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Soil salinity patterns in *Tamarix* invasions in the Bighorn Basin, Wyoming, USA

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Abstract

Saltcedar (*Tamarix* spp.) is an exotic, invasive shrub of riparian corridors in the western United States that can promote soil salinization via leaf exudates as *Tamarix* litter accumulates on the soil surface. *Tamarix* stands occur in association with big sagebrush (*Artemisia tridentata*), greasewood (*Sarcobatus vermiculatus*), and cottonwood (*Populus deltoides*) in northern Wyoming, depending on topographic position. Revegetation of *Tamarix*-invaded sites can be limited by altered soil conditions. *Tamarix* stands in northcentral Wyoming were selected to determine the relationship of *Tamarix* shrubs and associated vegetation to soil salinity, pH, and nutrients. In general, salinity of surface soils (0–5 cm) was greater and pH was lower than in deeper soils. Surface soils (0–5 cm) beneath *Tamarix* have greater salinity and lower pH than soil in interspaces. Because soil salinity in the Bighorn Basin is lower than levels documented in most *Tamarix* stands of the southwestern United States, many species used for revegetation should tolerate soil conditions here following *Tamarix* control.

Keywords: Saltcedar; Tamarisk; Soil pH; Soil nutrients; Invasive; Riparian

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1. Introduction

Tamarix ramosissima Ledebour, *T. chinensis* Loureiro, and their hybrids are introduced shrubs that have established along North American waterways from Mexico to Montana (Robinson, 1965). *Tamarix* invasions have contributed to the reduction of native riparian habitats in the southwestern United States by replacing native species and desiccating essential wetlands (Horton, 1977; Howe and Knopf, 1991; Busch and Smith, 1995). To a lesser extent and more recently, *Tamarix* has become naturalized in northern Rocky Mountain states and is a declared noxious weed in Wyoming and Montana. The northern extent of its range reaches into western North Dakota along the Missouri River (Pearce and Smith, 2003). The spread of these species into Wyoming and Montana elicits questions regarding *Tamarix* invasiveness and influence in northern, temperate arid lands. Because northern *Tamarix* establishment is relatively recent (1950s), the impact on soil salinity may not be problematic. *Tamarix* litter and roots may alter soil organic content and nutrient availability creating islands of fertility. We examine soil characteristics of northern Wyoming *Tamarix* stands differing in native species composition to characterize patterns of soil chemistry among microsites within stands.

Tamarix withstands saline soils by regulating its salt balance via excretion of excess salts through foliar glands (Decker, 1961). Salt excretion from *Tamarix* leaves promotes salinization of soils as invasions increase in dominance (Smith et al., 1998), providing an advantage over those species susceptible to a saline environment (Tomanek and Ziegler, 1962; Shafroth et al., 1995; Glenn et al., 1998). As salinity and moisture patterns change with controlled flow regimes and *Tamarix* invasion, some native species may not successfully establish. Saline and xeric soil conditions at *Tamarix*-dominated sites often remain after the control and removal of *Tamarix*. Recovery of native vegetation in areas where saltcedar is controlled varies widely with site conditions, the native species present, and water flow regime (Barrows, 1993; Lesica and DeLuca, 2004). Because *Tamarix* infestations in the northern United States have less vigorous growth (Sexton, 2000; Lesica and Miles, 2001) and in general are more recent invasions (Lesica and Miles, 2001; Pearce and Smith, 2003) than in the southwestern United States, soil salinity may be less problematic for native vegetation recovery and revegetation efforts. In addition, altered soil fertility via litterfall and organic exudates may limit the impact of salinization beneath *Tamarix* (Lesica and DeLuca, 2004).

The influence of *Tamarix* on soil salinity, pH, and nutrient availability is largely unknown. Only one study has compared the characteristics of soil beneath *Tamarix* individuals to surrounding soils (Lesica and DeLuca, 2004) but did not evaluate impacts of native woody species on soils in these sites. Native shrub species such as *Artemisia*, *Atriplex*, and *Sarcobatus* are known to create islands of fertility and alter soil pH and electrical conductivity (EC) beneath individuals, indicating the importance of assessing spatial patterning of soil characteristics beneath shrub canopies (Roberts, 1950; Charley and West, 1975; Halvorson et al., 1997). The ability of plants to alter their edaphic environment occurs primarily