SENATE FINANCE AND PUBLIC ADMINISTRATION REFERENCES COMMITTEE INQUIRY INTO LESSONS TO BE LEARNED IN RELATION TO THE AUSTRALIAN BUSHFIRE SEASON 2019-20

Written Questions on Notice

Senator Rice

Response from the Bureau of Meteorology, 28/09/2020

1. Is there a common definition or set of factors used to identify days with 'dangerous fire weather conditions'?

Dangerous fire weather conditions occur due to a combination of multiple weather, climatic and environmental conditions, such as heat, humidity, wind and the amount and type of fuel available. Because of the complex nature of these phenomena, there is no agreed set of factors to define days with 'dangerous fire weather conditions.'

There are, however, metrics that are in common use and agreed upon by fire agencies and the Bureau of Meteorology. The Forest Fire Danger Index (FFDI) and the Grass Fire Danger Index (GFDI) are indices that were developed in Australia by CSIRO in the 1960s. These indices are aimed at describing conditions under which forest and grassfires in Australia would spread rapidly and be difficult to control. They do not explicitly describe conditions under which a fire would ignite. The FFDI and GFDI are currently the basis of fire danger forecasts in Australia and use measures of windspeed, temperature, relative humidity, dryness, fuel type and fuel condition. These forecasts are used to provide fire weather warnings for fire weather forecast areas nationally.

The Fire Danger Rating scale provides a six-point scale (from low moderate to catastrophic) of fire weather danger (difficulty in controlling or suppressing fires) that are issued by state government emergency service agencies to the public. While these agencies work closely with the Bureau to determine the Fire Danger Ratings for any given forecast period, the Ratings that are issued take in additional information that is held at the state level, by those agencies. That additional information includes factors such as the specific location, population density, existing fires already burning, and a closer consideration of the state of the fuel.

2. Please provide the data that is available on current days with 'dangerous fire weather conditions' at whatever level is available (by state, city, natural resource management cluster or other geographic region), for whatever timeframe is available from 2010 onwards. How many days were above 25 on the Forest Fire Danger Index in each year from 2000 onwards, in each area?

The number of days where the Forest Fire Danger Index (FFDI) was greater than or equal to 25 in each year from 2000 onwards, nationally and for each state and territory, is provided below.

Number of days with an FFDI greater than, or equal to, 25; nationally and for each state and territory.

Year	Aus	Qld	NSW / ACT	Vic	Tas	SA	WA	NT
2000	81.61	58.81	39.33	26.21	1.76	111.91	102.83	88.42
2001	104.34	97.84	76.95	35.47	0.52	112.47	127.1	97.56
2002	167.7	153.11	108.92	45.28	0.96	163.82	188.17	217.02
2003	140.87	122.88	76.13	38.93	2.17	140.46	169.14	175.98
2004	131.05	112	88.3	40.61	0.65	151.34	143.51	165.91
2005	152.06	125.23	83.25	31.15	0.13	163.6	186.09	185.37
2006	128.81	113.78	102.96	62.96	1.98	156.86	132.7	153.87
2007	136.93	96.08	83.1	49.67	0.72	161.74	173	158.81
2008	141.74	103.97	63	42.61	3	144.79	175.89	197.29
2009	151.15	118.99	91.66	55.64	0.73	158.27	179.14	195.96
2010	85.26	29.26	21.8	25.23	0.97	83.23	158.04	76.28
2011	81.99	61.31	32.88	9.48	0	95.18	110.8	91.72
2012	128.23	93.92	61.68	40.57	0.9	148.27	158.97	162.8
2013	152.02	145.48	102.56	49.53	2.12	172.61	152.99	199.23
2014	140.31	123.71	91.13	53.33	1.94	155.05	159.91	166.3
2015	147.65	132.51	80.48	48.36	1.74	152.95	167.9	191.23
2016	125.82	94.29	74.71	37.32	0.76	129.84	161.18	150.5
2017	145.08	140.7	95.36	34.83	0.54	148.75	157.08	182.5
2018	172.56	156.88	117.42	52.6	0.81	169.73	189.68	226.42
2019	195.87	153.68	135.66	65.37	4.17	189.58	234.92	251.46

The data in the above table is based on *gridded* FFDI data rather than station data (gridded FFDI data is the interpolation of station data to an approximate 5km regular grid across Australia, covering all locations). The gridded FFDI is then used to calculate annual counts of the number of days with FFDI greater than or equal to 25 at each grid point. The annual counts are then averaged for each state and territory.

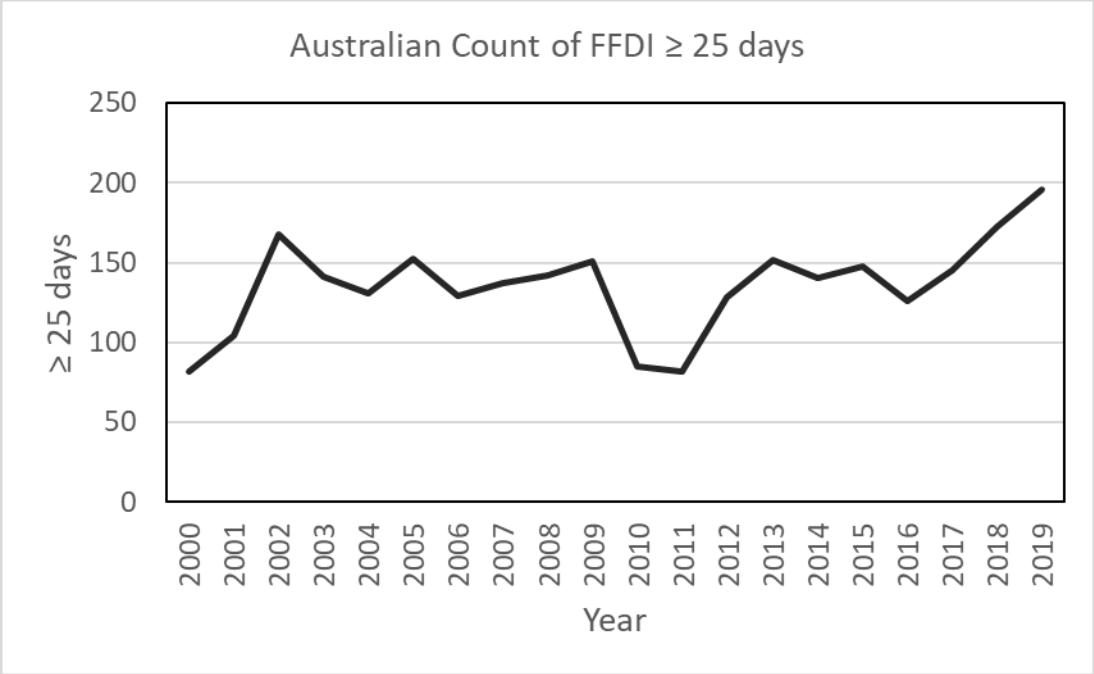

Figure: Timeseries of the number of FFDI greater than, or equal to, 25 days for Australia.

3. How has the number of 'dangerous fire weather condition' days increased due to the impact of climate change to date? Please provide any breakdowns available within Australia (e.g. state, city or NRM cluster). In relation to the warming Australia has experienced to date, how many more additional days with 'dangerous fire weather conditions' are associated with Australia's warming?

Linear trends over the past 50 years (1970-2019) in the number of days with a Forest Fire Danger Index (FFDI) of greater than, or equal to, 25 are provided below.

	Aus	Qld	NSW/ACT	Vic	Tas	SA	WA	NT
Trend in number of days per decade	+7.0	+8.9	+9.1	+6.1	+0.2	+6.7	+3.9	+9.9

Table: Trend in number of days with FFDI greater than, or equal to, 25 for Australia and each state and territory.

It is not currently possible to determine the component of the change that is due to Australia's warming temperature trends alone. The increase in the number of days with a FFDI of greater than, or equal to, 25 is influenced by:

- natural variability (and most pertinently the influence of the El Niño and La Niña per decade, and the influence of drought)
- rainfall trends (including changes in rainfall in the months leading into and during the fire season)
- trends in relative humidity (which are a function of many factors, including warming trends over land)
- changes in temperature at seasonal timescales

- changes in the frequency and intensity of heatwaves.

Further details on variability and change in Australian fire weather are available in the following Bureau publication: https://doi.org/10.1175/JAMC-D-17-0167.1

4. Are any estimates available for the number of days with dangerous fire weather conditions in future years, under different emissions scenarios? If so, please provide any available estimates for 2030 or subsequent years under different scenarios.

Yes.

Projections show a clear trend towards more dangerous near-surface fire weather conditions for Australia based on the FFDI, as well as increased pyroconvection risk factors for some regions of southern Australia.

An assessment of monthly changes in Forest Fire Danger Index (FFDI) was undertaken by the Bureau of Meteorology and the CSIRO for Climate Change in Australia, using three Global Climate Models and analyses produced. Further information can be found in Chapter 7.8 of the Climate Change in Australia Technical Reports at https://www.climatechangeinaustralia.gov.au/.

Further, a recent paper by Bureau of Meteorology, CSIRO and University of New South Wales authors examined changes in daily FFDI and another atmospheric index relevant to fire weather from 15 Global Climate Models. This study is available online at https://www.nature.com/articles/s41598-019-46362-x.