

Geomorphic Consequences of Russian Olive Invasion and Prospects for Restoration along the Escalante River, Utah

Michael L. Scott^{1*}, Lindsay V. Reynolds², Patrick B. Shafroth³ and John R. Spence⁴

¹Faculte Affiliate, Colorado State University, Fort Collins, CO, USA; scottmikeski@gmail.com

²Riparian & Wetland Lead, National Operations Center, Bureau of Land Management, Lakewood, CO, USA; lreynolds@blm.gov

³Fort Collins Science Center, U.S. Geological Survey, 2150 Centre Ave., Bldg C, Fort Collins, CO, USA; shafrothp@usgs.gov

⁴National Park Service, Glen Canyon National Recreation Area, Science & Resource Management Division, P.O. Box 1507, Page, AZ, USA; 86040, USA; John_Spence@nps.gov

Along rivers, feedbacks between vegetation and fluvial processes contribute to the complexity and dynamics of riparian ecosystems. For example, native and invasive species may establish and persist on active channel bedforms as part of channel narrowing. Using historical aerial photography and dendrochronology, we quantified spatial and temporal patterns of narrowing and vegetation expansion, including native Fremont cottonwood (*Populus fremontii*) and non-native Russian olive (*Elaeagnus angustifolia*), along the largely unregulated Escalante River in southwestern USA. Narrowing was initiated during a mid-20th century drought. Cottonwood rapidly colonized higher, bar surfaces between the 1950s and 1981. Small numbers of Russian olive established in moist sites during this initial period as the channel narrowed by nearly 80%. After 1981, there was no obvious cottonwood establishment but low channel bars and banks were rapidly colonized by Russian olive, narrowing the channel further. Exponential growth of this large-seeded, shade-tolerant species lagged its introduction by 30 years, apparently because of delayed reproductive maturity, limited seed availability and widespread availability of favorable establishment sites following initial channel narrowing. Sediment trapping, levee formation and modification of channel form by dense, channel-edge bands of Russian olive progressively limited new establishment sites and by 2000, recruitment declined sharply. Catchment-scale removal of Russian olive began in 2010. Anecdotal evidence suggests that post-removal erosion of levees and channel realignment are occurring in some locations but forward-looking monitoring is needed to assess the effectiveness of removal on overall recovery of channel form.