VEGETATION AND FUEL ASSESSMENT TECHNIQUES

Neil Burrows

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1. INTRODUCTION

Methods of describing and measuring live or dead vegetation vary according to the purpose of the measurement. Mostly, I have been interested in describing live and dead vegetation as a fuel. Even then, the technique employed changes according to the type of fuel and the fire behaviour model in which it is to be used.

In the jarrah forest areas and adjacent wandoo woodlands, three common primary fuel units are recognized. These are i) litter fuel on the forest floor (twigs, leaves, bark, floral parts etc. <10mm in diameter) ii) logs on the forest floor (branches, tops, etc. >10mm in diameter) iii) live and dead (trash) aerated vegetation. These fuel types may occur singularly or form complexes.

2. MEASURING LITTER FUELS

Fuel particles <10mm in diameter burn in the flaming zone so contribute most to fire spread. Two physical descriptions of litter fuels are important to determine how it performs as a fuel. These are i) quantity, normally expressed in tonnes per hectare and ii) spatial distribution, normally expressed as both bulk density (or packing ratio) and per cent ground cover (in woodlands especially).

2.1 *Measuring Litter Fuel Quantity*

The most precise and accurate way of measuring litter quantity is to destructive sample. Normally, I use 20cm x 20cm quadrats and remove all fine litter material down to mineral earth. This is bagged and an oven dry weight per unit area (tonnes/ha) determined. Sampling intensity varies according to size of area to be sampled, variability, purpose to which results are to be put and practical (resource) limitation. In the jarrah forest, we normally establish grid points (100m x 100m for say a 100ha plot) and take ten 20cm x 20cm quadrats from random locations about the grid point (up to 20m away). Typical results are shown below.

TABLE 1: A sample of litter fuel weight plot measurements in a jarrah forest of about 100ha.

Mean	9.7	S.E.	.60
Variance	40.3	Maximum	38.0
Minimum	0.0	S.D.	6.35
C.V. %	65.4	95% C.L.	8.49 to 10.91
No. cases	100		

2.2 *Measuring Bulk Density and Packing Ratio*

In some instances, 3 litter depth measurements are made along the diagonal of each litter quadrat to establish a relationship between litter quantity and depth. This relationship is useful for i) gaining quick estimates of fuel quantity using a depth gauge ii) determining the fuel array bulk density and packing ratio.

3. MEASURING LOGS

Normally, I use van Wagners (1968) line intercept method for measuring downed woody fuels. The reference should be consulted for details. The length of sample line can be adjusted to suit. Log weight is expressed in t/ha and by diameter class. As with litter fuels, measurements must be repeated before and after burning to determine the quantity and size of material burnt.

4. MEASURING SCRUB

Describing scrub fuels is the most difficult of all the fuel units. Often, it is the most variable both physically (weight, particle size, chemical composition, live/dead ratio, moisture content etc.) and spatially (horizontal and vertical structure). Also, none of the existing fire behaviour models can adequately deal with this enormous variability inherent in scrub fuels. Nevertheless, I recognize 3 important descriptions of scrub fuel.

4.1 *Scrub Weight*

As with litter and other fuels, the quantity of scrub which burns directly effects heat output (hence the power of the fire and its effect on burning and non burning surrounds). It will also directly effect suppression difficulty. There is really no substitute for an accurate measure of scrub fuels (on the types I have dealt with) by phytomass sampling. This is done by;

i) at each of the above mentioned grid sample points, make an abundance rating of all plant species within a 10m radius of the grid point (0-5).

ii) Having identified "types", then destructively sample from each of these types. In 2 000ha of jarrah forests about 5-10 vegetation types will emerge. Providing the area has the same fire history, then about 30 biomass samples from each type is adequate. A sample involves setting out a 3m x 1m quadrat and cutting and bagging all live and dead vegetation. This is taken back to the laboratory and sorted into live and dead and by size classes (<4mm or $\geq$4mm) i.e. what normally burns and what doesn't.

A less reliable method is to develop a relationship between scrub cover, scrub height and scrub biomass. Then, instead of destructive sample, one needs only measure scrub height and cover to estimate quantity. However, I have observed great variations in scrub bulk density which can make this technique dicey.

4.2 *Scrub Structure*

The structure of vegetation, i.e: its bulk density, particle size and spatial distribution, also effects its performance as a fuel. Unless structure is fairly constant (as is the case say with litter fuels) then it is erroneous to speak about scrub weight alone in terms of expected fire behaviour. I have used 2 techniques for measuring scrub structure:

1. Levy rods (Levy and Madden 1968?). This method works reasonably well in dense scrub such as is found in creeks and swamps in the forest regions. However, when scrub is variable, broken or sparse, it is necessary to put in extremely high numbers of levy rod measures.

I have partially overcome this problem by putting in permanent levy rod sample points (steel pipe set into the ground and protruding about 10cm above ground - the rod is dropped into the pipe each assessment).

Normally, in the jarrah forest it is necessary to make about 10 levy rod measurements per 3m² of biomass sample area.

4.3 *Brown's Planar Intercept Method*

This technique (Brown, 1972) involves counting the intercepts (live, dead, by size class) through a plane set and different heights and rotated about each setting. Unlike Lachies experience with this technique, I found it reproducible and reliable, although very slow. I modified the technique by cutting out and bagging the scrub, taking it back to the lab and running van Wagners line transects through the scrub which was spread out on a bench top. From these measures a number of structural parameters can be calculated including;

- surface area to volume ratio
- bulk density/packing ratio
- porosity
- particle spacing
- quantity
- height

These measures are needed to drive Rothermels model.

4.4 *Chemical Composition*

The chemistry of live vegetation very much effects its flammability. To date, no fire behaviour models take account of essential oils, although Rothermel does account for mineral content.