SPATIAL VARIABILITY AFTER PRESCRIBED BURNING: EFFECTS ON VEGETATION AND SOIL PROPERTIES

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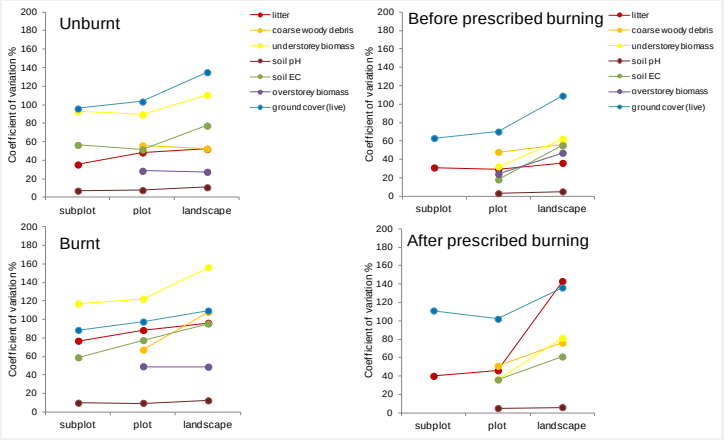
OPTIMISATION OF PRESCRIBED BURNING REQUIRES A STRONG UNDERSTANDING OF THE UNDERLYING VARIABILITY OF FUEL, VEGETATION AND SOIL

BACKGROUND

Empirical field measurements are commonly used to assess the effectiveness of prescribed burning. The general assumption is that variability increases from small (~1 m) to large spatial scales (~1 km). Based on our current sampling scheme, we tested the following questions: How much variability is captured in environmental measurements collected at different spatial scales? What is the optimal number of samples required for burnt and unburnt areas? How does fire size affect the accuracy of the measurements?

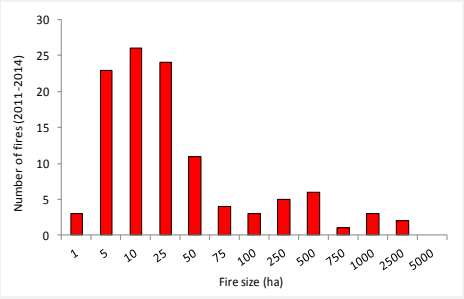
Sampling and statistical analyses

A total of 39 paired plots were sampled; 27 across 9 landscapes in VIC: before/after prescribed burning and 12 across 4 landscapes in the ACT: burnt/unburnt. Each pair of plots (~22.5 m radius equivalent to 0.16 ha) or a "burn unit" were located at least 500 m apart from the nearest burn unit, and included four circular subplots (~5 m radius) on N, E, S and W axes. Litter, understorey, ground cover biomass and soil properties were collected from subplots and coarse woody debris and overstorey biomass were collected from plots (3 plots with 4 subplots in each landscape). Spearman's rank correlation between coefficients of variation (100 × standard deviation (SD)/mean) and scale, and Mantel test were used to uncover the association between measurements and sampling scale. We found that variation was less affected by the scale at which measurements were collected in burnt areas compared to unburnt areas.



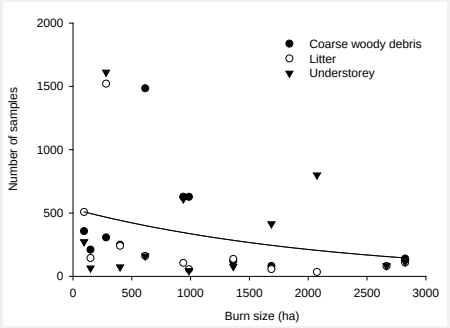
Fire size

Prescribed burns can vary in size by several orders of magnitude. For example, the size of prescribed burns completed between 2011 and 2014 in the ACT ranged from a few hectares to 2500 ha. In order to design an *a priori* sampling scheme with the appropriate statistical power, it is important to define a reliable sampling frequency and to determine how it is affected by the size of burn.



Sampling frequency

We found that larger prescribed burns generally require fewer samples to capture variability across the landscape than small prescribed burns (Spearman's rank $p < 0.05$).



The number of samples required at the landscape scale to estimate the mean to within 10% of its true value ($n_{0.10}$) varied with fuel type. $n_{0.10}$ was estimated following Mollitor et al. (1980).

	ACT			VIC		
Before prescribed burning	Mean	SD	$n_{0.10}$	Mean	SD	$n_{0.10}$
Litter (t ha^{-1})	12.67	6.63	112	14.55	8.19	125
Ground cover biomass (t ha^{-1})	0.55	1.07	1557	1.52	1.68	481
Understorey biomass (t ha^{-1})	24.82	33.43	740	11.14	6.76	156
Overstorey biomass (t ha^{-1})	226.04	80.12	64	367.09	164.20	85
Overstorey leaf area index	0.91	0.17	17	-	-	-
Coarse woody debris (t ha^{-1})	28.70	18.54	202	64.33	34.10	119
Soil pH	5.97	0.67	5	5.38	0.25	1
Soil EC (µs cm^{-1})	50.87	99.36	1557	28.06	16.00	138
After prescribed burning						
Litter (t ha^{-1})	5.33	4.77	327	1.98	2.87	826
Ground cover biomass (t ha^{-1})	0.06	0.22	5302	0.03	0.05	1683
Understorey biomass (t ha^{-1})	17.69	35.95	1685	7.82	6.00	249
Overstorey biomass (t ha^{-1})	335.19	269.78	331	-	-	-
Overstorey leaf area index	0.82	0.23	36	-	-	-
Coarse woody debris (t ha^{-1})	21.67	19.46	391	33.96	34.18	428
Soil pH	5.93	0.78	7	5.51	0.33	2
Soil EC (µs cm^{-1})	60.29	64.79	471	28.37	22.36	263

CONCLUSIONS

- Our current sampling scheme uses appropriate units of measurement to capture variation at a range of scales.
- Sampling in spatially separate burnt andunburnt plots is comparable to sampling the same plot before and after a fire.
- Measurement variability does not increase with scale for all fuel components. For example, coarse woody debris is as variable at the small scale (plot) as it is at the landscape scale.
- Fire characteristics change with fire size (e.g. intensity, patchiness) so the sampling frequency needs to take this into consideration.

WHAT IS NEXT?

- Complete sampling campaigns in northern and southern NSW.
- Provide training and resources for End Users for field data collection.

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REFERENCES

Mollitor A.V., Leaf A.L. & Morris L.A. (1980) Forest soil variability on northeastern flood plains. *Soil Science Society of America Journal* 44, 617-620.