Vegetation and fuel dynamics in frequently burned mixed conifer forests Northern Sierra Nevada Range, California

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Background

Due to climate change and massive fuel load accumulation as a result of fire suppression policy during the 20th century, many dry forests in the western U.S. are poised to burn at high severity and frequency. Now, extinguishing fire in order to arrest the biggest threat to timber resources and property in the wildland-urban interface is a battle of enormous cost. These threats have shifted the attention of land managers towards post-fire landscape management. Therefore, it is crucial to manage post-fire conditions to increase forest heterogeneity to promote sustainable functioning through future climatic changes.

Hypotheses

H1: Successive high severity fires create a positive feedback that promotes dominance by shrubs & homogenization of vegetation structure.

H2: Multiple low to moderate intensity fires in fire-excluded montane mixed conifer forests

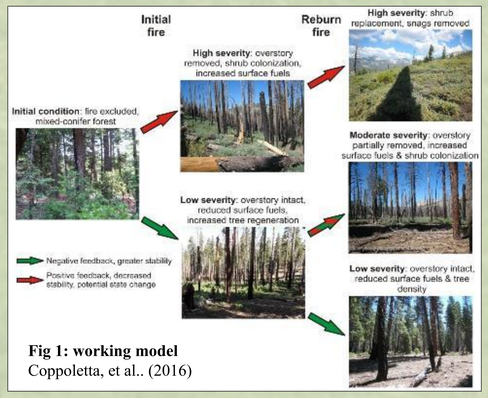

Fig 1: working model
Coppoletta, et al.. (2016)

will result in a stabilizing negative feedback by reducing surface fuels and small tree density, while maintaining larger over-story trees and promoting landscape-scale forest heterogeneity and structural diversity.

Study Area

The northern Sierra Nevada of California on the Plumas and Lassen National Forests.

The topography is mountainous and steep, with elevations 525m-2160m → 3 fires in 12-years.

- Storrie Fire: 2000
- Rich Fire: 2008,
- Reburn Chips Fire: the 2012

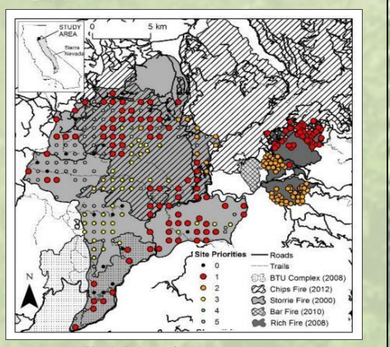

Fig 2: Map of study area

Methodology

138 Common Stand Exams were conducted in 2012-13, and repeated in 2017-18. Trees were identified and dbh and shrub cover were measured within circular plots. Four Brown's (1974) fuels transects per plot were sampled. Random forest (RF) and conditional inference trees (CIT) used for data analysis.

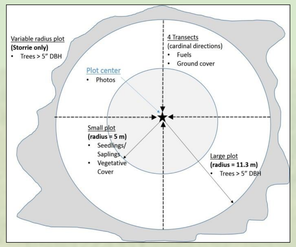

Fig 4: USDA Forest Service 2009

Results

Post-Chips, Mean Shrub Cover

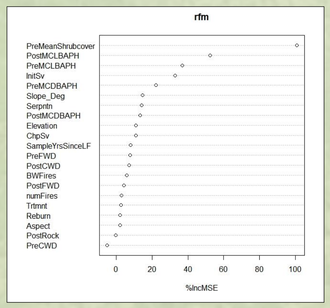

Fig 5: Random Forest Model Importance

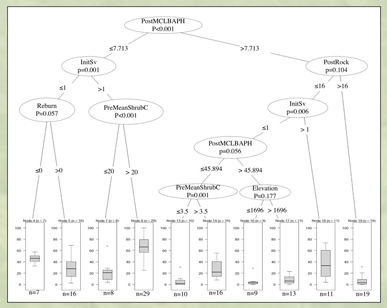

Fig 6: Conditional inference tree for the Shrub data

Post-Chips, Total Fuel

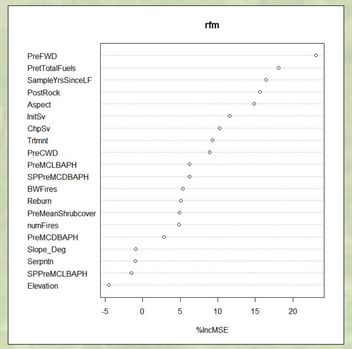

Fig 7: Random Forest Model Importance

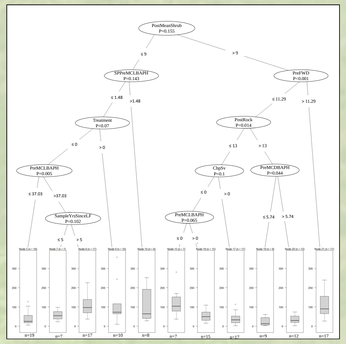

Fig 8: Conditional inference tree for the total fuel (fine and coarse woody debris) data

Post-Chips, Mixed Conifer Basal Area Per Ha

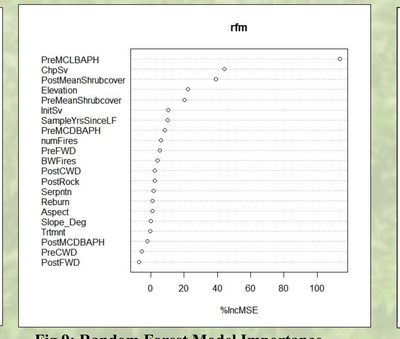

Fig 9: Random Forest Model Importance

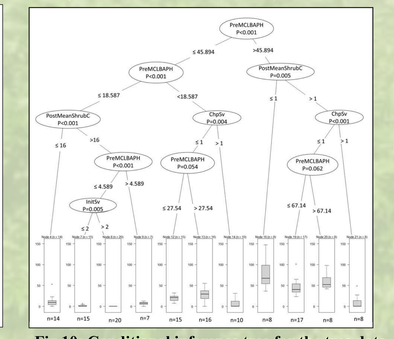

Fig 10: Conditional inference tree for the tree data

Conclusions

H1: partially supported

- ❖ Positive feedbacks:
  - Homogenization of vegetation - Higher initial severity and greater pre-shrub cover → significantly higher post shrub cover response.
  - High post shrub cover + high reburn severity → significantly decreases mixed conifer basal area.
- ❖ Alternatively, if reburn severity is higher → decreased shrub cover.

Conclusion H1

- ➢ High severity fire may not necessarily lead to persistent shrub dominance.
- ➢ Treatment has slight effects in decreasing post-reburn fuel loads.

H2: fully supported

- ❖ Large trees surviving - Low-moderate reburn severity → promotes forest heterogeneity and structural diversity → negative feedback

Conclusion H2

- ➢ RF and CIT analysis does examine species composition shifts at this point, trees are pooled.

Acknowledgements

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