CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Using historical aerial imagery to assess non-conifer vegetation type change under fire exclusion

Fertel, Hannah M., Brandon M. Collins, Jamie M. Lydersen, and Scott L. Stephens. 2023. Vegetation type change in California's Northern Bay Area: A comparison of contemporary and historical aerial imagery. Forest Ecology and Management 542 (August):121102. https://doi.org/10.1016/j.foreco.2023.121102

Management Implications

- Between 1948 and 2014, forest cover proportion and patch size increased, while woodlands and shrublands were most susceptible to conversion to forest types
- Removal of Indigenous burning is a possible driver of this vegetation change
- Increased fuel continuity and ladder fuels may warrant fuel reduction treatments in areas converted to dense forest

Background

Although vegetation types other than conifer forests make up the majority of burned area in California wildfires, relatively few studies quantify the drivers and patterns of vegetation change in these ecosystems. The impacts of fire exclusion on non-conifer systems remain poorly understood, and the relative influence of fuels compared to factors like climate change or type conversion on fire behavior is largely unknown. To address this knowledge gap, the authors investigated large-scale vegetation change as a possible driver of current trends in fire behavior within mixed-hardwood and shrub-dominated ecosystems in central and coastal Northern California.

Study Goals

To quantify vegetation change and potential drivers of change in these vegetation types in the absence of frequent fire, the authors mapped the extent and patch sizes of vegetation classes across a 52,000 ha study area based on historical (1948) and contemporary (2014) aerial imagery. With this dataset the authors aimed to 1) quantify landscape-scale vegetation patterns for both time periods; 2) assess major changes and pathways of change in vegetation types across the study area; and 3) evaluate important drivers of vegetation change, especially from non-forested to forested patches.

Key Findings

The authors detected a large increase (12%) in the relative landscape proportion and average patch size of the forest class (i.e. dense tree canopy cover). Woodlands (lower canopy cover) and shrub patches were most susceptible to vegetation type change, most commonly transitioning into denser forest. Herbaceous and forest patch types were more persistent throughout the study period. Whether an area had burned, elevation, and aspect were important influences on the likelihood of vegetation type persistence. A possible driver of the conversion of woodlands and shrublands to dense forest is the exclusion of frequent fire from the landscape.

The increase in dense forest due to the conversion of large areas of shrub and woodland vegetation may correspond to increased wildfire risk, and the authors note that fuel reduction treatments may be warranted in mixed-hardwood forests.

Detailed Methods

Vegetation types were classified by segmenting imagery homogeneous polygons and assigning a vegetation category using a random forest algorithm. The authors then analyzed patterns of change using spatial statistics and conditional inference tree analysis.

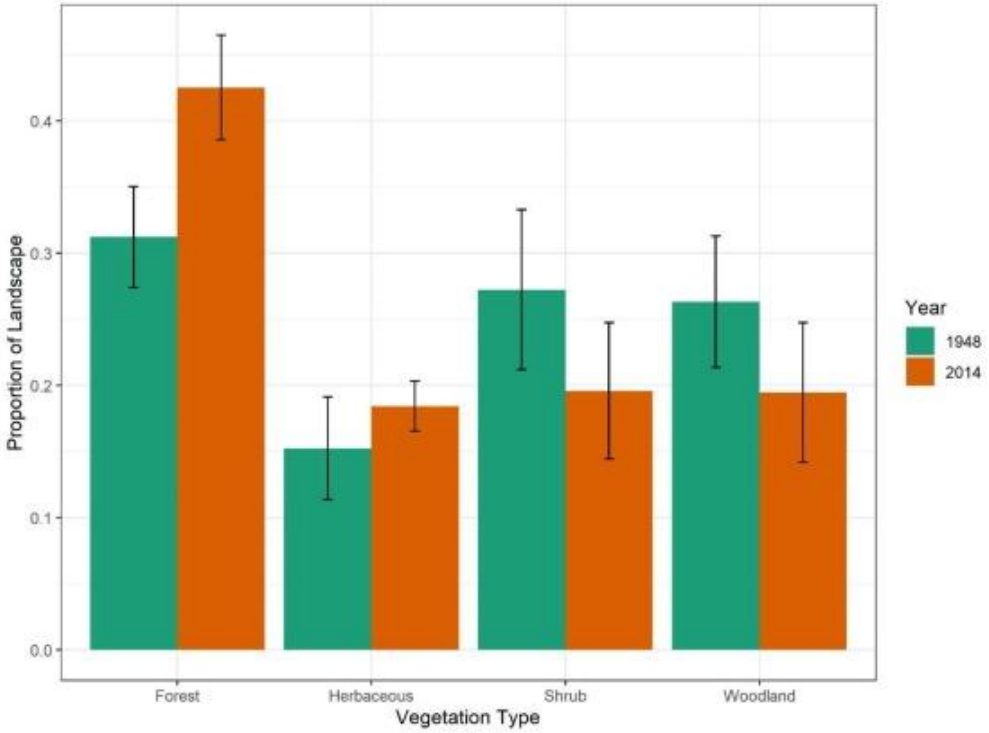

Figure 1. Bar graph comparing predictions for the proportion of the landscape of each vegetation type for 1948 and 2014 imagery, including 95% confidence intervals derived from post-classification accuracy rates. Our forest class was the only class that exhibited significant change in relative landscape proportions.

Further Reading

Evett, Rand R., Arthur Dawson, and James W. Bartolome. 2013. "Estimating Vegetation Reference Conditions by Combining Historical Source Analysis and Soil Phytolith Analysis at Pepperwood Preserve, Northern California Coast Ranges, U.S.A." *Restoration Ecology* 21 (4): 464–73. https://doi.org/10.1111/j.1526-100X.2012.00912.x.

Greenlee, Jason M., and Jean H. Langenheim. 1990. "Historic Fire Regimes and Their Relation to Vegetation Patterns in the Monterey Bay Area of California." *American Midland Naturalist* 124 (2): 239. https://doi.org/10.2307/2426173.

Keeley, Jon E. 2002. "Native American Impacts on Fire Regimes of the California Coastal Ranges." *Journal of Biogeography* 29 (3): 303–20. https://doi.org/10.1046/j.1365-2699.2002.00676.x.

Lake, Frank K., Vita Wright, Penelope Morgan, Mary McFadzen, Dave McWethy, and Camille Stevens-Rumann. 2017. "Returning Fire to the Land: Celebrating Traditional Knowledge and Fire." *Journal of Forestry* 115 (5): 343–53. https://doi.org/10.5849/jof.2016-043R2.

Lightfoot, Kent G, Rob Q Cuthrell, Mark G Hylkema, Valentin Lopez, Diane Gifford-Gonzalez, Roberta A Jewett, Michael A Grone, et al. 2021. "The Eco-Archaeological Investigation of Indigenous Stewardship Practices on the Santa Cruz Coast." *Journal of California and Great Basin Anthropology* 41 (2): 187–205.

Russell, William H., and Joe R. McBride. 2003. "Landscape Scale Vegetation-Type Conversion and Fire Hazard in the San Francisco Bay Area Open Spaces." *Landscape and Urban Planning* 64 (4):201–8. https://doi.org/10.1016/S0169-2046(02)00233-5.