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A classification system for Australian bushfire fuel

Australian land and rural fire agencies have recognised the need for a national-level bushfire fuel classification system to enable consistent characterisation and categorisation of fuels across the country. This would support a wide range of fire and fuel management activities including risk planning, fire danger rating and prediction of bushfire behaviour. The Bushfire Fuel Classification (BFC) system leverages existing vegetation data from a range of sources to classify bushfire fuel attributes within a hierarchical system of increasing detail.

A common fuel description framework for Australia

Quantification of the important attributes of fire-prone vegetation is a challenge for land and fire managers who need explicit fuel data to support fire management decision-making. Certain characteristics of vegetation determine the amount and rate of release of energy during combustion. These characteristics are often important determinants of fire propagation and behaviour, information essential to understanding suppression difficulty, assessing the potential risk of damage, undertaking risk mitigation and planning for hazard reduction burning.

A fuel classification scheme aims to provide a consistent, comprehensive and useful characterisation of fuel that groups vegetation communities with similar structural characteristics, combustion properties, and fire potential into identifiable fuel types, regardless of species composition. The framework classification described here evolved from a collaboration initiated by AFAC (Australasian Fire and Emergency Service Authorities Council), the Forest Fire Management Group (FFMG) and CSIRO. The framework arises from extensive consultation with land managers and rural fire authorities and the review of other fuel classification systems used around the world.

A number of primary design criteria were used to guide the development of the Australian Bushfire Fuel Classification (BFC). These were that the BFC should:

- categorise Australian fuels into a reasonably small and practical set of nationally consistent bushfire fuel types;
- enable the description of the physical characteristics of fuel;
- provide key inputs into current state-of-the-art bushfire behaviour prediction models and simulation tools, and be adaptable to future developments of these; and
- enable easy conversion of existing vegetation and/or fuel data into BFC fuel types.

The BFC is based on three hierarchical tiers suitable for a variety of fire management applications (Figure 1). The level of detail to which a fuel complex is described can vary from a coarse description in the top tier to more precise information in the bottom tier.

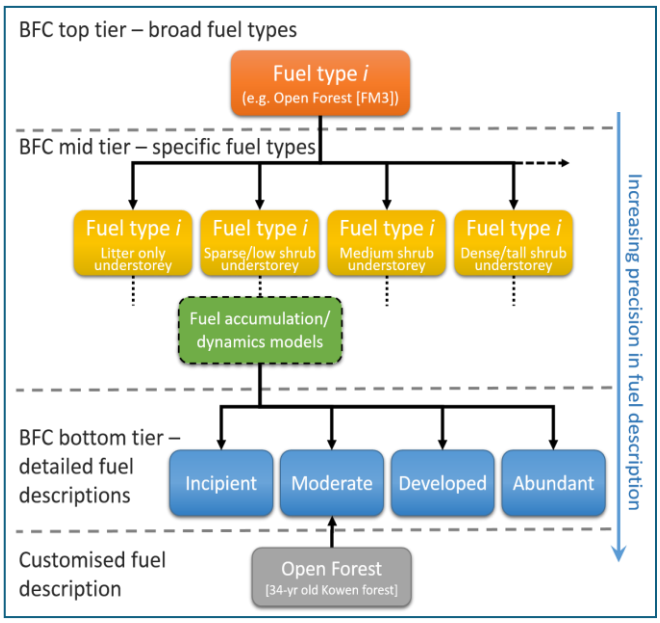

Figure 1. An example of the tiered structure of the BFC, moving from a top tier generalised description of fuel type down to lower tiers where more detail of fuel can be given.

The structure of the BFC system

The **top tier** organises the multitude of vegetation types found across Australia into a standardised set of broad fuel types defined by growth form, height and cover. At this level the BFC considers six broad fuel groups, covering native forests, woodlands, shrublands, grasslands and plantations along with other additional fuel groups such as non-combustible and wildland-urban interface zones. Considering all practical combinations of the top tier attributes, 32 fuel types have currently been classified at this level.

The **mid tier** refines the fuel type descriptions by identifying and differentiating the understorey fuels that determine the combustion and propagation processes influencing fire spread and intensity. Embedded in the mid tier are fuel dynamics (or accumulation) models that quantify changes in fuel structure with time and site productivity. At this level the BFC provides a quantitative description of the fuel complex that represents the fuel type in its most common development stage, i.e., in its pseudo-steady state condition.

The **bottom tier** provides standardised snapshots of fuel development and accumulation within a mid tier fuel type at particular times during its existence. This bottom tier uses available fuel dynamics models to describe fuel characteristics as they evolve over time as determined by environmental, disturbance type (e.g., fire) and severity, and climatic influences. In this tier time is used in a relative sense, as the patterns of fuel change are highly dependent on the site productivity and the response of the particular vegetation to fire intensity and frequency. Research into the definition and quantification of the bottom tier classes for all jurisdictions is ongoing.

In case the dynamic modelling from the mid tier and the standardised fuel descriptions from the bottom tier do not meet agency requirements for accuracy for particular purposes, the BFC allows users to define customised fuel complexes that are nested within the bottom tier. This user developed fuel description supports use of detailed measurements of certain fuel characteristics – such as litter, grass or bark load. By making use of standardised and locally sampled fuel information, the user develops a more accurate characterisation of the fuel complex than provided by the standard bottom tier description.

BFC- bushfire behaviour and fire danger linkages

A core function of the BFC is to facilitate the prediction of fire behaviour in Australian vegetation in a consistent and reproducible way. At each tier there is a full description of the fuel complex as required by the relevant fire behaviour models (e.g., Cruz et al. 2015) for that fuel type. Quantitative fuel data generally represents the estimate of the central tendency of that fuel (associated with the average or most common condition) plus its typical range. The differences between the three tiers relate to the precision of the fuel description and thus the precision and spatial applicability of the quantitative data.

The BFC framework results in the definition of detailed fuel descriptions nested within each fuel type. This allows a user to move from a broad fuel classification with a coarse description of fuel characteristics that do not vary much with time (e.g. grassland) through to a more precise division of fuel types and fuel characteristics that may change rapidly (e.g. grazed grassland). This structure with different levels of detail allows the system to be used for different practitioner applications at different scales.

Although each tier is not necessarily tied to a specific use or scale, it is expected that the level of detail at the top and mid tiers will be suitable for broad scale fire management decisions such as fire danger forecasting as well as for fire behaviour/propagation predictions and simulations at smaller spatial scales if no description of the bottom tier exist.

Further reading

Hollis JJ, Gould JS, Cruz MG and McCaw, LW (2015) Framework for an Australian fuel classification to support bushfire management. *Australian Forestry* 78, 1-17.

References

Cruz MG, Gould JS, Alexander ME, Sullivan AL, McCaw WL and Matthews S (2015) Empirical-based models for predicting head-fire rate of spread in Australian fuel types. *Australian Forestry* 78, 118-158.

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