
Ecological Restoration

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Volunteers from local chapters of the Audubon Society look for birds at the Emeralda Marsh Conservation Area in central Florida. The St. Johns River Water Management District recruited volunteers to observe birds over a five-year period after the draw down of the Lake Griffin Flowway, which is part of the Emeralda Marsh Conservation Area. The volunteers recorded 196 bird species, including 11 state and federally endangered and threatened species and species of special concern. Joy Marburger provides a report of their findings and what it means to the restoration of former agricultural lands in Florida. Her article begins on page 164. Photo courtesy of Joy Marburger

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up to 20 percent germination in petri dishes when the seed is left in its spikelet clusters. Maher observed that a fungus growing on the seeds and spikelets prevents germination. In future experiments, the author will test differences in germination between collection years and populations, the effects of fungus on germination, and whether the spikelet clusters work as mechanical or chemical germination inhibitors.

WOODLANDS

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Reintroduction of Fire Maintains Structure of Mechanically Restored Pinyon-Juniper Savanna (New Mexico)

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During the past 120 years, land use practices have drastically altered the structure of former savanna communities now dominated by pinyon (*Pinus edulis*) and one-seed juniper (*Juniperus monosperma*) in the Jemez Mountains near Los Alamos, New Mexico. These encroaching pinyon-juniper (PJ) woodland communities are characterized by dense stands of young (less than 100 years old) trees with semi-closed canopies, suppressed understories, exposed soils, and accelerated soil erosion that threatens prehistoric Puebloan cultural resources. Likewise, the cumulative effects of grazing, fire suppression, and drought are associated with the rapid expansion of PJ woodlands into higher altitude Ponderosa pine (*P. ponderosa*) and lower elevation grassland communities (Allen and Breshears 1998, Brockway and others 2002).

In 1994, we began experimenting with mechanical restoration treatments at multiple scales and intensities in order to allay erosion in degraded PJ woodlands (Jacobs and Gatewood 1999). We developed structural targets that retained all pre-settlement trees while reducing densities to levels required to stimulate a robust herbaceous response. We removed all trees less than 6-8 inches (15-20 cm) in diameter and used the rough slash to mulch exposed soils. Removing the trees reduced stem density by at least three-quarters and decreased overstory tree cover to approximately 10 percent on 100-acre (40-ha) study sites and less than 5 percent on 50-ft² (15-m²) plots. Five years later, total herbaceous cover increased several fold, while sediment losses associated with erosion decreased dramatically. However, subsequent tree reproduction and persistent woody sub-shrub dominance threatened retention of the savanna structure and potentially limited full recovery of the herbaceous understory. To address these concerns, we began additional studies in 1999 to evaluate the effects of fire and its utility as a tool for maintaining mechanically restored PJ woodland savannas.



Two growing seasons after a burn, a researcher monitors vegetation along 50-ft transects on the Garcia Mesa pinyon-juniper (*Pinus edulis*-*Juniperus monosperma*) savanna restoration site. Photo courtesy of the Vegetation Program, Bandelier National Park

In this note, we discuss the preliminary results of burns conducted in 2000 on two small-scale plots that were mechanically treated in 1995—one located on Frijoles Mesa in Bandelier National Monument and the other on Garcia Mesa in the adjacent Santa Fe National Forest. We measured total fuel loading, vegetative cover and density, and nitrogen availability (Frijoles Mesa only), and used repeat photos at whole plot and small quadrat scales to complement cover data. In late summer/fall 1999, we collected pre-burn data. Both sites were burned in spring 2000, and we collected post-burn data for two consecutive growing seasons in 2000 and 2001. The pre-burn understory community included warm-season grasses, such as blue grama (*Bouteloua gracilis*); sub-shrubs, such as worm sage (*Artemisia* spp.), snakeweed, (*Gutierrezia sarothrae*), and pinque (*Hymenoxys richardsonii*); and a variety of forbs.

Our intent was to use fire to 1) cull regenerating trees, 2) reduce sub-shrub dominance, and 3) increase the cover and productivity of native perennial forbs and grasses, while avoiding potential adverse fire effects. Slash mulch, for example, is an important component of the restoration treatment early on because it captures surface runoff and sediment, buffers soil moisture and temperature, and creates favorable microsites for herbaceous plant establishment on otherwise harsh bare soils. However, introduction of fire could compromise site recovery if applied too early in the restoration cycle or under a prescription in which complete consumption of slash mulch resulted in excessive loss of herbaceous perennials.

Prior to fire treatment, Frijoles Mesa had higher fuel loads and slightly less grass cover than Garcia Mesa. Following the burns, we found a reduction of fuel loads at both sites, with nearly complete consumption at Frijoles Mesa. Likewise, although mortality of tree seedlings and sub-shrubs was notable at both sites, the intensity of the burn at Frijoles Mesa resulted in greater mortality of perennial grasses and forbs compared to Garcia Mesa. At two years post-burn, grass cover at Garcia Mesa (about 40 percent) appears to be approaching pre-burn levels of approximately 50 percent cover. The response of sub-shrubs to fire was mixed: snakeweed and pinque decreased in cover, while rhizomatous species—such as worm sage—increased.

Although we consider the use of fire essential for maintenance of PJ savanna structure, there are inherent risks to the herbaceous understory. In particular, we noted that turf-forming individuals of blue grama with excessive amounts of dead aboveground biomass appeared to be more susceptible to heat effects associated with complete consumption of slash mulch than more-vigorous bunch grasses, such as little bluestem (*Schizachyrium scoparium*).

Our preliminary results suggest that fire can be effective in maintaining woodland savanna structure by killing tree seedlings, but damaging heat effects on forbs and grasses can result from excessive fuel loading or less-than-optimal burn conditions. Given the relative susceptibility of PJ tree seedlings to fire, burning should be delayed until perennial grass cover and composition have reached levels deemed sufficient to provide an acceptable post-burn herbaceous response.

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Tree Shelters Promote Oak Regeneration on a Small Bottomland Hardwood Site (South Carolina)

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It is common practice in bottomland hardwood mitigation projects to replant tree and shrub communities in order to accelerate the development of functional wetlands. Restorationists (Nixon 1994) have found that tree shelters can effectively increase growth and survivorship of plantings, especially oaks (*Quercus* spp.). While the cost of purchasing and maintaining tree shelters may not be financially feasible for large-scale mitigation projects, an 18-month study that we conducted suggests that they are a viable option for small-scale bottomland hardwood restoration projects, particularly when a project's success is measured in terms of tree density after a relatively short time period.

In 1996, we began a five-year program to monitor a 49-acre (20-ha) bottomland tract adjacent to the Enoree River in Spartanburg County, South Carolina. A mitigation project was completed there in March 1995 that included re-establishment of native trees, shrubs, and aquatic macrophytes. Bare root tree stocks were generally planted in drier zones, and containerized woody and herbaceous stocks were used in the wettest areas. The mitigation permit defined success as 70 percent survival of planted woody vegetation. By 1998, we found that several species of planted oaks had suffered greater than acceptable mortality. To compensate for this loss, we planted pin oaks (*Q. palustris*) and water oaks (*Q. nigra*) in the drier sections of the site during February 1999. We used this opportunity to measure the effectiveness of tree shelters in improving the short-term survivability and growth rates of these species.

We planted 353 pin oaks and 363 water oaks on a 10-ft x 10-ft (3-m x 3-m) spacing. The trees, which were purchased from Spandle Nurseries in Claxton, Georgia, were bare root and ranged in size from 0.2 to 2.6 ft (5-79 cm) for pin oak and 0.3 to 4.2 ft (8-127 cm) for water oak. We planted trees in rows, with every other tree encased in a 4-ft (1.2-m) high TREE PRO® tree shelter. We secured each shelter with plastic cable ties to a wooden stake that was inserted into the ground a few inches away from each of the sheltered plantings. To decrease bird and insect nesting, we placed a net of mesh material over the top of each shelter. We then tagged every other pair of sheltered/unsheltered trees with a numbered metal label.

In spring and fall 1999 and fall 2000, we surveyed the tagged trees and measured the height of surviving trees. Statistical evidence of a difference in survival was determined according to overlap of 95-percent confidence intervals on survival estimates. Similarly, we used a comparison of confidence intervals for average height of surviving trees in order to estimate significant increase in growth rates of sheltered trees.

More than 85 percent of the sheltered trees of both species were alive in fall 2000 (Table 1). The survival rate of sheltered pin oak was 27 percent more than unsheltered pin oak, suggest-