selected streamflow gage sites in 17 western states. Relatively long hydrologic records at these sites support the possible isolation of streamflow variables as determinants of the susceptibility of riparian sites to various non-native trees.

Application of Research: Better quantitative understanding of the hydrologic and geomorphic determinants of native and non-native plant distribution in western riparian systems will improve Department of the Interior decisions regarding reservoir operation, direct control of invasive plants, grazing management, and native ecosystem restoration. The functional relations developed from this research also contribute to meeting Department of the Interior responsibilities for endangered species utilizing riparian habitats and to the quantification of federal reserved water rights associated with Departmental riparian lands.

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Related Publications

- Friedman, J. M., M. L. Scott, and G. T. Auble. 1997. Water management and cottonwood forest dynamics along prairie streams. *Ecological Studies* 125:49-71.
- Auble, G. T., M. L. Scott, J. M. Friedman, J. Back, and V. J. Lee. 1997. Constraints on establishment of plains cottonwood in an urban riparian preserve. *Wetlands* 17(1):138-148.
- Springer, A. E., J. M. Wright, P. B. Shafroth, J. C. Stromberg, and D. T. Patten. 1996. Coupling ground-water and riparian vegetation models to simulate impact of a reservoir release from New Waddell Dam into the Agua Fria River, Maricopa County, Arizona. Pages 25-26 in 9th Annual Symposium of the Arizona Hydrological Society, Prescott, AZ.
- Shafroth, P. B., J. C. Stromberg, D.T. Patten. 1998. Woody riparian vegetation of the Bill Williams River, Arizona: seedling establishment, management recommendations, and comparisons with the unregulated Santa Maria River. 97 pp + appendices. Final Report, FWS Agreement #1448-00002-95-0605. Center for Environmental Studies, AZ State University, Tempe, AZ.
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- Friedman, J. M., W. R. Osterkamp, M. L. Scott, and G. T. Auble. *Submitted*. Downstream effects of dams: Regional patterns in the Great Plains. *Wetlands*.
- Friedman, J. M., and G. T. Auble. *Submitted*. Floods, flood control, and bottomland vegetation. Book chapter in "Inland flood hazards: human, riparian and aquatic communities." Ellen Wohl, editor. Cambridge University Press.
- Auble, G. T., M. L. Scott, and J. M. Friedman. *In Press*. Streamflow and the establishment of western riparian trees. In *Proceedings of Instream and Environmental Flows Symposium*, at 17th International Meeting of North American Lake Management Society, December 1-12, 1997, Houston, TX.
- Friedman, J. M. and G. T. Auble. *Submitted*. Removal of riparian trees by sediment mobilization and extended inundation. *Regulated Rivers: Research and Management*.
- Scott, M. L., P. B. Shafroth, and G. T. Auble. *Submitted*. Response of cottonwoods to alluvial water table declines. *Environmental Management*.
- Shafroth, P. B., G. T. Auble, J. C. Stromberg, and D. T. Patten. *In Press*. Establishment of woody riparian vegetation in relation to annual patterns of streamflow, Bill Williams River, Arizona. *Wetlands*.
- Auble, G. T. and M. L. Scott. *Submitted*. Fluvial disturbance patches and cottonwood recruitment along the upper Missouri River, Montana. *Wetlands*.
- Scott, M. L., P. B. Shafroth, G. T. Auble, and E.D. Eggleston. 1997. Riparian cottonwood

response to water table declines. The Green Line, Colorado riparian Association Newsletter 8 (4):6-7.

Related MESC Projects

- **Environmental Determinants of Exotic Riparian Tree Distribution in Western Riparian Ecosystems** - Jonathan Friedman, contact
- **Effects of Streamflow Alteration on Riparian Cottonwood and Willow Regeneration**, Mike Scott, contact
- **Hydrologic Control of the Streamward Extent of Riparian Vegetation** - Jonathan Friedman, contact
- **Gradient Models Predicting Changes in Riparian Vegetation from Altered Streamflow** - Greg Auble, contact
- **Effects of Groundwater Decline on Cottonwood** - Mike Scott, contact
- **Controls on Cottonwood Regeneration along the Wild and Scenic Reach of the Missouri River, MT** - Greg Auble, contact
- **Status of Vegetation-Wildlife-Hydrological Relationships in Arid Southwestern Wetland Ecosystems** - Douglas Andersen, contact
- **Ecology of Plant and Animal Species in Western Riparian and Wetland Systems** - Douglas Andersen, contact

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