

8.0 Fire danger and changing climate patterns

8.1 Overview

There has been much commentary over the influence changing climate patterns may have had on the intensity of the fires of 7 February 2009. This section provides an overview of a report that was prepared for the Climate Institute detailing observed and predicted FDI ratings for south east Australia under changing climate patterns.

8.2 Report by Lucas, Hennessy, Mills and Bathols

In September 2007, a report was prepared for the Climate Institute entitled *Bushfire Weather in Southeast Australia: Recent Trends and Projected Climate Change Impacts*. The report updated the findings of a 2005 study, with a wider range of observations analysed and additional sites included. The authors introduced two new fire danger categories for the report: 'very extreme' and 'catastrophic'.

In the study, the authors found the number of 'very high' fire danger days generally increased by 2-13 per cent by 2020 for the low scenarios and 10-30 per cent for the high scenarios. By 2050, the range is much broader, generally 5-23 per cent for the low scenarios and 20-100 per cent for the high scenarios. For the number of 'extreme' fire danger days, the authors found these generally increased 5-25 per cent by 2020 for the low scenarios and 15-65 per cent for the high scenarios. By 2050, the authors found increases were generally 10-50 per cent for the low scenarios and 100-300 per cent for the high scenarios. These figures are detailed in Table 8.1.

	2020		2050	
	Low global warming (0.4°C)	High global warming (1.0°C)	Low global warming (0.7°C)	High global warming (2.9°C)
Very high	+2-13%	+10-30%	+5-23%	+20-100%
Extreme	+5-25%	+15-65%	+10-50%	+100-300%

Table 8.1 Percent changes in the number of days with very high and extreme fire weather – 2020 and 2050, relative to 1990. (Source: Lucas et al 2007)

The authors found 'very extreme' days tended to occur only once every 2 to 11 years at most sites. By 2020, the low scenarios showed little change in frequency, although notable increases occur at some of the inland sites. The authors found the 2020 high scenarios indicated 'very extreme' days might occur about twice as often at many sites. By 2050, the low scenarios were similar to those for the 2020 high scenarios, while the 2050 high scenarios indicate a four to five-fold increase in frequency at many sites.

For 'catastrophic' fire days, the authors generally found little or no change in the frequency of occurrence at the sites, where 12 out of the 26 sites analysed had records of catastrophic fire danger days. For the 2020 high scenarios, the authors found 'catastrophic' days would occur at 20 sites, 10 of which have return periods of around 16 years or less. By 2050, the authors found the low scenarios would be similar to those for the 2020 high scenarios. The authors found the 2050 high scenarios exhibited 'catastrophic'

days occurring at 22 sites, 19 of which would have return periods of around eight years or less, while seven sites have return periods of three years or less.

Lucas et al (2007) found upward trends suggestive of increased fire danger are being observed during the most active period of the fire season and, to a lesser degree, in the surrounding seasons. The authors found that the annual cumulative Forest Fire Danger Index displayed a rapid increase in the late 1990s to the early 2000s at many locations. Increases of 10-40 percent between 1980-2000 and 2001-2007 are evident at most sites. Lucas et al (2007) found that the strength of these increases at the majority of sites analysed equalled or exceeded the changes originally estimated to occur by 2050 in the different projections. The hypothesis Lucas et al (2007) posit in their study is that the naturally occurring peak in fire danger, due to interdecadal variability, may have been exacerbated by climate change. This hypothesis remains to be fully tested in the coming years.

8.3 Did climate change exacerbate the fires of 7 February?

Did climate change exacerbate the fires of 7 February? Karoly (2009) believes it is highly likely changing climate patterns are influencing the frequency and intensity of fire danger days occurring in South East Australia. He states in his summary, posted online (Karoly 2009), that unprecedented records are being set for maximum temperatures, the number of consecutive days of high temperatures, low levels of relative humidity, extreme low levels of fuel moisture content and extended periods of low rainfall, of which, parts of the fire affected areas have experienced the lowest on record for the start of 2009. These influence the increase of the Fire Danger Index, through increases in the temperature, decrease in relative humidity, and increase in the drought factor. Where extreme to catastrophic fire danger days occur, these inputs to the Fire Danger Index can overpower low fuel levels to produce fires of very high intensity and spread (Tolhurst 2009 public lecture April 2009, Melbourne University).

9.0 Fuel reduction burns and extreme Fire Danger Index

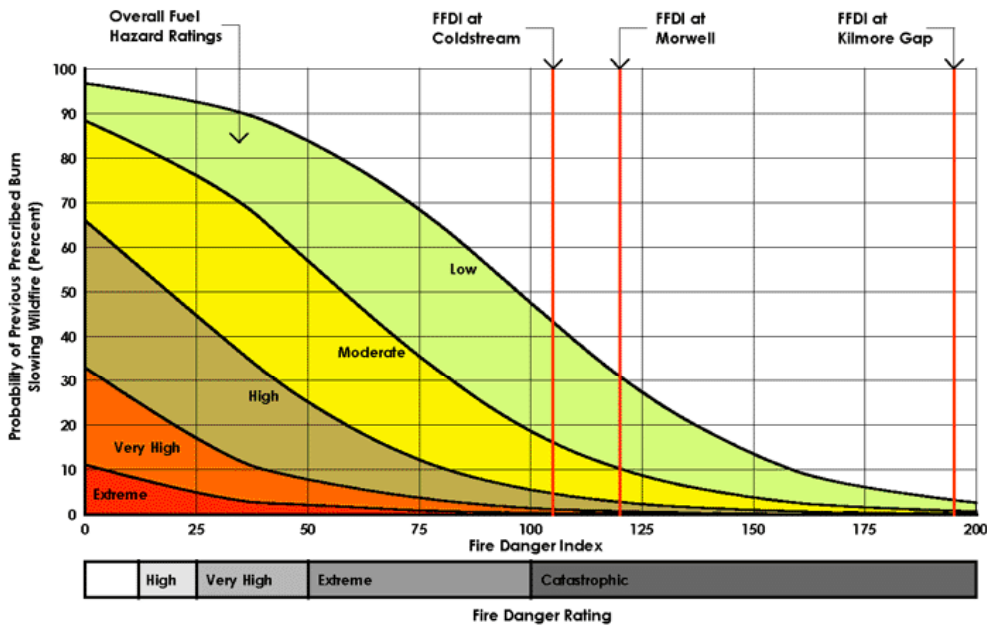
With observations and predictions of increasing intensities and occurrences of high, very high, extreme and catastrophic FDI days, as outlined in Lucas et al (2007), prescribed burning is less likely to slow and suppress head fires. McCarthy and Tolhurst (2001) used field data to develop a model indicating that the benefits of a prescribed burn decrease as the Fire Danger Index increases. They constructed a model, using the overall fuel hazard at the final control line and the Fire Danger Index, for predicting the probability of whether a previous prescribed burn would slow the head fire of a subsequent wildfire. McCarthy and Tolhurst (2001) constructed the model using a logistic procedure as follows:

$$\text{Probability of slowing head fire} = 1 - (1 / (1 + (1/e^b)))$$

$$\text{where } b = (1.37 * \text{OVEROL}) + (0.035 * \text{FDI}) - 4.77$$

The graph used in McCarthy and Tolhurst (2001) details the probability to a Fire Danger Index of 100. As the Fire Danger Index significantly exceeded a FFDI rating of 100 on 7 February, a modified graph has been constructed for this report using the above formula. Note this presumably exceeds the range of experimental data but is assumed to provide a

reasonable indication of general expected trends where FFDI exceeds 100. The graph is featured in Figure 9.1.



Probability of previous Prescribed Burn slowing the headfire of a subsequent Wildfire as a function of Overall Fuel Hazard and Fire Danger Index in forests

Based on McCarthy and Tolhurst 2001, McCarthy et al 1999 and Karoly 2009

Figure 9.1 Probability of previous prescribed burn slowing the head fire of a subsequent wildfire.

The Forest Fire Danger Indices, included on the extrapolated graph, suggest the broad probability of previous prescribed burns slowing the head fires that occurred in the 7 February fires. For the Kilmore Gap FFDI observations, the probability of previous prescribed burns slowing the head fire are broadly indicated to have been < 5% for a FFDI of >190.

The broad indications provided from the extrapolation of the McCarthy/Tolhurst graph beyond FDI 100, as well as observations of fire intensity in prescribe burnt areas subjected to the wildfires of 7 February, suggest a need to review the effectiveness of prescribed burns as a fire management tool in these conditions and determining relative strengths and weaknesses in relation to other fire management strategies.

The McCarthy/Tolhurst model reflects evidence presented to the Royal Commission that fire behaviour is unlikely to be controllable with current techniques of direct attack above an intensity of 4,000 KW/m (Waller 2009, Tolhurst 2009).

Under catastrophic FFDI conditions, these intensities can be reached with little fuel, reducing the relative effectiveness of fuel management in controlling fires.