HOTSPOTS FIRE PROJECT

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Fuel Fact Sheet 2

Understanding Fuel

... and fire behaviour

Australia's climate is becoming warmer and drier with the frequency and severity of bush fire conditions increasing due to increased greenhouse gas emissions and concentrations (BOM, 2022). Understanding how fuel in vegetation influences fire behaviour is essential to managing bush fire risk to life, property and natural ecosystems

Fire Intensity and Behaviour

Fire intensity is affected by the amount of the combustible fuel (fuel load), the heat yield (determined by vegetation characteristics) of that fuel and the forward rate of spread of the fire (determined by the weather conditions). The fine fuel structure is an important component of the fuel load, particularly surface and near surface fuels. It is these layers that contribute to the flame depth, flame height and rate of spread of a surface fire. Fire behaviour refers to how and where a fire burns, how fast it travels, how much heat it gives off and ultimately how difficult it is to suppress. Fire behaviour is influenced by three major factors: weather, fuel and topography. Turn over to learn more about these factors >>>

Fire Danger Ratings

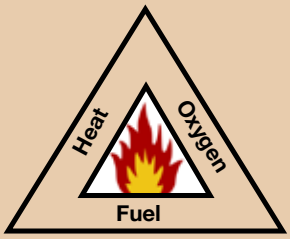
Fire Danger ratings are a guide to (the maximum) potential fire behaviour, during a 24-hour period, based on forecast weather conditions including based on forecast weather and fuel characteristics to model the potential level of danger should a bush fire start..

Knowing the Fire Danger Rating for your local area will help you prepare for bushfires and when planning prescribed burns. The higher the Fire Danger Rating the more difficult fires are to control. Fire Danger Ratings were changed in 2022 to provide a simpler, action-oriented system.

The Australian Fire Danger Ratings (AFDRS) levels are:

MODERATE Plan and prepare	HIGH Be ready to act
EXTREME Take action now to protect life and property	CATASTROPHIC For your survival, **leave bushfire risk areas**

The Fire Triangle



Fire is a chemical reaction that requires sufficient heat, oxygen and fuel. Managing fuel is a major consideration when managing bush fire risk. This is because we cannot modify heat or oxygen, which are driven by topography, climate and weather conditions, but we can remove or modify elements of the fuel.

The three factors of fire behaviour...

1) Topography

Topography refers to 'the lay of the land', its slope, orientation and elevation. Topography influences fire behaviour through interactions between weather and vegetation.

For example, northern and western aspects are warmer and drier and therefore influence the type of vegetation which grows there. Southern and eastern slopes may have higher fuel loads, but may not dry as quickly due to comparatively reduced exposure to the sun. Also, the steeper the slope, the faster a fire will travel.

2) Weather

The most important weather factors when it comes to fire behaviour are temperature, humidity and atmospheric stability. Long term climatic patterns such as droughts and climate change will also influence fire behaviour. Climate change is also increasing the incidence of extreme events.

Temperature: high temperatures dry out vegetation quicker, making it easier to ignite and burn.

Humidity: the level of moisture in the air (as well as in the vegetation and soil) determines how vegetation is consumed by fire.

Wind: The stronger the wind, the more oxygen supplied to the fire. The speed and direction of wind determines intensity, speed and how fire is controlled.

Atmospheric instability: refers to the rise and fall of air masses. This is important as vertical air motion can affect local wind patterns. In unstable atmospheric conditions fire behaviour can be erratic.

3) Fuel

Fuel has many characteristics that will influence fire intensity, flame height and rate of spread. Some of the most influential characteristics include:

Moisture: Fuel that is dry and fine will burn better than heavy fuels that are wet. The moisture content of fuel will affect ease of starting a fire, amount of heat from flames, how quickly the fire moves and how quickly fuel is consumed.

Quantity (Load): Fine fuels (leaves, twigs, grasses) are less than 6mm thick and mainly drive the forward spread of fire. Heavy fuels are over 6mm (sticks, branches, logs) and generally take longer to burn after the main fire front has passed.

Arrangement: Fuels are arranged horizontally and vertically. Fine, loosely-stacked fuels burn quickly and with greater intensity due to access to oxygen. A continuous ladder of fine fuel from the ground to the tops of the trees may encourage crown fires.

The amount, type and arrangement of fuel is highly variable across different vegetation formations and locations across the state.

For example... in Grassy Woodlands (above), abundant grass may contribute to a very high rating for surface fine fuel, but the woodland's smooth gums have very little bark, which can limit fire spotting or laddering.

A Dry Sclerophyll Shrubby Forest (left) dominated by stringybarks has much more bark, which contributes to the generation of embers that can cause spotting fires and thus a higher bush fire risk rating.

References: Commonwealth of Australia. 2022 Bureau of Meteorology. http://www.bom.gov.au/weather-services/fire-weather-centre/bushfire-weather/index.shtml.

Peterson, D.A., Fromm, D.A., McRae, R.H.D, Campbell, J.R., Hyer, E.J., Taha, G., Camacho, C.P., Kablick, G.P., Schmidt, C.C., DeLand, M.T. (2021) *Australia's Black Summer pyrocumulonimbus super outbreak reveals potential for increasingly extreme stratospheric smoke events.* Climate and Atmospheric Science, 4, 38. https://doi.org/10.1038/s41612-021-00192-9

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