

“FOREST FIRE WEATHER”

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The commercial forests of Western Australia are confined almost entirely to the south-west corner of the State. This region experiences a wet winter and a long dry summer. The average annual rainfall is 40-50 inches of which about 70 per cent. falls in the months of May to August, and less than 1½ inches total for the three months, December to February, during which period the mean maximum temperatures are 80 degrees, 82.5 degrees and 84.8 degrees, respectively. Fires commence to run in the forests from mid September and in a dry year controlled burning may be still carried on as late as mid July of the following year.

A fire hazard exists on more than 90 per cent. of the days from the first of November until the commencement of the winter rains (usually in late April). During this long period fire hazards persist right through the nights and even minor relief occasioned by favourable weather changes is welcomed by the forester.

In an endeavour to arrive at a better understanding of the factors influencing the start and spread of bush fires in Western Australia, a Meteorological Station was set up at Dwellingup, in the heart of the Jarrah forest in 1934. The particular objects of the investigation were:—

1. To find a measure of current fire danger.
2. To consider the possibility of forecasting forest fires weather.

The Dwellingup unit has been maintained as a full weather reporting station, and during the fire season, further weather information is supplied from stations at Pemberton (Karri forest) and Ludlow (coastal), while daily reading of temperature, humidity and wind are made from all divisional headquarters.

The original work proceeded along the lines of American investigations and results were confirmed in general for Western Australian conditions. In particular it was established that no single weather element could be used as a criterion of current fire danger.

Working from first principles, on the assumption that the moisture content of fuel had a major effect on its burning qualities, investigations were carried out on the moisture content of small pieces of wood. Half-inch, one inch and two inch cylinders of locally grown Pine (*p. radiata*), Jarrah and Cedar were tried, together with 12 in. x 1 in. x ½ in. lathes, and 6 in. x 4 in. x ¼ in. end sections of the same species.

These determinations were made at two hourly intervals during the day in conjunction with the ordinary weather observations.

In order to gain some idea of the then immeasurable "fire danger" all field officers (11) operating in the Division at the time were asked to give an estimate of the maximum degree of fire danger for each day on an empirical scale of 0-10, being a day when a fire would not run and 10 being a day of maximum fire danger.

The estimates given were consistently close and it was decided that a mean of these personal estimates would give a reasonable indication of the maximum degree of fire danger for any day.

In this connection where occasional personal estimates varied from the mean by more than one, they were discarded for the daily average.

All weather readings, moisture contents and mean estimates were plotted daily and in the first season the close relationship between the variations in the mean estimate graph and that of the half-inch cylinder was readily apparent. Further extensive checking in the following season allowed the moisture content of the half-inch pine cylinder to be adopted as a measure of current fire danger in this State.

Late investigations at Pemberton indicated that the same standards could be applied in the Karri forest region and continued observations have supported this opinion.

While the original determinations were made on individual wood cylinders this was obviously cumbersome and the present method is to establish 3-stick units of 50gms. oven dry weight. Increase in weight in this case is then doubled to arrive at moisture content.

When this method was introduced in 1936 certain peculiarities in behaviour of the cylinders towards the end of the fire season became more obvious and it was found after investigation that there is a loss of oven weight which commences immediately after exposure and which continues throughout the life of the cylinder.

The effect of this weathering was to indicate lowered moisture contents than was actually the case. When the trend of loss of weight was determined, compensation was allowed on the moisture content Fire Hazard Graph, by lowering the graph periodically during the season and still using 50 grams as the apparent oven dry weight. Similar experiences have since been reported from America and Canada with other species.

For general purposes it was found desirable to have some descriptive scale of fire danger and the following Fire Hazard Scale was adopted:—

General	Empirical	Moisture Content
N.1	1	over 17%
Low	1. 4	17%—13%
Moderate	4. 6	13%—7.8%
Average Summer	6. 7	7.8%—6.5%
High Summer	7. 8	6.5%—5.3%
Severe Summer	8. 9	5.3%—4.2%
Dangerous	9. 10	4.2%—3.2%

In two cases only in the past 15 years has the true moisture content been below 3.2 per cent. These were 3 per cent. and 2.9 per cent., both occurring after prolonged periods of dangerous weather.

The question of forecasting was found to be much more complicated and required an assured supply of general synoptic charts covering this State. These were available only from the Weather Bureau in Perth, and were usually 30 hours old on arrival at Dwellingup. Despite this disadvantage, forecasting was commenced from Dwellingup daily throughout the summer in 1936, and broadcast from National Stations for the benefit of forest officers and the general public.

After two years, during which close co-operation was maintained with the Divisional Meteorologist, this officer was asked, in view of the greater scope of his weather information, to take over the fire hazards forecasts. Further co-operation with local meteorological officers and the sending of the officer in charge at Dwellingup to a Meteorological school in 1939 considerably improved the technique of fire weather forecasting which soon reached a high standard of accuracy.

The present routine incorporates both national and departmental dissemination of weather information and forecasts. The Dwellingup and Pemberton stations report daily to the Meteorological Bureau at 9 a.m. and 3 p.m. and to the afternoon telegram add the current fire hazard. The Bureau having its own three hourly synoptic charts and 3 p.m. readings from all over the State, compiles the forecasts for the following day and transmits them by telephone to Dwellingup before 1615 hours. This office, which maintains departmental radio control in the South-West, checks the forecasts and transmits them at 1615 hours to all forest stations.

The forecast normally takes the form of a brief weather message giving in particular, wind direction and strength, together with the maximum hazard expected for the following day, e.g.:—

The fire weather forecasts for the following Jarrah Forest Area is:—Slightly higher temperatures, lower humidities and light to moderate E.N.E. winds backing N.W. in the late afternoon. Fire Hazard—High summer.

Karri Forest Region.—Moderate E. winds veering S.W. in the afternoon. Fire Hazard—Average summer.

By this means all officers are given an indication of weather trends well in advance. On the following morning, weather reports and moisture contents are received by radio at Dwellingup from Pemberton and Ludlow. A check is made on the overnight forecast, which is amended if considered desirable and transmitted to all stations at 0745 hours, i.e., before the men have left their headquarters for the day's work.

Here again great assistance is given by the Meteorological Bureau, whose officers send warnings or amended forecasts of any sudden and unforeseen change in weather which may occur after the 1615 hours forecast. Arrangements have been made for a check with the bureau at 0730 hours daily in the approaching fire season.

The reliability of these forecasts over the past decade and the knowledge that a special forecast can be obtained at any time of the day or night from Dwellingup has imbued the field staff with confidence in this service, which forms the basis of the Forests Department's organisation during the summer months.

Apart from departmental officers, the general public which hears the forecasts repeated at intervals during the day, has shown marked interest in recent years and particular attention is now being paid by farmers to these forecasts on bush fire weather. Perhaps one reason of the greater public interest in recent years and particular attention, is that these forecasts are broadcast every day of the summer at the same times, whether the hazard is dangerous or nil.