SOIL DISTURBANCE, FLOOD MANAGEMENT, AND RIPARIAN WOODY PLANT ESTABLISHMENT IN THE RIO GRANDE FLOODPLAIN

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Abstract: The exotic saltcedar (Tamarix ramosissima) has become the dominant woody plant in many riparian systems in the southwestern United States. We evaluated the effects of saltcedar clearing and overbank river flooding on recruitment of cottonwood (Populus fremontii) and saltcedar vegetation in the Rio Grande floodplain of central New Mexico, USA in 1993 and 1994. Overbank flooding coincided with the natural river hydrograph. After two seasons of growth, cleared areas supported more 1993 cohort cottonwoods and saltcedar than uncleared controlled areas. There were no differences between cleared and uncleared areas for the 1994 cohort after one growing season. Although there was a 2-week difference in the date of peak river flows between 1993 and 1994, similar seedling densities of both species were recorded for both years. The descending limb of the 1993 hydrograph was more gradual than the 1994 hydrograph, however, resulting in a higher survival rate of 1993 seedlings. Soil texture, soil salinity, elevation, and soil moisture data were collected from all plots and compared with seedling densities for each seedling sample date. Elevation and soil moisture indices were the most influential variables on seedling density. Decreasing soil moisture variables resulted in consistent seedling mortality for all species in cleared and uncleared plots for both cohorts. Secondary channels developed as a result of vegetative clearing where natural river fluvial processes provided topographic relief and sediment deposition for seedling establishment. Greater densities of cottonwoods and coyote willows (Salix exigua) were found on these deposits compared with remaining portions of cleared plots. Saltcedar clearing in conjunction with peak river flows in late May or early June encourages recruitment of native riparian plants, particularly along sand deposits created as a result of secondary channel development. Receding flows correlated with a receding water-table level of about 2 cm/day enhances native seedling densities relative to saltcedar.

Key Words: saltcedar, Tamarix ramosissima, cottonwood, Populus fremontii, Rio Grande floodplain, recruitment, overbank flooding, soil disturbance

INTRODUCTION

One of the most extensive remaining cottonwood (Populus fremontii S. Wats.) gallery forests in the southwestern United States occurs along the Middle Rio Grande of central New Mexico (Howe and Knopf 1991). This forest or “bosque” developed with river flooding events that provided soil disturbance and moist areas for the germination of primarily aerially dispersed seed (Fenner et al. 1985). River meandering eroded banks and deposited fresh sediment, creating new channel braids and gradients of forest vegetation (Szaro 1989, Bullard and Wells 1992). Plant species responded to annual and long-term river flooding cycles by dispersing short-lived seed to coincide with river flooding events and by quickly developing root systems to maintain contact with declining water tables (Scott et al. 1993). Seedling establishment and survival were also influenced by soil moisture, texture, and salinity as well as relative elevation (Anderson 1989, Mahoney and Rood 1991a, 1992, Shafroth et al. 1995).

Native riparian communities have been negatively impacted, however, through human perturbation. The construction of dams has altered flood-flow timing, duration, and sediment dynamics, while the construction of levee systems has restricted channel movement. These actions have resulted in the decadence of existing native flora and a decrease in recruitment of replacement plants (Szaro 1989, Howe and Knopf 1991).
Exotic flora, most notably saltcedar (*Tamarix ramosissima* Ledeb.), escaped cultivation into southwestern riparian drainages by 1926, spreading rapidly in the wake of altered river flooding cycles and resulting changes in native plant community structure (Robinson 1965, Horton 1977). Stabilized channel banks now support thick fringes of saltcedar vegetation that further impede channel movement and braid development (Graf 1978).

Responding to new agency mission statements regarding an environmental emphasis on river flow management, the U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers simulated flooding events following historic annual river hydrographs in 1993 and 1994 (U.S. Bureau of Reclamation 1992). To avoid impacts to flood control levees, however, water levels were brought up slowly to reduce scouring effects that historically provided site disturbance and suitable soil substrates for germination of native riparian vegetation. In this study, sites along the active Rio Grande channel were mechanically cleared of vegetation to simulate historic flood effects on soil substrates. We compared exotic and native woody plant seedling recruitment and survival after overbank flooding in cleared (soil disturbance) and uncleared sites and assessed several abiotic factors that may influence seedling recruitment and survival.

**STUDY AREA**

The study was conducted at the Bosque del Apache National Wildlife Refuge (NWR) (33°34'48", 106°53'5") in central New Mexico, USA along 0.8 km of Rio Grande channel bank. The Rio Grande Valley is 5.2 km wide at the study site. The active floodplain width is restricted to 1 km by a spoil levee built in the late 1950s on the west side of the river in conjunction with construction of the Low Flow Conveyance Channel (Figure 1). There is no floodplain restriction on the east side of the river. The Middle Rio Grande basin in the study area is bounded by mountain ranges rising 2,000 m to the west and 1,600 m to the east. Valley floor elevations average 1,470 m.

Historically, river flows were characterized by an annual hydrograph typical of many river systems in western North America (Scott et al. 1993). The best representation of natural streamflow on the Rio Grande is mean daily flow data derived from 101 years of continuous record at a U.S. Geological Survey (USGS) gauging station at Embudo, New Mexico (Figure 2).

Diverse riparian vegetation communities thrived on the refuge prior to irrigation diversions and flood control developments (Bosque del Apache NWR, unpublished data). Although cottonwood gallery forest

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**Figure 1.** Location of study site showing treatment plots in the Bosque del Apache National Wildlife Refuge, NM, USA.