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Author(s): B. K. Kerns and M. A. Day
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Fuel Reduction, Seeding, and Vegetation in a Juniper Woodland

B. K. Kerns[1] and M. A. Day[2]

Authors are [1]Research Ecologist, US Department of Agriculture Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, USA; and [2]Faculty Research Assistant, College of Forestry, Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331, USA.

Western juniper has increased in density and distribution in the interior Pacific Northwest since the late 1800s. Management goals for many juniper woodlands are now focused on reducing tree densities and promoting biodiversity, prompting the use of fuel reduction treatments. Fuel reduction often involves mechanical cutting and disturbances such as slash pile burning and skid trail formation. While these activities may reduce tree densities, the extent to which they will restore native biodiversity and community composition, particularly in woodlands invaded by exotic annual grasses, is unclear. We evaluated the effects of juniper cutting in two experiments of disturbance type (slash piles and skid trails) followed by three native seeding treatments (cultivar, locally sourced, and no seed) on vegetation in central Oregon. Prior to cutting, native perennial grass cover and richness were positively associated and exotic grass cover was negatively associated with juniper basal area. After cutting and 2 yr after seeding, species composition was altered for both disturbance types. Some seeded areas had higher total species richness, higher native species richness, higher cover of seeded species, and higher overall cover compared to areas that were not seeded. But seeding effectiveness in mitigating exotic species spread varied based on exotic species functional group, pretreatment propagule pressure, and experiment disturbance type. Neither seed mix lowered exotic grass cover. There was limited evidence that the cultivar mix outperformed the locally sourced native seed mix. In the short term, fuel reduction activities may have facilitated further conversion of this woodland to an exotic grassland, but longer-term evaluation is needed. In juniper woodlands that have been invaded by exotic species, fuel reduction activities may facilitate further invasion, and exotic species control may be needed to limit invasion and promote native vegetation.

Key Words: big sagebrush, biotic resistance, exotic invasive plants, juniper encroachment, *Juniperus occidentalis*, thinning

INTRODUCTION

Western juniper (*Juniperus occidentalis* Hook.) woodlands represent the northwestern extension of the pinyon-juniper woodlands of the Great Basin (Young and Evans 1981). Pinyon and juniper woodlands have expanded their range since the late 1800s at the expense of sagebrush steppe and other Great Basin plant communities. This expansion has been attributed to climatic variability, historically heavy livestock grazing around the turn of the 20th century, fire suppression, and increases in atmospheric CO_2 (Young and Evans 1981; Eddleman 1987; Miller et al. 1987; Miller and Wigand 1994; Knapp and Soulé 1998; Miller and Rose 1999; Miller et al. 2005). As a result of the increased density and distribution of western juniper, significant impacts on a variety of ecosystem functions have been reported, such as soil resources, plant community structure and composition (loss of shrubs, lower herbaceous cover), water and nutrient cycles, wildlife habitat, and biodiversity (Bates et al. 2000; Miller et al. 2000, 2005; Pierson et al. 2007). Control of western juniper has been a major land management focus since the early 1960s.

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At the time of research, M. A. Day was M. A. Buonopane, Biological Technician, US Dept of Agriculture Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, USA.

Correspondence: B. K. Kerns, US Dept of Agriculture Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, USA. Email: bkerns@fs.fed.us

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Fuel reduction treatments that reduce juniper density, such as cutting and burning, have been implemented by land managers to reduce wildfire severity and restore sagebrush steppe and grassland ecosystems. Various treatments to reduce juniper density can increase herbaceous production and cover following treatment, although failures are reported if sites lack adequate herbaceous perennial vegetation to prevent invasive species invasion (Young et al. 1985; Vaitkus and Eddleman 1987; Bates et al. 2000, 2005, 2011; Miller et al. 2005; Bates and Svejcar 2009; Baughman et al. 2010; Condon et al. 2011). Disturbances such as tree cutting, slash pile burning, and skid trail formation alter resource availability by opening forest canopies and reducing above- and belowground competition (Davis et al. 2000). Slash pile burning typically results in complete vegetation mortality, probable reduction of seed bank resources (Korb et al. 2004), and ash bed formation. Skid trail disturbance typically leads to limited mortality of existing vegetation. However, trails expose large areas of bare compacted soil by repeated disturbance as logs are transferred to landings. Examination of vegetation recovery following fuel reduction, slash pile burning, and skid trail formation can assist the development of appropriate management practices.

Restoration of native biodiversity in juniper woodlands after fuel reduction activities often depends on the threat of exotic plant invasion, especially invasive annual grasses (e.g., cheatgrass, *Bromus tectorum* L., medusahead, *Taeniatherum caput-medusae* [L.] Nevski, and North Africa grass, *Ventenata dubia* [Leers] Coss.), particularly at lower-elevation sites that are highly disturbed (Miller et al. 2005; Davies et al. 2011). Exotic invasive species are well adapted to exploit postdisturbance environments frequently characterized by increased resources. Factors that