8. Prediction of fire behaviour in open eucalypt forest

Two operational fire behaviour models are used widely in Australia to predict forward rate of spread, flame height, spotting and crowning. These are the McArthur Fire Behaviour Tables incorporated in the Forest Fire Danger Meter (FFDM) (McArthur 1967, 1973) and later formatted as equations by Noble *et al.* (1980); and, the Forest Fire Behaviour Tables for Western Australia (FFBT) (Sneeuwjagt and Peet 1985) formatted as equations by Beck (1995).

These tables were developed independently, from measurements of small experimental fires lit in open eucalypt forest fuel comprised of leaf litter and occasional low shrubs (McArthur 1962, Peet 1965). Although designed primarily to predict the behaviour of fires for prescribed burning operations, the guides were extrapolated to predict the behaviour of high-intensity fires using observational reports of spread of wildfires.

Preliminary analysis of the behaviour of high intensity fires burnt during Project Aquarius (Gould *et al.* 1996) and work by Burrows (1994, 1999) suggested that these models consistently under-predict the rate of spread of fires burning under dry summer conditions by a factor of 2 or more. Similar conclusions have been reached from case studies of wildfires burning under more severe conditions such as on Ash Wednesday in 1983 (Rawson *et al.* 1983). Experimental fires conducted during Project Vesta spread at 2 to 3 times the rate predicted by the FFDM or the FFBT (McCaw *et al.* in press). The difference between predicted and observed rates of spread was less at the low shrub fuel site (Dee Vee) and when wind speeds were <12.5 km h^{-1}. Under similar forest fire danger indices to the Dee Vee experiments, both models grossly under-predicted the rate of spread at the tall shrub fuel site (McCorkhill) and when wind speeds were >12.5 km h^{-1}.

An extensive analysis of the effects of fuel characteristics on fire spread (Chapter 6) concluded that:

- rate of spread is directly related to wind speed,
- rate of spread is weakly related to surface fuel loading,
- the near-surface fuel layer has significant effect on rate of spread, and
- the best variables to include in a practical fire spread model for field use are wind speed, fine fuel moisture, surface fuel hazard score and near-surface fuel hazard score and height.

This chapter outlines the development of a fire behaviour model to predict rate of spread and flame height in dry eucalypt forest. Predictions from this model are compared with observed rates of spread of independent experimental fires and wildfires. The model is based on data from the Project Vesta experiments but a number of logical assumptions were necessary to predict fire spread beyond the range of the experimental data.