Invasive Potential of Ashe Juniper After Mechanical Disturbance

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BOTTOM LINE

When 8-20 juniper trees per acre are left on a site, tree spatial arrangement has a significant effect on reinvasion rates.

Summary

- Seed density in the litter layer ranged from 111 to 133 seeds/ft^2 and in the soil layer from 30 to 57 seeds/ft^2.

- Seed rain ranged from 25 to 34 seeds/ft^2 over all tree arrangements.

- Viability and germinability within the seedbank were low (4% and 0%, respectively). The juvenile seedling bank contained a sufficient number of seedlings (165 seedlings per acre) for ashe juniper to regain dominance on the site through growth.

Introduction

Mechanical disturbance of juniper communities typically results in a mosaic of single trees and tree mottes within a grassland. Reestablishment of Ashe juniper (*Juniperus ashei*) after mechanical treatment must originate from residual seed in the seed bank, seed rain or input after the treatment, and/or the seedling bank of juvenile trees. A long-lived, viable seed bank allows a population to respond to episodic precipitation and other favorable establishment conditions. Many small to intermediate size islands of vegetation may be more effective at revegetating adjacent land through seed rain than a few large islands. Lastly, seedling banks represent not a reinvasion but rather a population of trees or shrubs already present on the site.

The objectives of our study were: 1) to identify and quantify the major source (or sources) of potential reestablishment by Ashe juniper into treated juniper communities, and 2) to determine the effect of tree arrangement on the seed bank, seed production, and seed rain of Ashe juniper.

Experimental Approach

The study was conducted on the Silver Lake Ranch, located 37 miles northwest of Uvalde, Texas. Two study sites were mechanically treated using a combination of one-way chaining and bulldozing. Three common tree arrangements, including single juniper trees scattered across the landscape, small mottes with 5 or fewer neighbors in a group, and large mottes with 10 or more neighbors, were identified within each site. Two years later, 5 repetitions of each tree arrangement and an additional 5 repetitions of undisturbed trees in adjacent communities were located on each study site.

Juniper berry production was estimated using a modified reference unit method. The soil seed bank was sampled using a plot placed at the base of the tree, mid-way between the bole and the canopy dripline, at the dripline, and at 3 ft intervals for 15 ft past the dripline. The litter layer and the top 2 in. of the A soil horizon were collected by coring and were bagged separately. Seed rain was estimated by collecting and counting all seeds on the soil surface at the same locations used for the soil seed bank study. Seeds were tested for viability and germinability. The seedling population was sampled in 20 randomly located transects on each replication.

Results

A simple model of potential invasion was developed using the residual seed bank, seed rain, viability and germinability data for each of the tree arrangements. The actual ground area of each concentric ring representing the distance from the bole of the tree was calculated based on average sized mature juniper trees. At a density of 20 reproducing trees per acre, the small and large motte arrangements affected significantly less area than either single trees or native communities (Figure 1). When 8 to

20 trees were left on the site, spatial arrangement of single trees yielded approximately 30% more land area affected by seed rain than the same number of trees in either small motte or large motte arrangements. When only 4 trees per acre were left on the site, there were no differences in land area affected between the 3 tree patterns.

Discussion

The reservoir of viable seeds in the litter and mineral soil was immense. In every tree arrangement, there were more than 95,000 seeds in the seed bank yielding 3,767 viable seeds which could potentially replace the single mature tree. The density of germinable seeds was much less, however, since germinability under the test conditions was 0% in the litter and mineral soil. In our trials 0 seeds germinated from the 1,000 tested, but a germinability rate of even 1 in 10,000 would contribute substantially to a new juniper community.

Spatial arrangement of trees can affect reinvasion rates of treated juniper communities. If residual density of trees is greater than 8 trees per acre, then leaving trees in groups of 2 or 4 to create islands of juniper mottes will result in a lower potential invasion rate than leaving the same number of trees as randomly distributed single trees. The single trees serve as satellite foci for the invasion process, which increases the rate of spread for the population. Leaving trees in mottes reduces the distribution of seeds into the interspace regions so potential invasion is lower. Post-dispersal seed predation and movement were not investigated in this study so it is possible that an unknown number of seeds may be redistributed by either vertebrates or invertebrates. These seeds may be placed in microsites which favor establishment or they may be placed in areas where establishment is impossible. Successful, long-term management of ashe juniper populations is unlikely without considering both the input of new seed and reduction of the seedling bank.

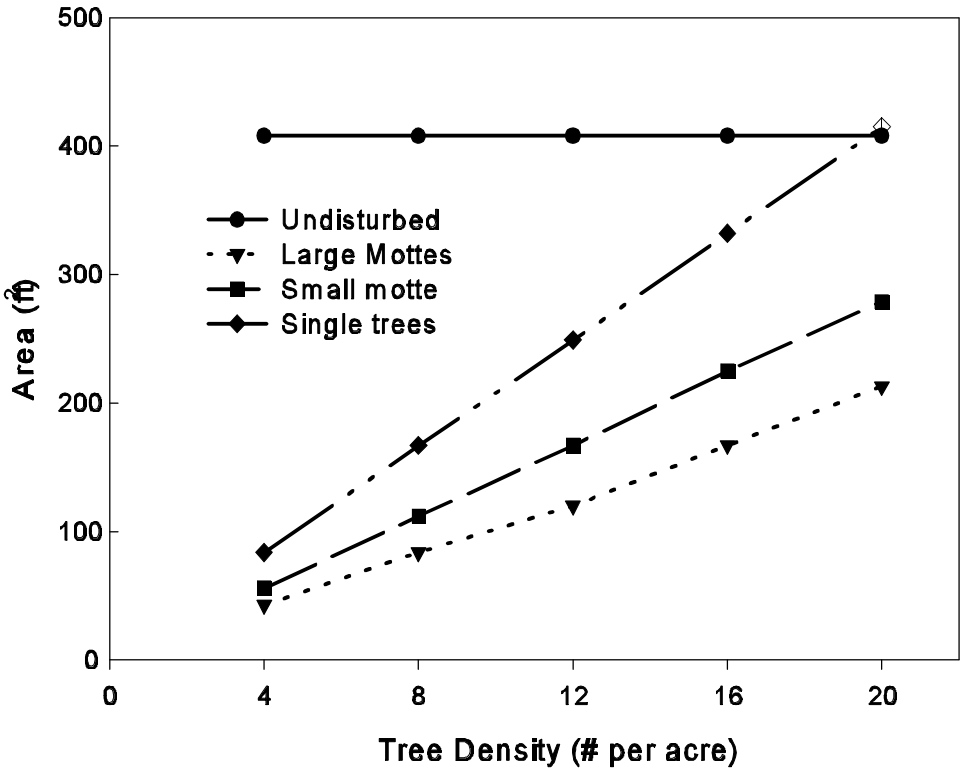

Figure 1. Predicted area affected by seed input by increasing tree density from 4 different spatial arrangements of trees.