10. Spotting behaviour and firebrand distribution

Firebrands are flaming or glowing pieces of fuel, including fruit, cones, leaves, twigs or bark, that are transported ahead of a fire-front by wind or by the combination of wind and the fire's convection column. In the latter case, the burning firebrand is entrained into and lofted by the convection column and then released at some height downwind of the fire-front. Firebrand transport is determined by the aerodynamic and combustion characteristics of the firebrand as well as the interaction of the convection plume and the wind field (Ellis 2000). Firebrands are often called 'embers' by the media and fire agencies. This term is incorrect and is not used in this study, as it implies that the burning material is in the final stages of combustion.

When firebrands land on suitable fuel they may ignite new fires, called spotfires or 'hopovers'. Even very small firebrands have the potential to ignite fine fuel (i.e., to 'spot') on days of high fire danger (*viz* high temperatures and low relative humidity). Spotting allows fires to spread quickly across uneven terrain and to cross discontinuities in the fuel. Spotting determines the upper limit of fire intensity at which suppression will be effective and is the main cause of loss of control of both wildfires and prescribed fires. Firebrands are the main cause of house losses during bushfires. This occurs directly by penetration of the structure or lodgment against flammable components, or indirectly by igniting adjacent fuels such as gardens, fences and adjoining buildings. Dealing with spotfires represents a significant proportion of both bushfire suppression costs and resources. In certain weather conditions and topography spotting can also pose a grave hazard by trapping fire crews between a fire-front and new fires initiated by spotting.

The trajectory of a firebrand, most commonly a piece of burning bark, is illustrated in Figure 10.1. Most firebrands burn out within the convection column. The maximum density of firebrands will occur when a bushfire reaches a break in fuel, such as a ridge top or a natural or man-made firebreak. The base of the convection column moves over unburned ground and exposes the burning trees on the edge of the break to the downdraft wind that was feeding into the base of the fire (see Plate 6.3). This results in a shower of firebrands a short distance downwind of the break in fuel under the direct effect of the wind (trajectory A, Figure 10.1).

A firebrand lofted within the convection column may be carried to a considerable height before falling out and descending to earth. The distance the firebrand will travel is then dependent upon the height at which it exited from the column, the wind field through which it is falling (U(h)) and the speed at which it falls (Wf), which is not necessarily constant if it is burning. If the burnout time of the firebrand is longer than its flight time, it will land alight and may start a spotfire (trajectory B, Figure 10.1). If its flight time is longer than its burnout time, it will not be alight when it lands and will not start a spotfire (trajectory D, Figure 10.1). The maximum spotting distance thus occurs when the burnout time is only slightly longer than the flight time of the firebrand (trajectory C, Figure 10.1).