APPLICATION OF THE BYRAM DROUGHT INDEX IN THE MANJIMUP FOREST REGION.

by

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INTRODUCTION:

The following article is a report on the work carried out in relation to the Byram Drought Index. It is also part of an investigation into the variables involved in the litter drying studies in Karri forest.

At the present moment, techniques used for burning northern Jarrah forest are applied to the southern Karri forests, using modified rain correction tables to predict fuel availability. These tables in their present form have on occasions proved incorrect when compared with actual conditions in the field.

One of the reasons for this, may be that rainfall over the previous month or months, has not been taken into account in the rainfall correction factor now used. The Byram Drought Index overcomes this problem and has been defined as a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff or upper soil layers.

EXPLANATION OF DROUGHT INDEX.

The drought index is a numerical value ranging from 0 to 800 given to a state of fuel dryness in forest areas and is based on past weather conditions. The system was devised by Byram and Keetch (1963) and has been reviewed with an eye on Australian conditions by McArthur (1966).

The following points are parts of the work by Byram and Keetch.

The moisture content of the upper soil, as well as that of the covering layer of duff has an important effect on the fire suppression effort. Also it is noted that extremely difficult fire suppression is associated with cumulative dryness or drought. During these extreme drought conditions, moisture contents of living scrub and tree crowns may be lowered, so that fires may crown more readily.

The concept of drought can be expressed in numerical terms. Values would range from zero (saturation point) up to some maximum value which corresponds to the absence of available moisture in the soil and duff. Drought index thus is a quantity that relates to the flammability of organic material on or in the ground. A prolonged drought influences fire intensity largely because more fuel is available for combustion.

The drought index does not replace the Fire Danger Rating, because it represents an entirely different moisture regime in which the response to weather changes is much slower than with the Buildup Index.

Although the drought index number has a definite meaning in terms of moisture deficiency, the significance of a particular stage of drought for fire control must be determined locally.

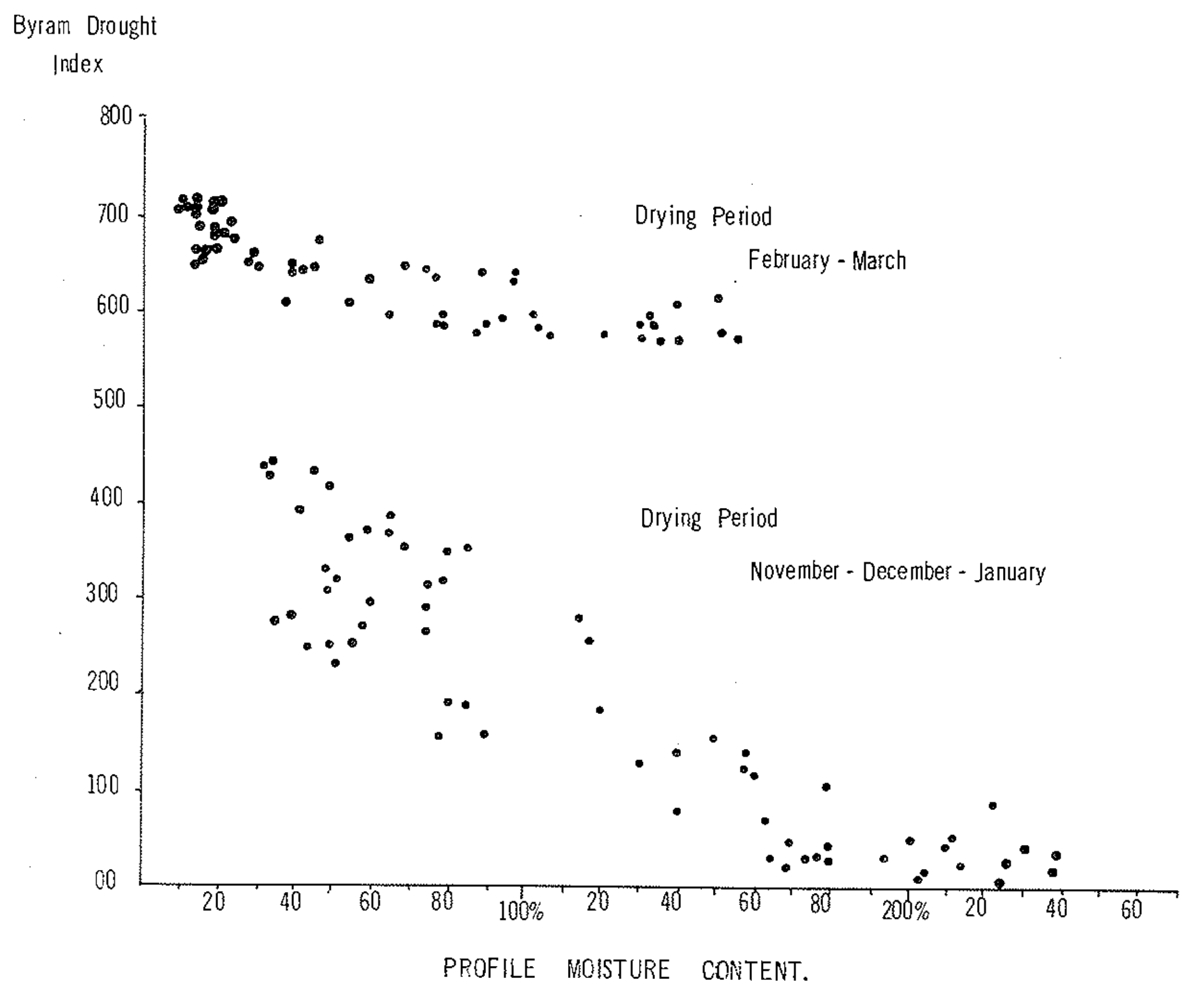

Fig. I Relationship between the profile fuel moisture content of karri fuel and the Byram drought index. Each dot represents a fuel moisture sample in karri, at Channybearup during '65 to '69.

EXPERIMENTAL RESULTS

(A) Profile Moisture Content. To check if there is any relationship between the drought index and profile moisture content the following procedure was adopted. Samples of profile moisture content taken in heavy Karri fuels of eight to ten tons per acre were plotted as points against the Byram drought index figures. The results showed some correlation between profile moisture content and the Byram drought index in both autumn and spring. (See Fig. I).

(i) During the drying period between November, December and January the profile moisture content ranged from 250% MC when fully saturated at a zero index; to 40% MC at the driest point when the index reached 440.

(ii) During the drying period of February through to March, the profile moisture content ranged from 160% MC occurring at an index level of 550; down to 9% MC occurring at an index level of 720.

(B) Rainfall correction factor. To provide a rainfall fuel correction table for Karri, 147 individual moisture content figures were fed into a computer. A multiple regression analysis using actual profile moisture contents, with twenty-seven independent variables, which included the Byram index gave some good results.

Tbe following seven combinations were used to explain the difference in moisture content and gave a correlation coefficient of 0.87.

(1) Byram drought index
(2) Accumulated rainfall over 30 days.
(3) Number of days since rain.
(4) Mean temperature today.
(5) Average of max, and min. temp.
(6) Mean R.H. past two days.
(7) Mean Dew point past two days.

Even so some of the variables will have to be changed or substituted to make them more manageable.

(C) Forest type. Data obtained from experimental fires carried out in the Manjimup district, provided information on different forest types. Plotting of points to compare the drought index to forest types or when they were burnt; appears to give some indication of when different forest fuel types reach a stage of inflammability at certain points on the Drought Index.

(i) Indications suggest that pure Jarrah and Jarrah-Marri forest fuel types are burnt during an index of 40 to 400.

(ii) Mixed forest types such as Jarrah-Karri-Marri, Karri-Marri and Marri-Karri etc., all have fuel types which are burnt when the index rises above 150. The upper limit under which burning was carried out was 720.

(iii) Pure Karri without any admixture of tree types required a relatively high drought index, with several fires just above 450; while the majority of fires occurred when the index rises above 600.

(D) Scrub Types. Later information from experimental fires in the Strickland Road plots, seemed to indicate that scrub cover may be a better indication for selecting burning conditions than tree types.

(i) Acacia pulchella could be burnt. when the index rose above 100, an upper limit of 400 was set, to prevent an excessive amount of scrub flare which occurred above this figure.

(ii) Acacia strigosa burnt satisfactorily when the index rises above 180 with an upper limit of 400.

(iii) Bossiae aquafolium or netic burnt mainly when the index rose above 400 although some very light intensity fires were achieved at 200. No upper limit seems to exist for this scrub.

(iv) Trymalium spathulatum or Karri hazel required a relatively high drought index, with several fires above 400, but the majority of fires occurred when the index rose above 600. No upper limit seems to exist.

The following table shows approximate dates when it is considered three of the scrub species would have become available for burning in the past burning seasons.

Pulchella	Netic	Trymalium	End of Season
14.11.64	12. 1.65	24. 2.65	25.3.65
14.12.65	21. 1.66	24. 3.66	11.4.66
6.11.66	17.12.66	2. 2.67	14.3.67
29. 9.67	18.12.67	15. 2.68	25.3.68
14.11.68	28.12.68	28. 1.69	6.4.69
5.10.69	16.12.69	22.12.69	9.4.70

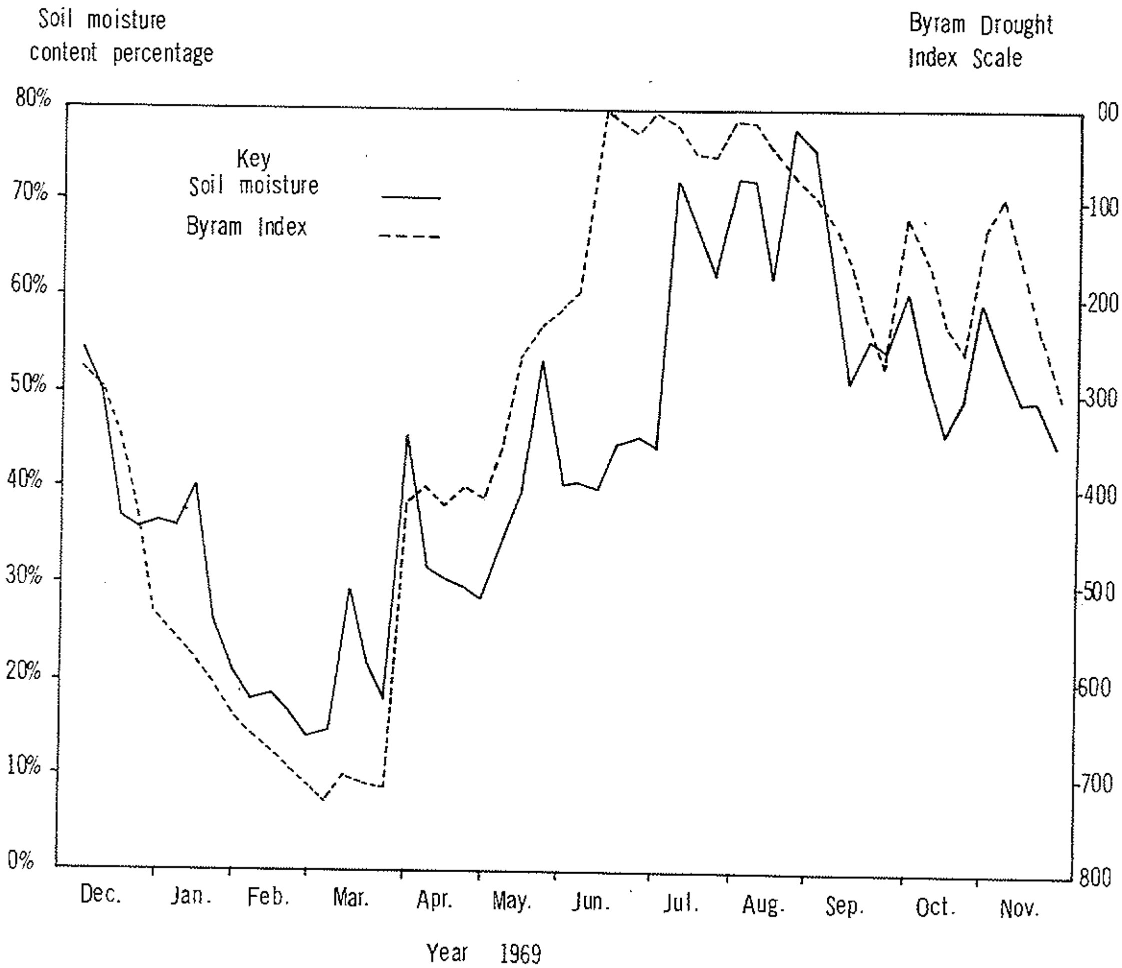

Fig. II Comparison between the Byram drought index and soil moisture content in the upper six inches.

From this type of information it would seem desirable to lift or suspend the present burning restrictions in pure Karri, where the scrub cover is predominantly Trymalium spathulatum, that is, if we are completely serious about carrying out a policy of control burning in Karri to reduce the fuel build up.

(E) Soil Moisture. To test one of the basic assumptions:– that the soil-duff layer gains moisture from rainfall and loses moisture by evapotranspiration are demonstrated by two graphs, superimposed on one another. (See Fig. II).

One graph representing the Byram drought index, the other the actual moisture content of the soil in the upper six inches are compared for a complete year. Results here, are favourable enough to warrant further investigation for other research purposes.

Data supplied by P. Christensen of the Silviculture research section. Details of actual sampling site are: from a poorly drained section in cutover Jarrah forest.

(F) Fire Suppression. In fire control, the effect of suppression problems were observed to occur above a drought index of 550; it was noted at this stage that dry stags and dead limbs caught alight. It must be noted that these observations are only based on one season, and would need to be confirmed in subsequent years to be of any value.

However, a study of large uncontrolled fires in the Manjimup district between '65 and '69 showed that large fires occurred between an index range of 224 up to 703. (A fire was considered large if it reached over 50 acres before being suppressed).

The following percentage of fires occurred at different stages on the index.

30 per cent of all large fires occurred between 500 to 600.
40 per cent of all large fires occurred between 600 to 700.

Discussion. Other possibilities to use as drought or moisture deficiency indicators were investigated, but proved unsuitable due to method and duration of sampling. They were: the moisture content of outer bark,, limbs, groundwood, duff and surface leaves.

Although the drought index has been shown to have a definite meaning in terms of fuel availability in forest types, the reason is probably the type of scrub cover rather than tree types, in the Karri forest around Manjimup.

The index has shortcomings which must be realized, that is:– The index is only of value on a rising hazard or scale. Recent rainfall must still be taken into account to describe the fuel moisture content of the fine fuels.

REFERENCES

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