PROGRESS REPORT - PROJECT NARRIK (W.P. 28/78) No 1.

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INTRODUCTION

The Forests Department recognizes that prescribed forest fire may have application beyond fuel management. For example, disease control, promoting forest health and fauna habitat management.

Such fires generally require burning under drier fuel conditions and at higher intensities than is currently practised with fuel reduction burns. Past experience and recent pilot studies have shown that i) existing models of steady state fire behaviour require validation (and improvement where necessary) for fires burning under dry fuel conditions, ii) massed fires burning under dry fuel conditions often display unpredictable, "blow-up" behaviour.

OBJECTIVES

Objectives of this project are to;

(i) validate and improve the Forest Fire Behaviour Tables for Western Australia (Sneeuwjagt & Peet) over a wide range of burning conditions.

(ii) examine factors contributing to "blow-up" of massed fires under dry fuel conditions and to relate these factors in such a way as to enable the occurrence and intensity of this phenomenon to be predicted within reasonable limits.

(iii) gather information on control problems arising from such fires.

(iv) examine the effect of such fires on forest values, esp. timber.

(v) examine the effect of such fires on several vegetation types.

METHOD

The following is a brief summary of methods employed to achieve objectives.

- 11 plots each of approximately 100 ha established in jarrah (*E. marginata*) forest west of Nannup (in 7 y.o. fuels ~ 7.5 tonnes/ha litter)

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- extensive survey of litter, logs and scrub fuels undertaken
- extensive assessment of vegetation - species and abundance - permanent plots established
- several hundred jarrah trees displaying no fire damage were located and permanently marked - D.B.H.O.B. and D.B.H.U.B. measured
- plots were ignited using electrical incendiaries on a pre-determined grid
- an aircrafted mounted thermal scanner provided fire spread rate data

FIRE NO.	IGNITION SPACING	IGNITION TIME	BURN-OUT TIME
1	300m x 300m	1720 (night)	2200
2	100m x 100m	1203	1317
3	100m x 100m	1225	1340
4	200m x 200m	1200	1320
5	100m x 100m	1530	1630
6	200m x 200m	1845 (night)	1000 (following day)
7	200m x 100m	1800 (night)	2120

RESULTS

At this stage, data are being collated in preparation for analysis. The following are generalizations and observations.

RE IO.	MIN. MOISTURE CONTENT % FINE FUEL	$\bar{x}$ TEMP. °C	$\bar{x}$ R.H. %	$\bar{x}$ WIND 10m ABOVE CANOPY K.P.H.	* $\bar{x}$ HFROS M/HR	$\bar{x}$ H.F. INTENSITY KW/M	* MAX. HFROS M/HR	TIME TO REACH MAX. HFROS (MINS.)	** CONTROL DIFFICULTY
	8.8	22-19	63-65	24-28	~100	~500	~471	65	M
	11.5	22	47	19-22	~120	~600	~400	50	M
	8.0	32	23	10-15	~85	~425	~200	32	M
	8.0	28	34	20-22	~380	~1900	~800	36	H
	8.0	27	40	15-20	~180	~990	~600	30	L
	13.2	18	76	8-10	~30	~150	~40	25	L
	10.2	20	66	14	~45	~225	~500	140	L

These results are approximations only. Greatly improved results will be available in the near future.

** L = Low
M = Moderate
H = High

see progress report No 2 attached.

• From the outset and without having analysed much of the data at this stage, it is apparent that the intensity of massed fires can quickly esculate under dry conditions. A further observation is that massed fires become wind driven and did not appear to influence each others behaviour greatly when all of the following apply;

- winds (10 m above the canopy) exceeded 20 k.p.h.
- fuel moisture content was 9-12%
- fuel loads (litter) were 7-9 tonnes/ha
- fires were > 200m apart

Prior to the linking of these fires, fire behaviour was observed to increase at heads and flanks.

• Massed fires quickly coalesced, resulting in increasing fire behaviour activity when;

- winds were less than 15 k.p.h.
- fuels were dry; 6-8%, R.H. < 35%
- temperatures were high 28-35^{o}C
- fuel loads at 7-9 tonnes/ha
- ignition was intense (100m x 100m)

Mean and maximum headfire spread rates were generally lower over a greater portion of the burn under these low wind conditions, even though fire winds were generated and coalescence was observed.

• Coalescence of massed fires under dry fuel conditions and low winds could be delayed when fuel moisture content increased from 10-13% throughout the duration of the burn, R.H. increased from 45-65% and temperatures dropped from 24-19^{o}C. A spacing of 200m x 100m was utilized The significance of this is the quantity of fire rather than geometric design.

Under these night-time conditions, excellent fuel consumption, hence soil heating, was achieved and intensities were kept relatively low (50-300 kw/m). While such burns would be effective in regenerating legumes, they would not be effective in controlling *B. grandis* thickets (this requires the first fire to be near 1000 kw/m).

No fire effects results are available at this stage.

FIG. 1. Variability of 3 fires lit simultaneously and 200m apart in summer. Predicted r.o.s. = 60 m/hr.

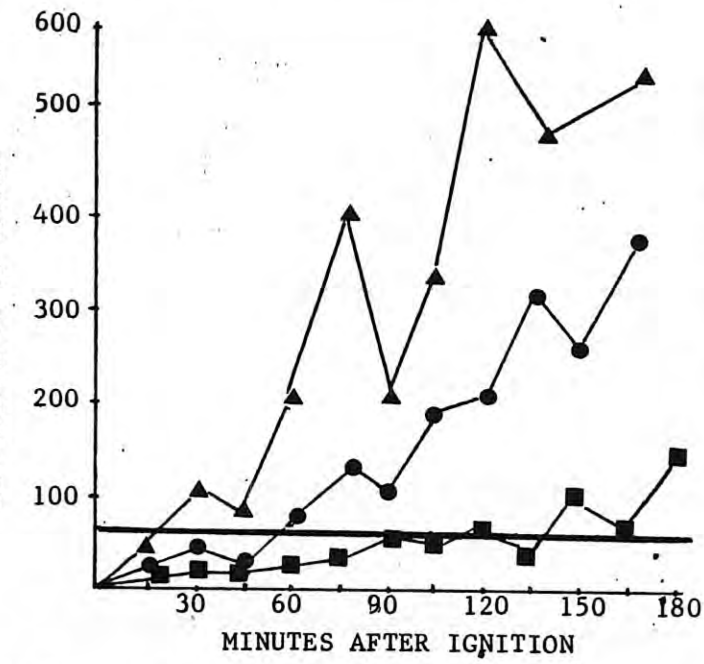
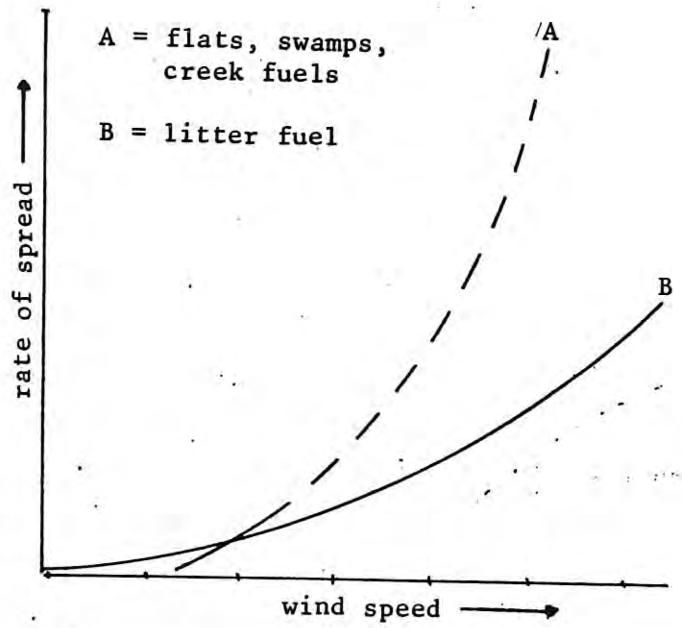
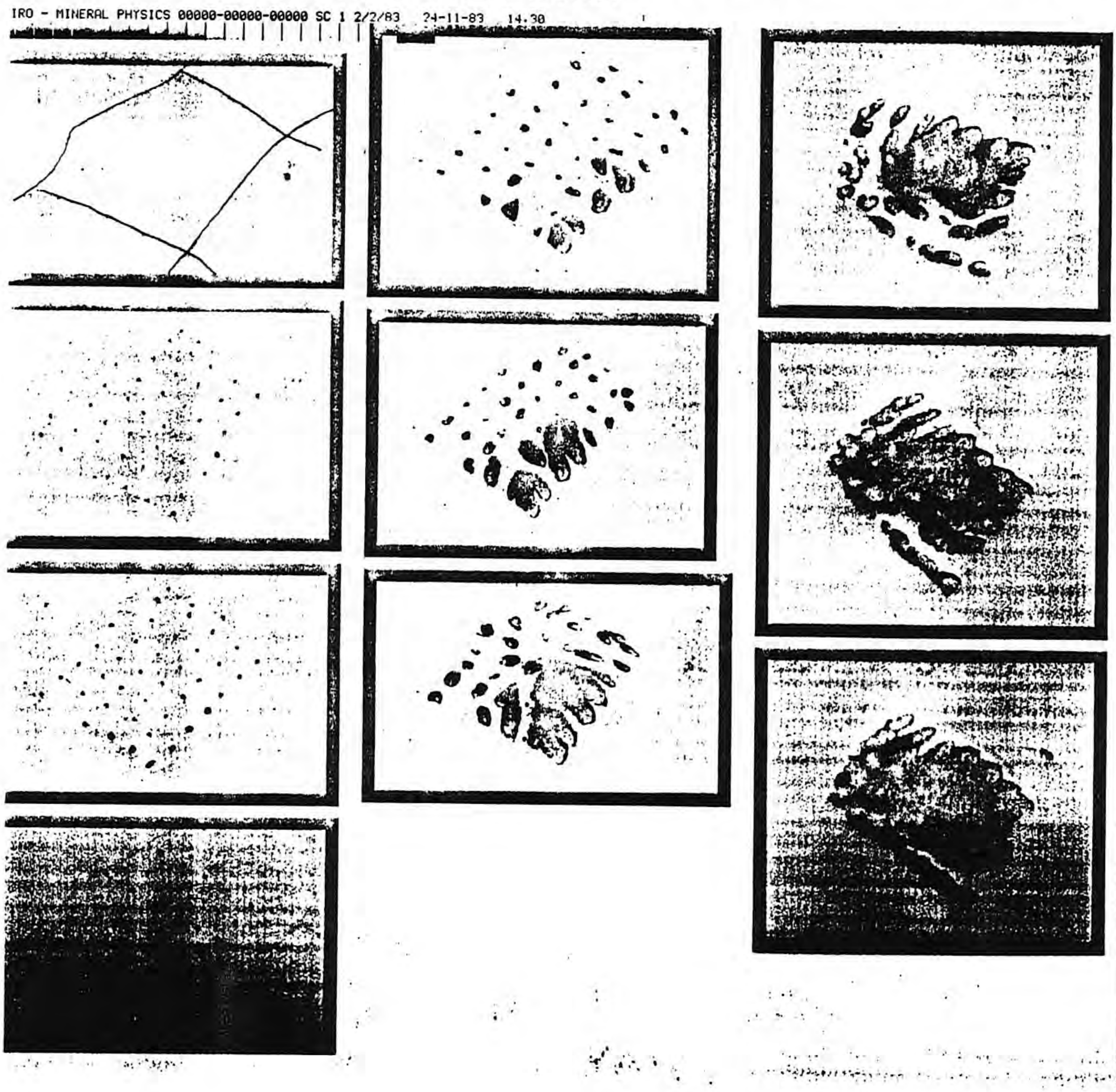


FIG. 2. Relationship between windspeed and spread rate of fires burning in 2 different jarrah fuels in summer.



G, 3. I/R aerial scans taken at 15-20 minute intervals of a mass ignition fire under dry conditions (~100 ha block).



SUMMARY OF COMMON CAUSES OF BLOW-UP OF JARRAH FIRES

1. FUELS

• Low Fuel Moisture Content - fire litter fuels are below 7% and the Soil Dryness Index is high (> 1200).

LOW RH = LOW FUEL MOISTURE ⟶ RAPID CHANGES IN FIRE BEHAVIOUR CAUSED BY SLIGHT CHANGES IN WIND, SLOPE, FUEL STRUCTURE, FUEL LOAD.

• Changes in Fuel Type - litter fuels to scrub fuels in creeks, flats or swamps. Under dry conditions (see above) scrub fuels in creeks, flats and swamps burn up to 4 times faster than litter fuels under tree canopy.

• Fuel Quantity - fires may burn from areas of light fuel to heavy fuels such as in creeks, unburnt pockets, logging debris.

2. WEATHER

• Wind Shifts - most common cause of blow-up fires in the south west. The influence of wind on a fire can alter by:

- Change in slope and topography — wind will ⟶ travel faster around the sides of hills, up slopes, when funnelled by gullies. Large scale eddies off the Darling Scarp can also influence fires burning nearby.
- Changes in vegetation structure - wind travels faster over treeless flats through the forest.
- Onset of sea-breeze.

3. ATMOSPHERIC STABILITY

• Unstable atmospheric conditions promote the rapid development of convection columns. Combined with strong winds at high levels, spotting potential is increased considerably.

4. FIRE INTERACTION

• Massed effect of fires - Numerous fires burning in close proximity such as from spotting, can be drawn together violently to form a massive conflagration.

The conditions under which this is most likely to happen have been discussed earlier. Small fires (5-10 ha) burning under these conditions have been observed to "draw" backfires lit off an edge some 150m downwind of the fires. The line of backfire lit as edging reached a rate of spread twice that of the headfires of the smaller fires (480 m/hr) causing crowning and long distance spotting. Backfiring under such conditions should not be attempted unless very carefully considered.