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RESEARCH ARTICLE

Salvage Logging Versus the Use of Burnt Wood as a Nurse Object to Promote Post-Fire Tree Seedling Establishment

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Abstract

Intense debate surrounds the effects of post-fire salvage logging (SL) versus nonintervention policies on forest regeneration, but scant support is available from experimental studies. We analyze the effect of three post-fire management treatments on the recruitment of a serotinous pine (*Pinus pinaster*) at a Mediterranean mountain. Treatments were applied 7 months after the fire and differ in the degree of intervention, ranging from "no intervention" (NI, all trees left standing) to "partial cut plus lopping" (PCL, felling most of the trees, cutting the main branches, and leaving all the biomass in situ without mastication), and "SL" (felling and piling the logs, and masticating the woody debris). Seedling survival after 3 years was the highest in PCL (47.3% versus 38.7% in SL). This was associated with the amelioration of microclimatic conditions under the scattered branches, which reduced radiation and soil temperature while increasing soil moisture. Seedling density after 2 years was approximately 5.5 times higher in PCL than in SL, as in SL a large fraction of seedlings was lost as a consequence of mechanized mastication. The NI treatment showed the lowest seedling survival (17.3%). Nevertheless, seedling density was similar to SL. Seedling growth scarcely differed among treatments. Our results show that branches left onsite acted as nurse objects that improved key microclimatic conditions for seedling recruitment. This creates a facilitative interaction ideal for seedling establishment in moisture-deficient ecosystems, as it provides the benefit of a shading overstory but without underground competition.

Key words: facilitation, nurse structures, *Pinus pinaster* regeneration, post-fire restoration, salvage harvesting.

Introduction

A current controversial issue among restoration ecologists and forest managers is the appropriate management of dead burnt trees after fire. Post-fire salvage logging (SL) (i.e., the felling and removal of the burnt tree trunks, also often eliminating the remaining woody debris [branches, logs, and snags] by chipping, mastication, fire, etc.) has historically been routinely and widely practiced by forest administrations around the world (McIver & Starr 2000; Bautista et al. 2004; Beschta et al. 2004; Spanos et al. 2005; Lindenmayer & Noss 2006), particularly in the case of burnt conifer forests. However, there is currently an intense debate about the suitability of this approach. Several recent studies show that the felling and removal of burnt trees using ground-based yarding techniques may hamper the regeneration of the plant community by increasing soil erosion and compaction, reducing nutrient availability, damaging the seedling bank, or reducing species richness and diversity (McIver & Starr 2000, 2001; Beschta et al. 2004; Donato et al. 2006; Lindenmayer & Noss 2006). As a result, there are increasing calls to implement less aggressive post-fire treatment policies and actions, including nonintervention, associated with evidence that snags and decaying burnt wood are important components of natural systems that promote ecosystem recovery and diversity (Beschta et al. 2004; Lindenmayer et al. 2004; DellaSala et al. 2006; Hutto 2006).

The reasons commonly invoked to justify post-fire SL may be summarized into five core rationales: (1) recover economic returns from burnt logs; (2) reduce subsequent fire risk; (3) improve site conditions for managed reforestation work in the future (e.g., tree planting); (4) decrease risk of insect pests provoked by burnt wood; and (5) reduce risk of accidents to humans from treefall (Ne'eman et al. 1995; Martínez-Sánchez et al. 1999; McIver & Starr 2000; Bautista et al. 2004; Spanos et al. 2005). These potential reasons to support post-fire SL, however, depend on the characteristics

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