CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Post-fire Accumulation and Spatial Arrangement of Fuels in Varying Aged Chaparral Stands

Kellie A. Uyeda, Douglas A. Stow, John F. O'Leary, Ian T. Schmidt, and Philip J. Riggan. 2016. Spatial variation of fuel loading within varying aged stands of chaparral. Applied Vegetation Science, 19: 267–279. doi: 10.1111/avsc.12209.

Management Implications

- Combining detailed field measurements with remotely sensed classification of dominant species groups is a valuable method for mapping the spatial arrangement of fuels in chaparral.
- There is a high level of spatial-variability within chaparral stands that should be incorporated in fuel modelling efforts.

Chaparral shrublands cover a significant portion of southern California. The abundance of wildfire that occurs in chaparral due to the interaction of humans and the environment has created a need to better understand how aboveground biomass in these stands accumulates after fire across the landscape. While shrub cover increases rapidly after fire, less is known about biomass accumulation. Uyeda *et al.* demonstrate how combining detailed field measurements with remote sensing imagery is a valuable method for capturing the spatial arrangement and variation of fuel loading in a chaparral landscape.

Uyeda *et al.* estimated live and dead aboveground biomass and calculated the aggregation indexes (landscape pattern metrics) for three different aged chaparral stands using pre-determined biomass coefficients. They did this for 3 species groups that were established using high-resolution imagery. These species groups included a broad-leaf category consisting predominantly of *Quercus berberidifolia* and *Ceanothus perplexans*, a Af/Ag category consisting only of *Adenostoma fasciculatum* and *A. glandulosa*, and lastly, a sub-shrub category which consisted of mostly *Salvia apiana* but included several other sub-shrubs. A bare category and a dead category were also included.

Estimated biomass values were highly variable among the sampling plots within each stand age but in general, biomass calculated from field surveys was lowest in 7-yr-old plots and highest in 68-yr-old plots (Fig. 1). In many cases 28-yr-old plots had biomass values overlapping those of the 68-yr-old plots and there was little difference in the spatial arrangement of species groups in these two older areas. There was significant variation in biomass values at the plot level within even-aged stands indicating fine-scale variation that is difficult to map and that likely contributes to fire behavior.

The proportion of dead biomass was highest in the older stands with, again, no significant difference between the 28- and 68-yr-old stands. The variability in dead biomass, however, does not allow for confident estimates across the landscape and the authors note that it is not feasible to map dead biomass in chaparral shrubfields due to its lack of visibility above the live shrub canopy. Future research on improving the mapping of dead biomass is essential for successful fuel modelling.

Because a two part scaling approach is necessary to reach landscape-scale estimates of biomass, there is plenty of room for error. There is first a stem-to-biomass regression relationship and then a field-measured biomass-to-mapped cover category relationship. Despite the potential for error, however, the authors believe it is worthwhile to extrapolate across a larger area in hopes of including as much of the fine-scale variation in the stands as possible.

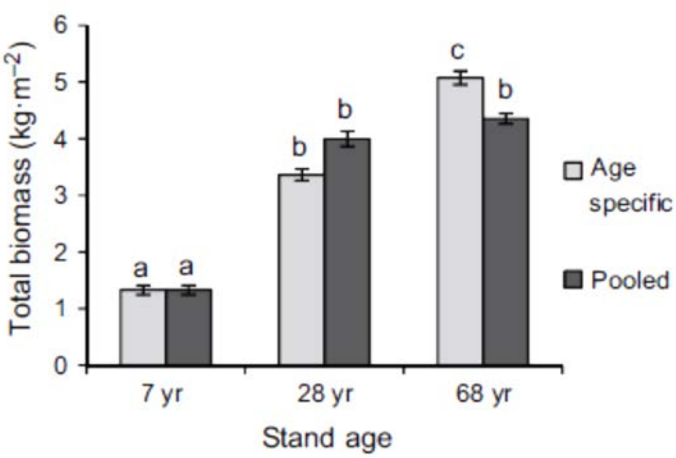

Figure 1. Total biomass means using age-specific biomass coefficients and pooled biomass coefficients. Error bars indicate SE and letters indicate post-hoc Tukey tests. Bars with different letters are significantly different ($P < 0.05$)

The approach of using high spatial resolution imagery in combination with object-based methods is an effective way to map fine-scale variation in species composition on the landscapes. The authors suggest the use of high spatial resolution color infrared imagery to further improve accurate mapping at the species category level and thus, more accurate biomass estimations. The authors also note that caution should be used when using biomass coefficients to calculate stand-level biomass from low resolution imagery that cannot reliably differentiate between shrub and ground cover categories.

Further reading:

Keane, R.E., Burgan, R. & van Wagtendonk, J. 2001. Mapping wildland fuels for fire management across multiple scales: integrating remote sensing, GIS, and biophysical modeling. International Journal of Wildland Fire 10: 301–319.

Lu, D. 2006. The potential and challenge of remote sensing based biomass estimation. International Journal of Remote Sensing 27: 1297–1328.

Riggan, P.J., Goode, S., Jacks, P.M. & Lockwood, R.N. 1988. Interaction of fire and community development in chaparral of Southern California. Ecological Monographs 58: 156–176.

Regelbrugge, J.C. & Conard, S.G. 1996. Biomass and fuel characteristics of chaparral in southern California. 13th Conference on Fire and Forest Meteorology.