Alien Plants and Riparian Ecosystem Restoration:

The Tamarix Case

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What differentiates an "alien" species from a native one? Ecosystems, by definition, are open to flows of energy and matter, and biological communities do not have fixed, unchanging rosters. Therefore, eliminating alien species from riparian (or any) ecosystems is theoretically a non-issue. Nevertheless there is strong sentiment against aliens, and a great deal of effort is expended in attempts to suppress or eliminate them. Much of the concern stems from the role of these newcomers as indicators of loss – fearing their presence indicates a disappearance of familiar, native plant species, lower habitat values, reduced native biodiversity, reduced stream flow, and other changes that many people deplore and would like to reverse through restoration.

Upper photo: cottonwood trees. Lower photo: salt cedar trees. (Photos: J.C. Stromberg)

One of the most widespread newcomers in riparian corridors of the southwestern United States is salt cedar (Tamarix ramosissima, T. chinensis, or the endemic American hybrid, T. ramosissima x chinensis). Salt cedars were introduced to the United States in the late 1800's from Europe and Asia as ornamentals, and for windbreaks and erosion control. They subsequently spread along water courses throughout the country, and they now cover nearly 1.5 million acres of floodplain area in 23 states (Di Tomaso 1998, Zavaleta 2000), infiltrating or replacing large expanses of cottonwood-willow (Populus-Salix sp.) forests.

As pioneer species, cottonwood, willow, and salt cedar display short generation times, grow rapidly, and produce large numbers of small seeds. All three species colonize bare stream edges, and their establishment is closely adapted to hydrologic regimes. Cottonwoods and willows have evolved to exploit dependable regional spring flooding by producing seeds only during a short annual period. A flood coinciding with seed dispersal scours away existing vegetation and creates a germination site. The flood must then recede slowly enough that a seedling's growing roots can maintain contact with the water table, without rising to inundate them again.

Salt Cedar's Competitive Advantages

Salt cedars are adapted to less predictable disturbance regimes, and sometimes produce seeds nearly year-round. They also root deeply when required and tolerate extended drought and inundation. Salt cedar's "pre-adaptations" give it competitive advantages over native riparian trees along rivers with culturally modified hydrologic regimes. Human influences have helped give salt cedars a competitive advantage as well. Dams, surface water diversions, and groundwater pumping have revised the hydrology of most western riparian ecosystems. Flood peaks are reduced and delayed as spring runoff is captured in reservoirs and released for summer irrigation. This timing suppresses recruitment of cottonwoods and willows, but salt cedar can continue to germinate around reservoirs as storage diminishes and along rivers as irrigation deliveries dwindle. Deeper rooting than the natives, salt cedar can also thrive on rivers where pumpage from groundwater wells reduces the elevation of the alluvial aquifer. Excreting salts, it survives where dissolved solids are concentrated by irrigation runoff and reservoir evaporation. Salt cedar also has an advantage along rivers with culturally modified grazing regimes, given its low palatability to cattle.

The more we change the abiotic components of an ecosystem, the more we stress the native biotic community and create niches for new species. As we drastically manipulate waters, we have to expect consequent changes in riparian flora and dependent fauna. Simplifying that equation, suppressing floods also suppresses riparian biodiversity. Salt cedar often gets the blame for loss of ecosystem function when the underlying reason for the loss is the alteration of river processes, leading to the absence of cottonwoods and willows or to the loss of habitat diversity (Stromberg and Chew 2002).

Because many bird species evolved with and prefer tall cottonwood-willow forests, salt cedar stands often support lower avian species densities and diversities (Ellis 1995). But there are also cases where salt cedar provides valuable ecosystem functions. Along the middle Pecos River, for example, salt cedar serves as an important habitat for birds (Hunter et al. 1988). Stromberg (1998a) found salt cedar forests along the San Pedro River to be functionally equivalent for six out of 13 defined "ecosystem functioning" traits, such as maintenance of plant species diversity and floodplain sedimentation. These findings suggest that salt cedar not only invades, but participates in ecosystems where native species are failing. Removal itself may be increasingly harmful as salt cedar is assimilated into American ecosystems. As a case in point, salt cedar has become an important nesting site for southwestern willow flycatcher, an endangered bird species.

Salt Cedar Restoration: Worth the Effort?

"Restoring" riparian areas by eliminating salt cedar is a popular exercise. Large amounts of time, money, and labor are expended in burning, hacking, applying herbicides, and deploying biological controls, but at best these offer no more than a cosmetic fix. Removal of exotics, with or without replanting native trees, often fails because it does not address the underlying causes of species replacement. Cottonwoods and willows are traditionally described as poor competitors in relation to salt cedar, but in a laboratory experiment, cottonwood seedlings out competed salt cedar seedlings under conditions simulating natural seasonal hydrology (Sher et al. 2000). Along perennial, free-flooding portions of Arizona's San Pedro River where livestock were excluded, young cottonwood and willow trees now outnumber salt cedar (Stromberg 1998b). Such studies suggest that riparian biota can recover without further human intervention after historical stream flow rates and patterns and grazing regimes have been restored through appropriate management actions. Because cottonwood seedlings are larger and grow faster than salt cedars, cottonwoods can physically dominate by shading out salt cedars under normal conditions.

Since the success of the native trees is strongly coupled to particular hydrologic and grazing regimes, and when favored, the natives outcompete the exotics, it follows that the most ecologically viable long-term anti-salt cedar strategy is to restore the physical conditions that favor the natives. Our lost native riparian woodlands can be found again, by finding the will to give them what they need. Lacking that will, salt cedar is the present and future keystone of riparian forests. Salt cedar is now effectively the "more native" plant, not by simplistic standards of geographical origin, but by demonstrated fitness and continued survival and reproduction under prevailing conditions. Punishing it for succeeding while simultaneously providing it with ideal conditions is an absurd and futile exercise.

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Fire and Riparian Ecosystems

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Is fire on the increase in riparian ecosystems of the American Southwest? Along flow-regulated desert rivers including the lower Colorado, floods no longer scour vegetation and organic debris, and riparian fire is increasingly common. Recreational and other human uses have increased ignitions along many rivers, including the upper San Pedro, where nearly a third of the woodland burned between 1990 and 2000. However, we know little about historic riparian fire frequency.

Lightning fires probably were more common in riparian areas surrounded by desert grassland and woodland than by desert scrub, although generalities on fire frequency are complicated by pre-Columbian setting of riparian fires. Ecologically, fire can locally reduce abundance of Fremont cottonwoods and convert riparian forests into savannas, but Goodding willow, Arizona sycamore, saltcedar, and many other riparian tree and shrub species will resprout from live roots. Many riparian grasses and forbs germinate or resprout after fire and can be favored by canopy light gaps, although post-burn hydrophobic soils can retard revegetation. Extreme fires that burn entire watersheds with high intensity likely produce different effects from smaller, more localized burns, but more studies are needed to increase our understanding of the complexities of riparian fire ecology.

*Background photo: Incised channel created by erosion following the Cerro Grande fire near Los Alamos, NM in 2000. (Photo: John A. Moody, U.S. Geological Survey.)
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