FROM THE ARCHIVES: A NEW INSIGHT INTO FIRE GROWTH RATE AND ACCELERATION

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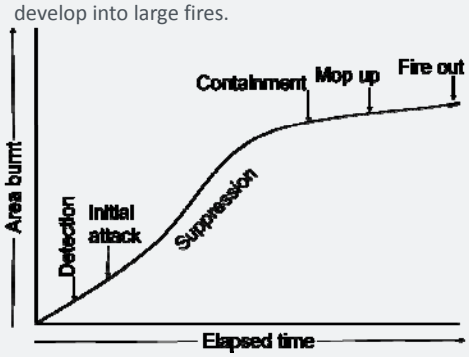
Background

It is certainty true that a bushfire's spread at the instant of ignition is somewhat less than the full quasi-steady spread rate for the given fuel and burning conditions. Fires generally start in the surface fuels and, depending on the understorey fuel properties and environmental conditions, may grow in size and intensity and develop into large fires.



Schematic diagram illustrating the relationship between area burnt time and suppression.

Knowledge of the rate of growth in terms of fire area and perimeter within the first hour or so is extremely useful for making fire management decisions concerning pre-suppression and suppression planning, and prescribed burning.

Historical fire behaviour data

There are over 450 experimental fires with 5,600 individual fire spread observations from McArthur's studies. Only a handful of these data, including some experimental fires in jarrah forest in Western Australia, were used by McArthur to develop prescribe burning guides and McArthur's forest fire danger meter.

Additional data from George Peet's experiments in Western Australian jarrah forest is also being collated for this project (DEC, WA). The compilation of historical experimental fires provides data on a wide range of fire behaviour observations in dry eucalypt forest with different understorey fuel structures. This provides an excellent source of empirical data to develop curves of fire growth (area, perimeter and spread rate) over time to construct fire growth models or indices for various situations.

2 minutes after ignition

6 minutes after ignition

12minutes after ignition

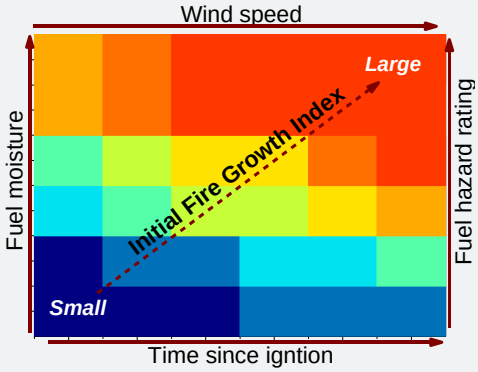
14 minutes after ignition

Photographic illustration of fire growth from the point ignition of experimental fire 24 in Kowen Forest, ACT. Temperature 22°C, relative humidity 17%, and open 10 m wind speed of 20 km h^{-1} , FFDI 22 (High). (Photos by A.G. McArthur, 1957; CSIRO data collection).

Practical Applications

Suppression planning and allocation

Valuable time can be lost between the moment of ignition and the start of effective suppression at the fire perimeter while an initiating fire gradually expands in area (see photographs). New knowledge and models of rate of growth and acceleration in different fuels and environmental conditions will provide better estimates of the different stages of fire development. Models calculating fire growth (i.e., area, perimeter, length-breath ratios), combined with models estimating suppression effectiveness and efficiency, will lead to developing a user-friendly decision support system for optimising deployment of suppression resources.



Conceptual diagram showing range of fire behaviour variables in developing a fire growth model or an Initial Fire Growth Index (IFGI) indicating the heightened potential fire size

Prescribe burning

It is important to recognise fire acceleration phenomena when planning prescribed burns, especially when determining ignition patterns. The chosen ignition pattern is critical to the success of a prescribed burning operation and the timing and sequence of ignition is the major control factor that a prescribed burning manager has to influence fire behaviour. Thus, better knowledge of fire development of different ignition techniques is essential. To some extent the time required to reach a quasi-steady spread rate can be manipulated by using different lighting patterns.