Title Burn severity and pre-fire seral state interact to shape vegetation responses to fire in a young, western Cascade Range forest

Do young forests respond to fire differently than older forests? Does pre-fire seral stage impact species richness and diversity during recovery? The authors investigated the response of understory plants to fire in a previously logged forest. They measured species composition, richness, diversity, and evenness before and after a controlled burn. The authors described changes for early-seral annuals and perennials and for forest generalists, which are mainly shade-tolerant shrubs.

Key Findings

- Fire impacted cover of functional groups differently. Two years post-fire shrub cover decreased drastically and herb cover increased. Early-seral and forest shrubs were less abundant while early-seral perennials were much more abundant. More subtle changes in species richness followed the same pattern.
- Greater fire-severity and more mature seral state were associated with greater compositional change post-fire. Increasing fire severity led to decreasing diversity and evenness, while richness was unchanged. The impact of tree cover loss depended on fire intensity and pre-fire seral state. Diversity and evenness increased with tree cover loss.

How did plant functional groups respond to fire and loss of tree cover?

- Annual and perennial herb cover increased with fire severity, but annuals accounted for only 1% of total herb cover.
- The response of early-seral shrubs cover depended on whether the species were fire-sensitive or fire-insensitive. Richness of early-seral herbs did not increase with fire severity. Early-seral herbs did increase with loss of tree cover.
- Both cover and richness of forest herbs and shrubs declined with increased fire severity. Shrub cover declined in proportion to pre-fire cover. Subshrub cover did not respond to fire severity, although richness decreased where it had been higher pre-fire.
- As loss of tree cover increased and ground fire was absent, shrub cover did not change, subshrub cover increased, and herb cover increased but was dependent on pre-fire conditions.

Management Implications

- Species with exposed or shallow regenerative structures declined with increased fire severity. Species with deeper regenerative structures did not decline.
- Frequency and cover of fire-sensitive species did not change drastically across the entire study area. This may be because these species can quickly grow or expand in areas with lower fire severity.
- Past disturbance of a forest may impact seral stage recovery. If a forest is impacted by fire before the forest shrub functional group has been reestablished, the seral progression to forest species may be delayed.

Use of Findings

Additional research is needed to determine the longer-term effects of fire on regenerating forests at various stages of early succession.

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Keywords early seral, fire severity, forest understory, functional group, seral state, species diversity

Images (Snip best images from paper)

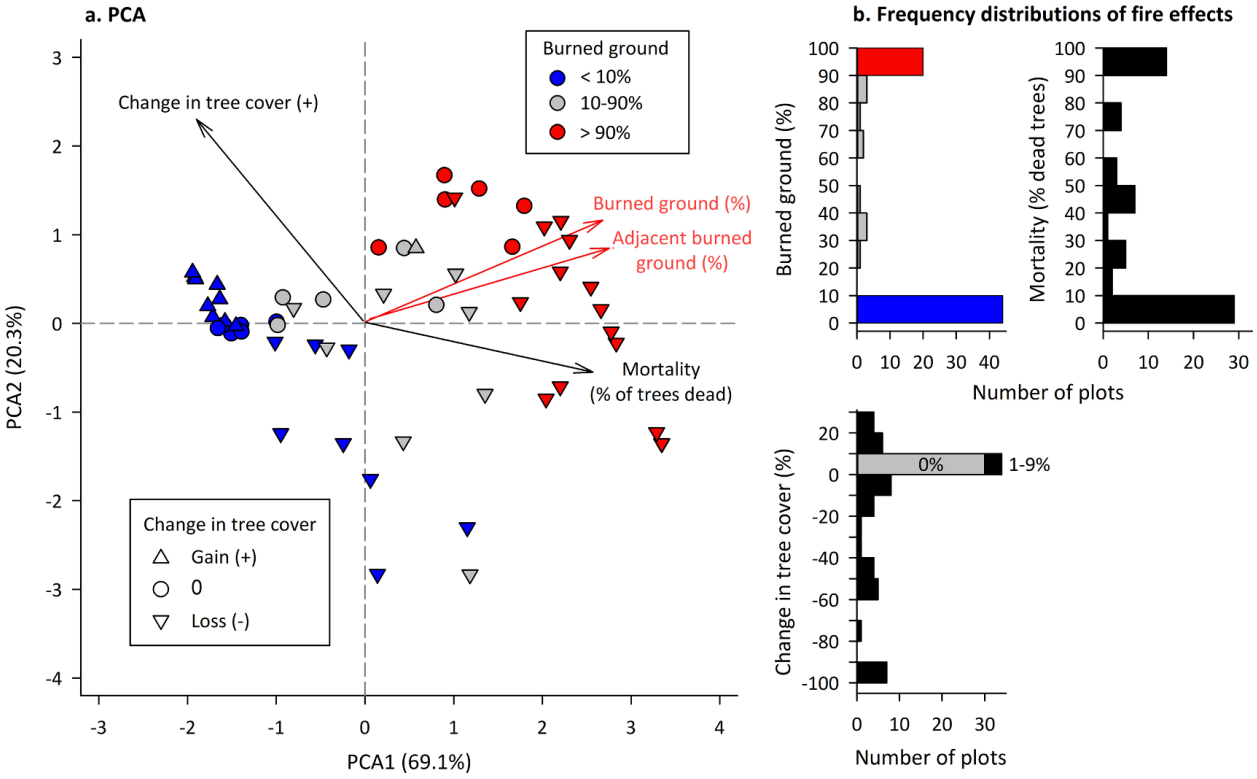

Fig. 3 from paper. (a) Principal components analysis (PCA) of fire-effects variables. Arrows represent variable correlations with axes. PCA1, which explains 69.1% of the total variation, is positively correlated with cover of burned ground in and adjacent to the plot (r = 0.89 and 0.93, respectively) and with tree mortality (% of trees dying within 2.5 m of the plot; r = 0.85). PCA2 explains 20.3% of the variation, with lower scores corresponding to greater loss of tree cover (r = 0.74). Colors correspond to cover of burned ground and symbols correspond to the direction of change in tree cover (loss, no change, or gain). (b) Frequency distributions of fire-effects variables. Among the 75 plots, 30 had no change in tree cover (grey bar).

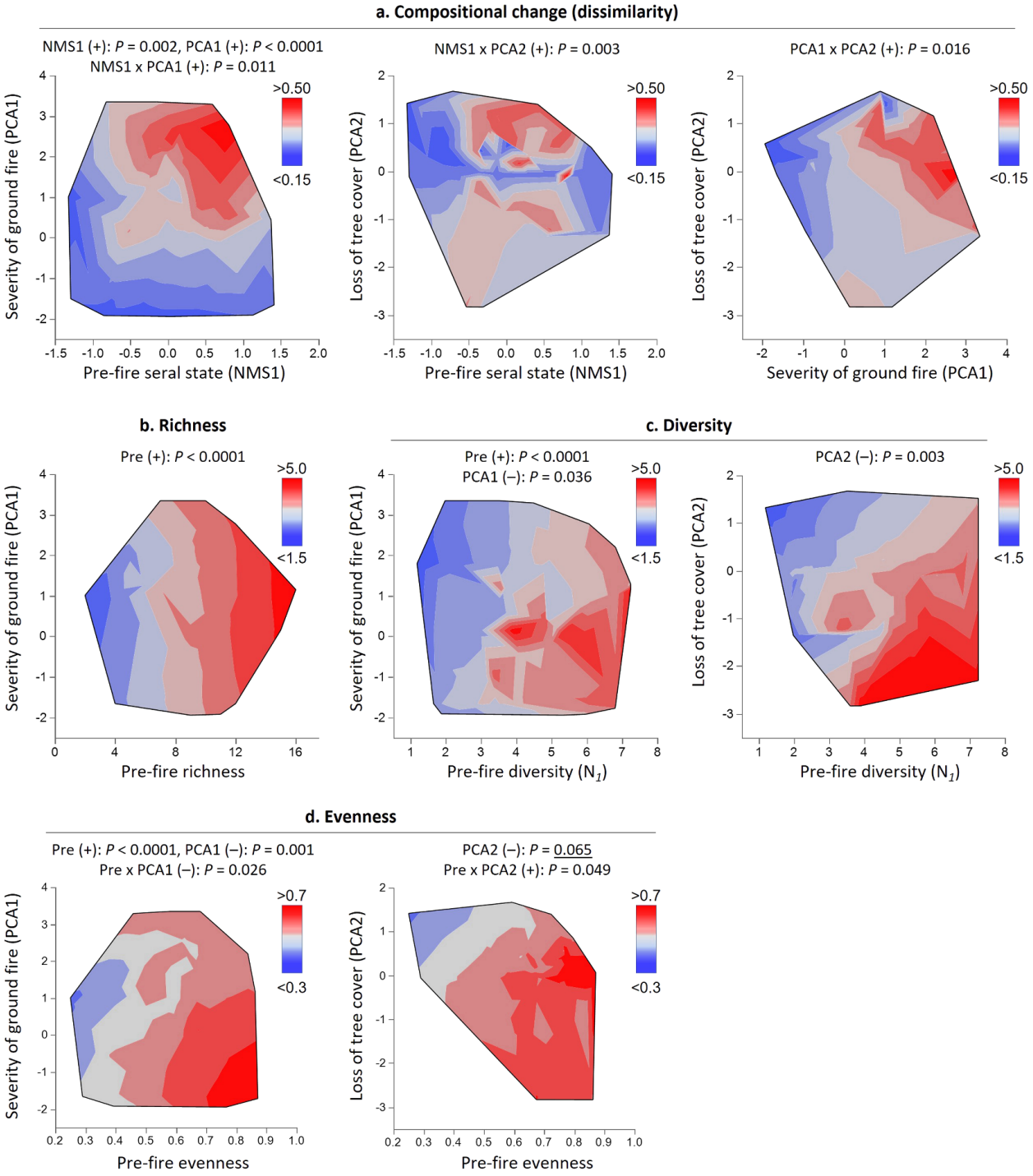

Fig. 4 from paper. Modeled relationships of community-level metrics in year 2 to pre-fire conditions (Pre), PCA1 (proxy for severity of ground fire), and PCA2 (proxy for loss of tree cover, with lower scores corresponding to greater loss of cover). Predicted values are plotted, increasing in magnitude from blue to red. The signs (+ or □) and significance of model terms, including interactions, are shown above each panel. Table 3 contains full model results. (a) Compositional change (Bray-Curtis dissimilarity pre- to post-fire), (b) species richness (number of species/1-m2 plot), (c) species diversity (Hill's N*1*, the exponential of Shannon's index), and (d) species evenness (the modified Hill's ratio, [N*2*-1]/[N*1*-1]).