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Fire exclusion effects on riparian forest dynamics in southwestern Oregon

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ABSTRACT

Euro-American settlement and organized fire suppression have been associated with structural and compositional changes in many upland forests of the western United States, but little is known about the impacts on riparian forests, portions of the landscape protected for habitat and water quality. In this study, we used dendro-ecological methods to characterize the pre-settlement disturbance and tree recruitment processes of riparian forests in the Rogue River basin of southwestern Oregon and to identify changes to the forest structure and composition post-settlement. Our results suggest riparian forests in our study area developed with frequent disturbance by fire and that Euro-American land management shifted these forests onto a new successional trajectory. Our findings indicate the current hands-off management regime for riparian forests under the Northwest Forest Plan will continue along this altered trajectory and have ecologically undesirable consequences. We suggest that the restoration of pre-settlement forest dynamics in fire-prone forests of southwestern Oregon will be most effective where it includes density reductions in overstory trees and prescribed fire in both upland and riparian forests.
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1. Introduction

Euro-American settlement and organized fire suppression have effectively excluded fire from many portions of the western United States, and this exclusion has been associated with structural and compositional changes in forests that historically burned under low- or mixed-severity fire regimes (Agee, 1993). While the impacts on upland forests have been well documented (Agee, 1993, 1998; Sensenig 2002), little is known about the impacts on riparian forests, portions of the landscape protected for habitat and water quality. Under the 1994 Northwest Forest Plan (NWFP), a riparian reserve system was created to protect riparian ecosystems from the impacts of timber harvest and other anthropogenic disturbance (FEMAT, 1993; USDA and USDI, 1994; Hann et al., 1997; Sedell et al., 1997; USDI et al., 1999). The hands-off management approach for riparian forests under the NWFP has led some to question how separate management practices for riparian reserves might affect natural disturbance processes (Everett et al., 2003). Previous studies of fire disturbance in Pacific Northwest riparian forests have focused on fire history reconstruction (Skinner, 1997; Everett et al., 2003; Olson and Agee, 2005), drivers of riparian fire severity (Halofsky and Hibbs, 2008), and post-fire vegetation response (Halofsky and Hibbs, 2009). The effects of fire exclusion on riparian forest structure and composition remain largely unknown.

Fires occurred frequently in southwestern Oregon, a part of the Klamath-Siskiyou bioregion (Taylor and Skinner, 1998), making it an excellent area in which to study the role of fire in riparian forest systems and the changes in structure and composition that may have occurred with fire exclusion. The Mediterranean climate of southwestern Oregon is characterized by cool and moist conditions for much of the year, with a summer drought and fire season typically lasting over three months. Frequent fires have shaped upland forests throughout southwestern Oregon and fire exclusion effects have been documented in these uplands (Sensenig, 2002; Taylor and Skinner, 2003). Fires have likely been important in shaping and maintaining riparian forests as well.

In this study, we used temporal and spatial recruitment patterns, fire scar evidence, and the autecological characteristics of co-occurring species to make inferences about what type of fire regime historically shaped riparian areas within low- and mid-elevation forests of southwestern Oregon. The fire regime of upland mixed conifer forests of southwestern Oregon and the greater Klamath-Siskiyou bioregion has been described as mixed-severity, in which topographic complexity is a major driver of the spatial patterns of fire and its effects on vegetation (Taylor and Skinner, 2003). We expected the fire regime and stand structures in riparian areas of our study region to be similar to that of the adjacent uplands; however, we considered the riparian microclimate could have moderated fire effects (Halofsky and Hibbs, 2008) and re-

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sulted in denser forests than were present upslope with a greater representation of shade-tolerant and fire-sensitive species. The objectives of this study were to (1) characterize the pre-Euro-American settlement fire regime and stand characteristics for riparian forests in the region and to determine the changes in (2) overall tree density, (3) species composition, (4) age structure, and (5) temporal recruitment patterns that have occurred since Euro-American settlement. We hypothesized that riparian forests in southwestern Oregon developed with frequent disturbance by low- and mixed-severity fire and that Euro-American settlement and fire suppression shifted these forests into a new successional trajectory with (1) uncharacteristically high tree densities, (2) increased recruitment of fire-sensitive species and (3) temporal patterns of tree recruitment unlike those of the past.

2. Methods

2.1. Site selection

We investigated structural and compositional changes in riparian forests of two fire-prone regions of southwestern Oregon: the upper Applegate Valley and the Butte Falls Resource Area of the USDI Bureau of Land Management (BLM). Both regions are part of the greater Rogue River basin and are managed by the BLM and USDA Forest Service (USFS). We used BLM and USFS data sources to identify all unmanaged, first and second order headwater stream reaches (hereinafter referred to as 'sites') in our study area. We then inspected potential sites to select those with no evidence of tree harvest or hydraulic mining. We chose among the acceptable sites a group that represented the range of stream sizes and forest vegetation types in our study area. The selected sites ranged from 500 to 1000 m in elevation and are representative of the low- to mid-elevation forests held by the BLM and USFS in southwestern Oregon. Riparian forests sampled in both study regions were dominated by Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and bigleaf maple (*Acer macrophyllum* Pursh), with adjacent upland forests in two vegetation zones: the more mesic Mixed Conifer (*Pinus–Pseudotsuga–Calocedrus–Abies*) and the more xeric Interior Valley (*Pinus–Quercus–Pseudotsuga*) (Franklin and Dyrness, 1973). Each of these vegetation zones represents a geographic area with a similar climate, similar species composition, and similar historic disturbance regime. Vegetation zones were the basis for our sampling design and are the primary units for analysis. Fifteen sites were sampled during the summer of 2007 in the upper Applegate Valley region, with eight sites in the Mixed Conifer vegetation zone, and seven in the Interior Valley zone (Fig. 1). In the summer of 2008, thirteen sites were sampled in the Butte Falls Resource Area of the Bureau of Land Management, with seven sites in the Mixed Conifer zone and six in the Interior Valley zone.

2.2. Site descriptions

The Mixed Conifer vegetation zone is typical of mid-elevation forests in the southern Oregon Cascade Range and eastern Siskiyou Mountains and is the northern extent of the Sierran montane or mixed-conifer forests (Franklin and Dyrness, 1973). The Mixed Conifer zone is bounded by the Interior Valley and *Abies concolor* types at its lower and upper limits, respectively. Annual precipitation varies from about 900 to 1300 mm, little of which occurs in the summer months. The major overstory tree species in Mixed Conifer riparian forests include: Douglas-fir, white fir (*A. concolor* (Gord. & Glend.) Lindl. ex Hildebr.), incense cedar (*Calocedrus decurrens* (Torr.) Florin), white alder (*Alnus rhombifolia* Nutt.) and

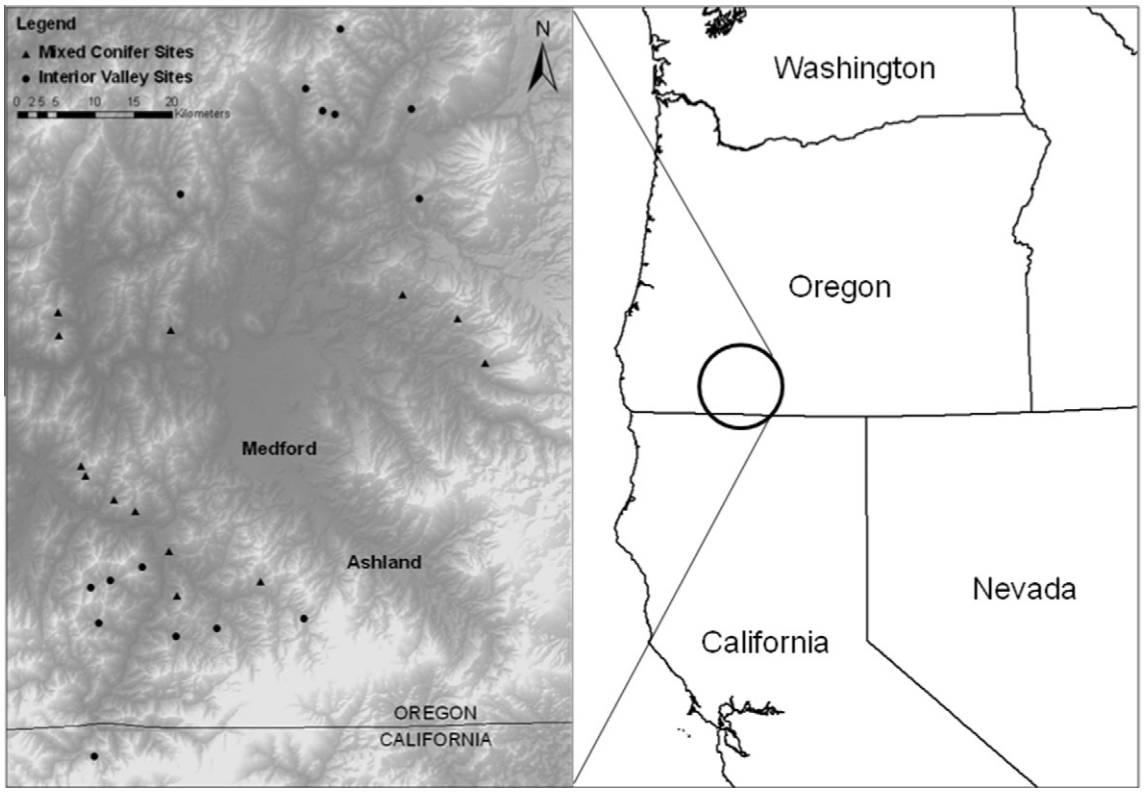

Fig. 1. Locations of riparian study sites in the Mixed Conifer and Interior Valley vegetation zones, Rogue River basin, Oregon. Topography of the study area is displayed in the left panel, with higher elevations appearing lighter.

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