# A DESCRIPTION OF FUELS IN DRYANDRA STATE FOREST



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## SUMMARY

In order to determine the best action for minimizing the risk of devastating wildfires, it is necessary to determine the extent and magnitude of the fire hazard. A useful measure of this is in a description of fuels including quantity, rate of accumulation, distribution, variability, structure and flammability.

From a recent survey of fuels in Dryandra State Forest, it is clear that the rate of fuel accumulation, of both leaf litter and scrub, is very slow and highly variable. The rate of leaf litter accumulation is dependent on tree basal area and time. For example, for a tree basal area of about 10 $m^2$/ha, the rate of fuel accumulation is in the order of 0.4 tonnes/ha/annum. The stocking of trees is highly variable within a forest block (non plantation) and so too is the fuel loading. With the exception of lateritic uplands (which carry dense thickets of Dryandra sp.) scrub does not contribute significantly to fuel loading. Scrub loadings of 10-12 t/ha were recorded on the lateritic soils at the back of breakaways. These sites carry very little leaf litter (2-3 tonnes/ha).

On the basis of fuel measurements done in June 1984, attempting to broadacre burn forest blocks in Dryandra under mild conditions is unnecessary, undesirable and likely to be very difficult, resulting in a patchy burn. As fuels are generally light and discontinuous (except in mallet plantation) it is recommended that protective burning be limited to strategic areas such as adjacent to farmland or along major access roads. Other methods of fuel reduction, such as spraying with herbicides, should be tested along boundaries with farmland. Frequent burning encourages grass development, hence an annual fire problem.

It is also recommended that fire breaks adjacent to private property and surrounding mallet plantations be cleaned up and maintained. Many of these are overgrown.

Burning for habitat management is not seen as necessary yet. Trapping results indicate that animal numbers are high and that the existing fuel ages and vegetation structures are providing suitable habitat. Further

monitoring and research is needed to define appropriate fire regimes. Until this is done, burning should be limited to strategic strips and edging for fuel reduction. It is crucial that wildfires are excluded from the central block. Likewise, wildfires should not leave the forest. This is the key management function for the moment.

# FUEL LOADINGS, FUEL TYPES AND FUEL ACCUMULATION RATES - DRYANDRA STATE FOREST - A PROGRESS REPORT -

## 1. INTRODUCTION

Manjimup Research staff spent 2 weeks at Dryandra State forest in June 1984 to examine:

(i) existing fuel loading and distribution
(ii) existing fuel types
(iii) fuel accumulation rates
(iv) fire ecology of small animals
(v) vegetation distribution and its relationship with landform

This is a progress report on the fuels present in Dryandra [illegible] and is based on some 560 samples taken throughout the main [illegible] 140 samples taken from within mallet plantations. The report [illegible] quantify the "fire proneness" of Dryandra and follow up work [illegible] devising an appropriate burning plan to prevent wildfires [illegible] leaving the forest and to maximize conservation values.

## 2. GENERAL FIRE HISTORY

Since about 1938, most of Dryandra has experienced only edge [illegible] off major roads and tracks in autumn and spring. Very [illegible] burning has been done, but it is likely that some of the edging [illegible] in autumn) ran deep into the blocks. Since records have been kept, there have been very few wildfires in Dryandra forest itself. [illegible] since 1938, the largest fire burnt 150 ha of State Forest. The average area burnt (of State Forest) by a wildfire is 40 ha. There has been [illegible] 80 wildfires in surrounding farmland (within a 20 km radius of Dryandra fire tower). Almost all of these were caused by harvesting [illegible]. Of the 13 fires to burn into Dryandra, about 60% started [illegible] during harvesting. The remainder were either lightning strikes [illegible] billy fires. It would be reasonable to say then, that Dryandra is under greater threat from wildfires coming into the forest than the reversal and that the level of fire proneness is lower than forests further west.

In recent years (since 1979) there has been some attempt at broadacre fuel reduction burning. The results have been very patchy, often only 20-50% of the block burning out. The following is a description of the fuel condition in 6 blocks studied in June/July 1984 (see figure 1 for blocks studied).

Block 1 - Skelton Block

Fuel age (litter fuels)

2% of area - 1 year old.

16% of area - 4 year old fuels.

16% of area - 5 year old fuels.

This is the result of frequent edging which ran into the block.

6% of area - 46 year old fuels.

Fuel load (litter)

mean fuel loading = 7.8 t/ha

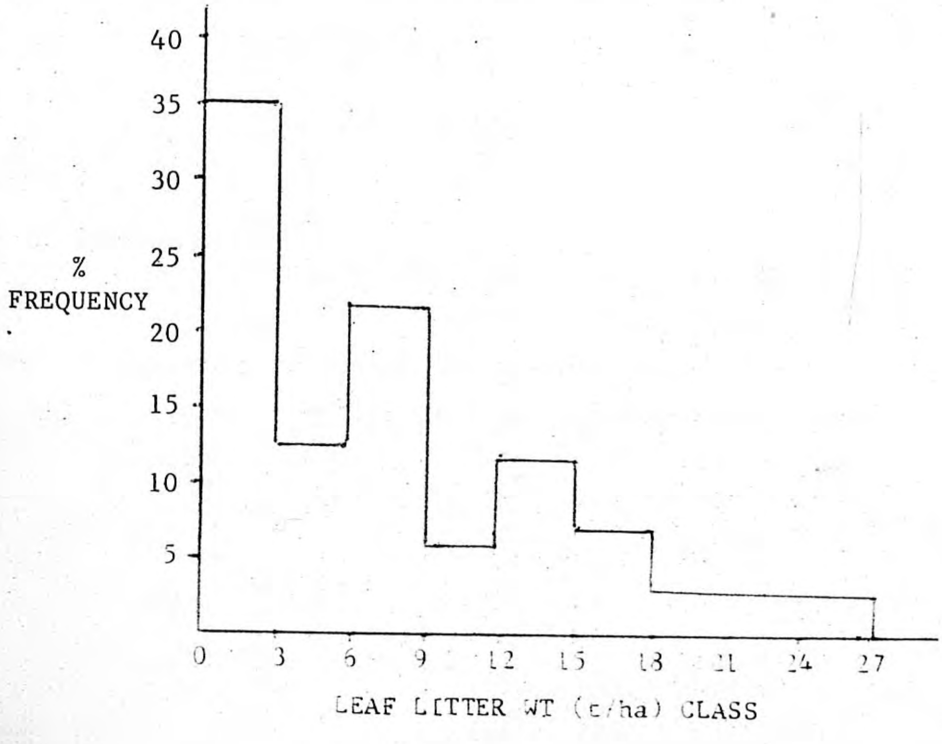
minimum fuel loading = 1.0 t/ha

maximum fuel loading = 42 t/ha

standard error 1.03 t/ha

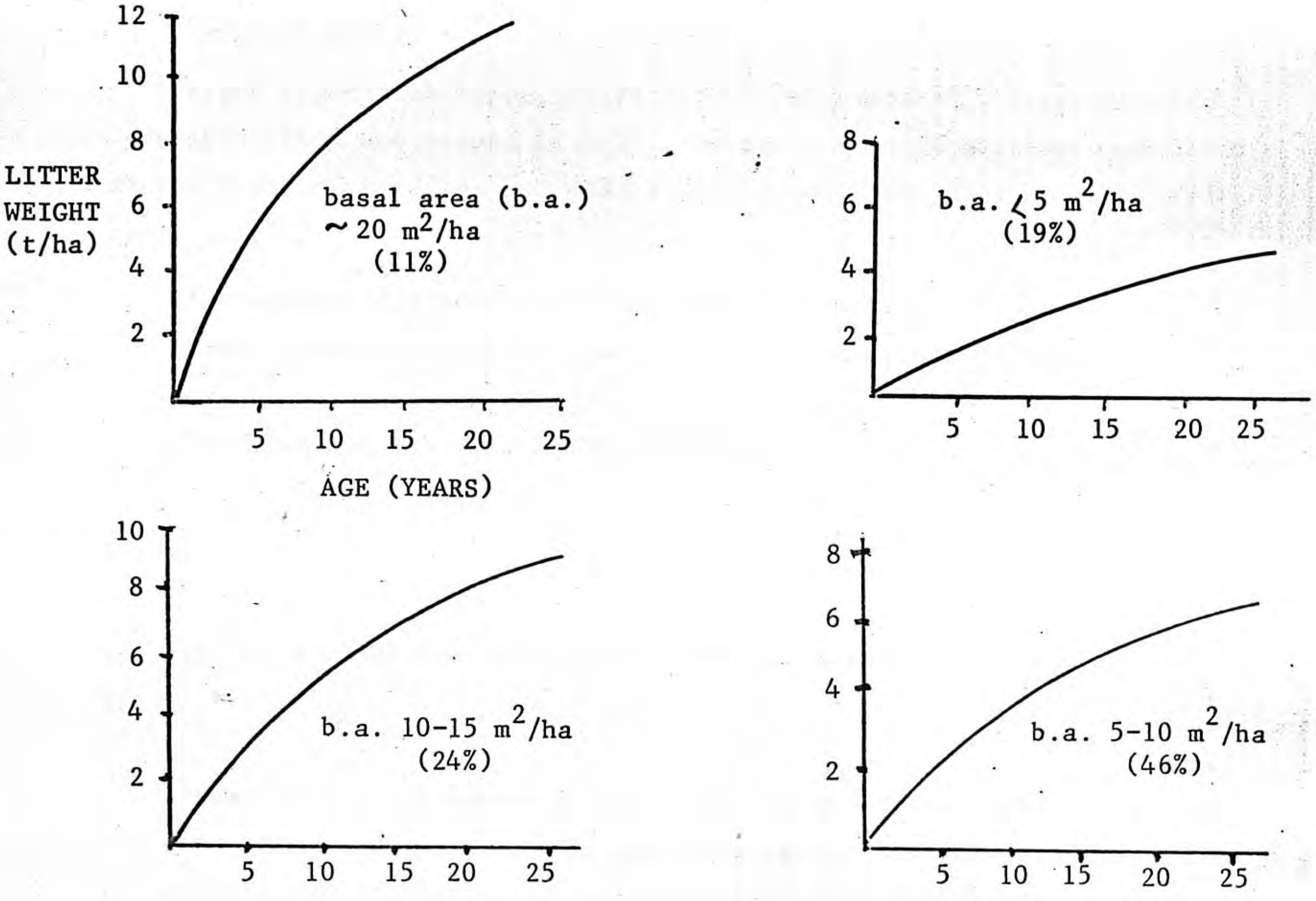
62% of the block carries ≤ 8 t/ha (see figure 2 below)

FIGURE 2: Leaf-litter weight class frequency distribution - Block 1. Other Blocks show similar variability. 66% of Block 1 carries 46 y.o. litter.



The high variability and patchiness of fuel loadings is due to different fire history and, more importantly, variability in tree canopy cover. Tree basal area and fuel age (or time since last fire) will determine the fuel quantity and accumulation rate (see figure 3 below).

FIGURE 3: Range of litter accumulation rates in Block 1. Bracketted is the % area carrying the specified basal area. Mean b.a. for Block 1 is 10.58 $m^2$/ha. (66% of Block 1 carries 46 y.o. litter.)




It is accepted that 8 t/ha is the maximum allowable fuel loading for fire control purposes then it is not necessary to burn Block 1, even though most of the fuels are 46 years old. If this block was to be burnt on a 20 year rotation, then the fuel loadings (litter) would be similar to that shown in table 1.

TABLE 1: Expected fuel loadings after 20 years.

| % AREA BURNT | LITTER FUEL LOAD (t/ha) | ACCUMULATIVE % |
|---|---|---|
| 20 | 4 | 20 |
| 45 | 6 | 65 |
| 24 | 8 | 89 |
| 11 | 11 | 100 |

. SCRUB AS FUEL

Eight vegetation types, based largely on overstorey tree species, were identified and mapped in 1937. We are currently sorting vegetation on the basis of landform and understorey species composition. The 1937 types are;

1 = wandoo, 2 = powder bark wandoo, 3 = jarrah, 4 = marri,
5 = *E. drummondii*, 6 = casuarina, 7 = mallet, 8 = Dryandra.

The mean weights of these types are;

| | 1 | 2 | 3 | 4 & 5 combined | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| $\bar{x}$ t/ha | 2.3 | 2.4 | 3.0 | 12.3 | 0.8 | 1.2 | 4.7 |

Figure 4 shows the relationship between scrub weight, scrub type and age.

There were insufficient samples in a range of fuel ages, to determine the rate of biomass increase for most vegetation types. Even given high variability, some patterns emerge for the wandoo and Dryandra scrub types (figure 4). Scrub weight remains constant after about 20 years. Overall scrub biomass increment is very low (e.g. = for wandoo, ~ 0.1 t/ha/annum). Most vegetation types have a biomass of 2-3 t/ha, of which only about 40% would burn on a wildfire of moderate to high intensity. The marri/ *E. drummondii* types carry about 12 t/ha after 20 plus years. Table 2 contains the percent area of each vegetation type for each of the non mallet plantation blocks.

FIGURE 4: Age of vegetation vs weight of available fuel for 8 overstorey types in Dryandra forest.

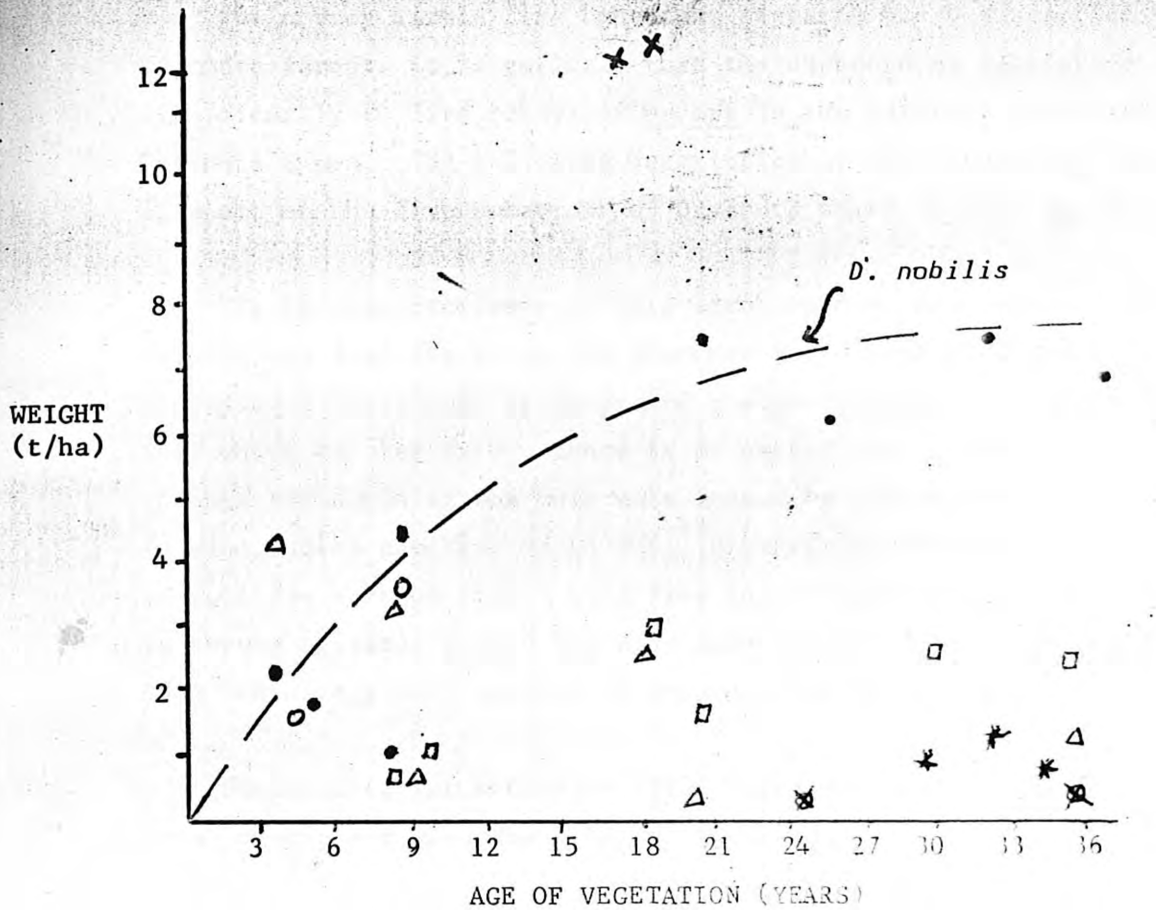



Table 2: Per cent area of each vegetation type

| BLOCK NO. | VEGETATION TYPE (1937) | | | | | | |
|---|---|---|---|---|---|---|---|
| | WANDOO | POWDER BARK | JARRAH | MARRI & *E. DRUMMONDII* | CASUARINA | MALLET | DRYANDRA |
| 1 | 17 | 6 | 35 | 0 | 4 | 30 | 8 |
| 2 | 15 | 50 | 0 | 6 | 0 | 0 | 29 |
| * 3 | - | - | - | - | - | - | - |
| * 4 | - | - | - | - | - | - | - |
| 5 | 15 | 26 | 0 | 0 | 6 | 27 | 26 |
| 6 | 87 | 2 | 8 | 2 | 0 | 0 | 0 |

* NOT AVAILABLE

## FIRE BEHAVIOUR - SCRUB FUELS

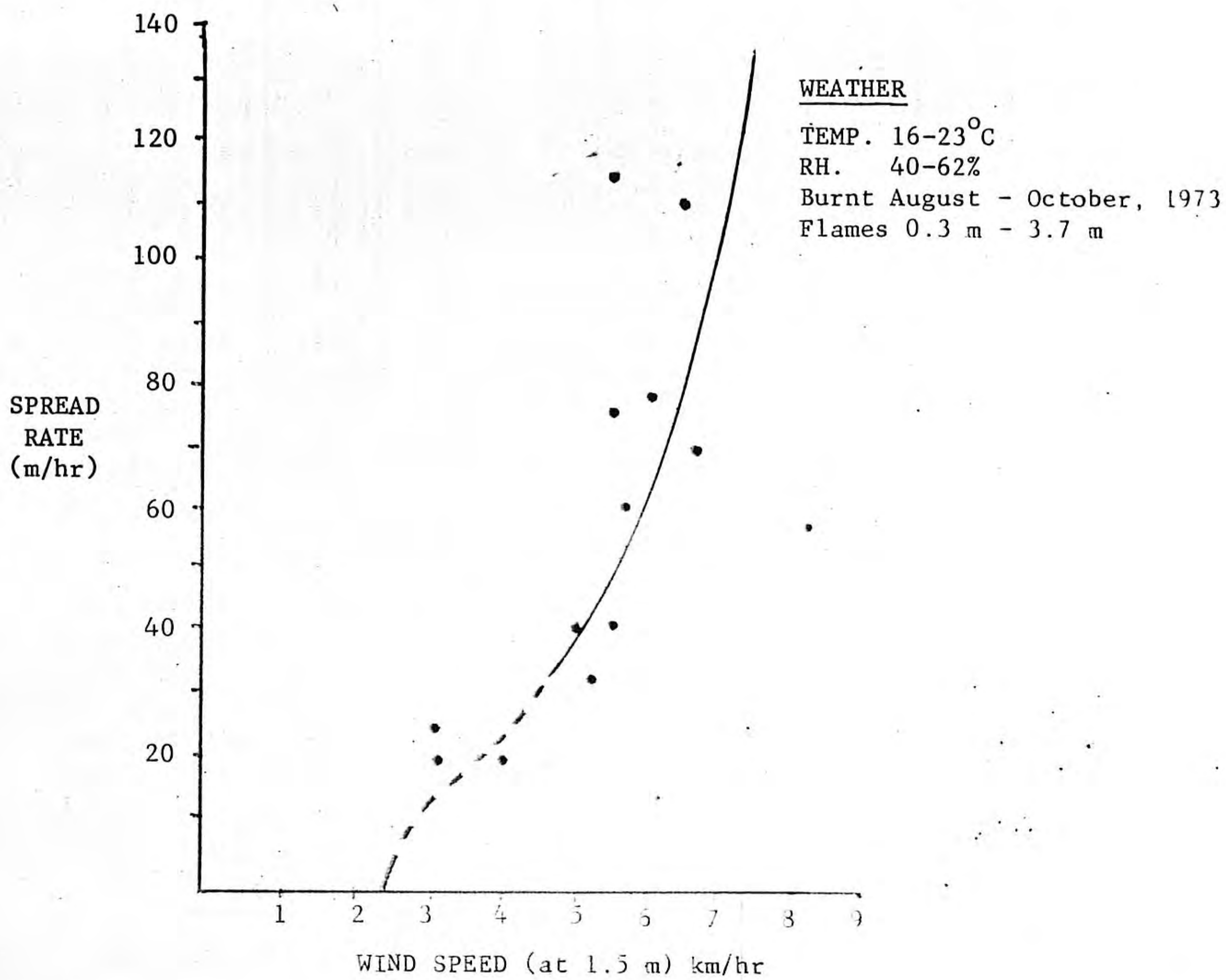
While very little fire behaviour research has been carried out in Dryandra forest, it is unlikely that the understorey vegetation contributes significantly to fire behaviour <u>except</u> in the marri/*E. drummondii* and Dryandra types. The following description of fire behaviour is taken from a report on the fire behaviour of Dryandra scrub by John McCormick (1973).

"It is characteristic of this scrub species *(D. nobilis)* that it retains its dead leaves on its branches for a number of years, thus providing a "fuel bed" at about 1-2 m above the ground. It is this aerial fuel which carries fire. There is no ground fuel. Fire can progress through the scrub crowns only when fanned by strong winds. A brief fall in wind causes the fire to go out. Dryandra scrub does not lend itself to ignition by spot fire. Line fire is a superior technique. Winds must be strong (greater than 6 kph near ground or > 25 kph tower). Because the dead leaves are well aerated, Dryandra scrub will burn most of the year."

Figure 5 (after McCormick 1973) illustrates the spread rate/wind relationship for *Dryandra nobilis)* thickets.

While Dryandra thickets can exhibit severe fire behaviour, these thickets are only localised and rarely extend for more than several hundred meters. Fire run would be short and sharp.

FIGURE 5: Rate of spread vs wind speed - fires burning in 26 y.o. *Dryandra nobilis* thicket.




Leaf Litter Loading in Other Blocks

Table 3 contains the fuel ages as a per cent area of each of the blocks studied.

TABLE 3: Fuel age by % area, in each block.

| FUEL AGE YEARS | BLOCK NUMBER | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | ALL BLOCKS |
| 1 | 2 | 0 | 0 | 0 | 0 | 20 | 4 |
| 3 | 0 | 0 | 0 | 77 | 0 | 20 | 17 |
| 4 | 16 | 0 | 89 | 0 | 0 | 0 | 19 |
| 5 | 16 | 0 | 0 | 0 | 0 | 8 | 4 |
| 8 | 0 | 42 | 0 | 0 | 0 | 12 | 10 |
| 9 | 0 | 34 | 0 | 0 | 0 | 0 | 6 |
| 15 | 0 | 0 | 0 | 0 | 0 | 40 | 0 |
| 20 | 0 | 24 | 0 | 0 | 0 | 0 | 4 |
| 44 | 0 | 0 | 11 | 0 | 0 | 0 | 2 |
| 46 | 66 | 0 | 0 | 23 | 100 | 0 | 34 |
| TOTAL | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

As can be seen from the Table above, a wide range of fuel ages exist in Dryandra with 40% of the non plantation area, being in excess of 20 years old. The mean litter fuel loadings (and variability) for each block studied is shown in Table below. Block 20, 30 and 40 are mallet plantations.

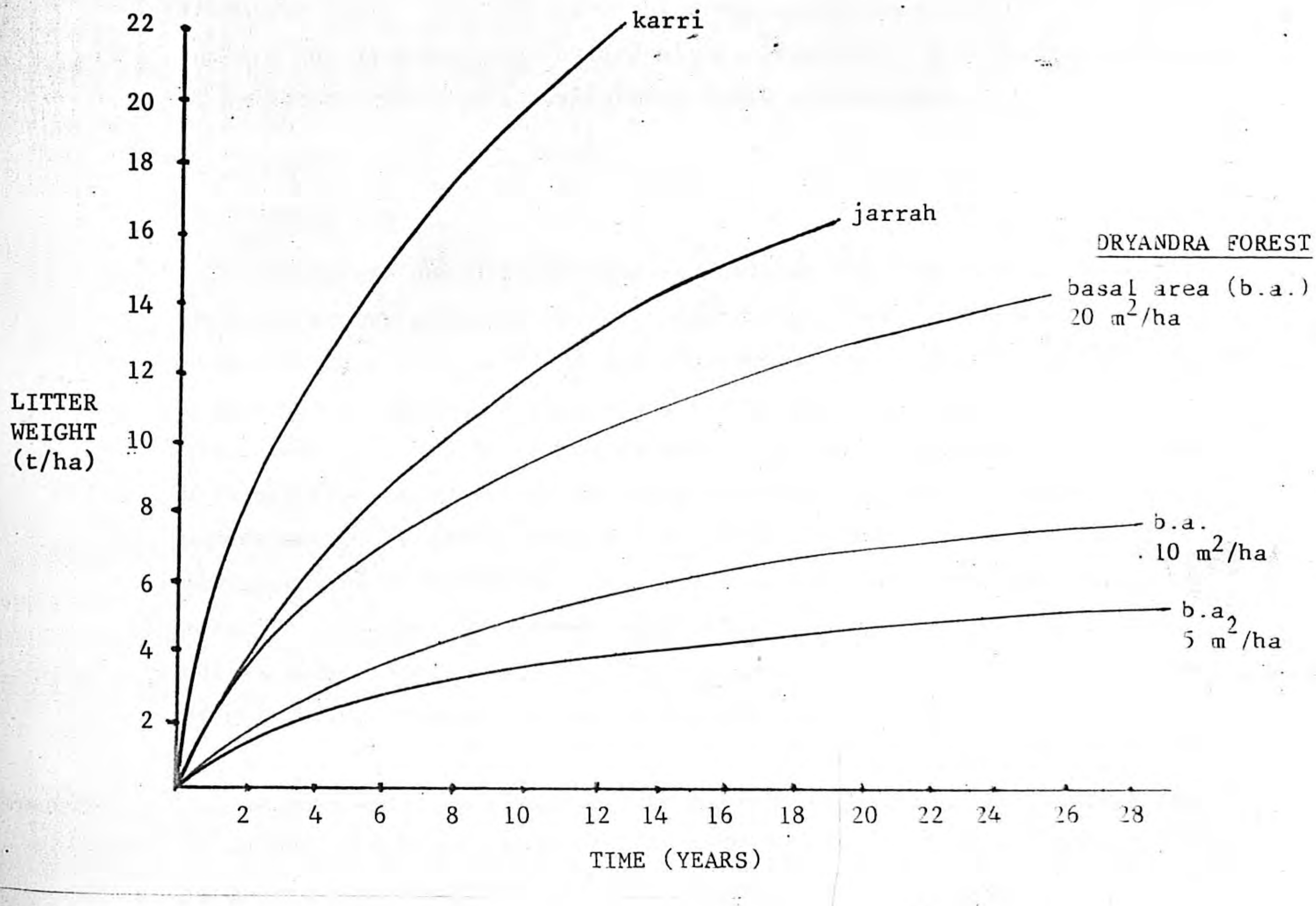
TABLE 4: Leaf litter fuel loadings for blocks studied. Blocks 20, 30 and 40 are mallet plantations (good quality).

| PLOT NO. | MEAN | VARIANCE | RANGE | S.E. | MIN | MAX. |
|---|---|---|---|---|---|---|
| 1 | 7.78 | 57.0 | 42.0 | 1.03 | 0.9 | 42.9 |
| 2 | 6.24 | 20.54 | 21.4 | .61 | .2 | 21.6 |
| 3 | 3.95 | 5.4 | 9.3 | 0.3 | .4 | 9.7 |
| 4 | 3.11 | 3.31 | 3.3 | 0.3 | 0.6 | 3.9 |
| 5 | 12.05 | 75.5 | 37.7 | 0.89 | 0.2 | 37.9 |
| 20 | 13.25 | 56.7 | 32.0 | .86 | 3.1 | 35.0 |
| 30 | 15.28 | 47.1 | 20.3 | 2.17 | 4.0 | 24.3 |
| 40 | 20.43 | 94.4 | 46.6 | 1.56 | 5.9 | 52.5 |

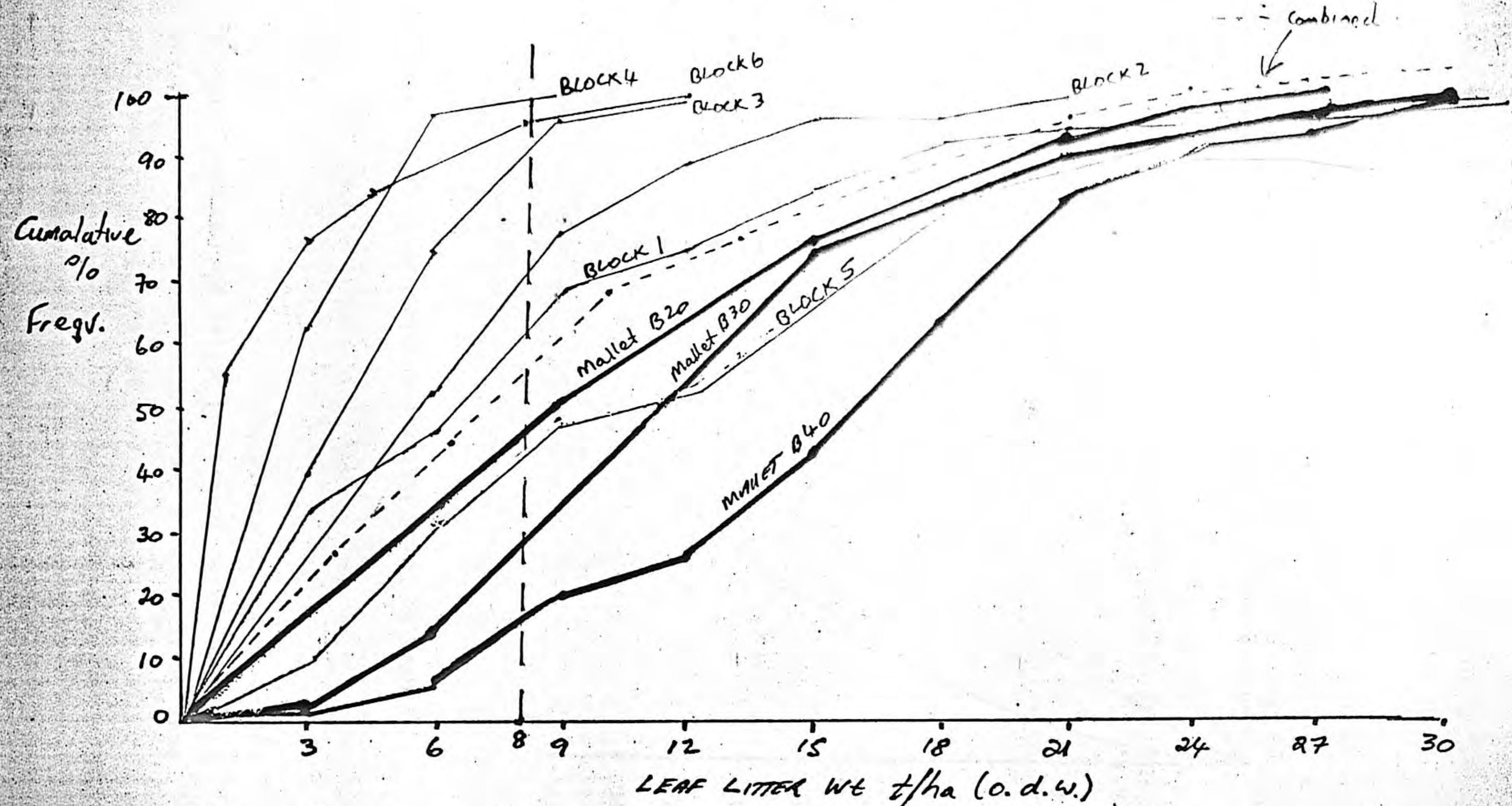
Predicting Leaf Litter Accumulation Rate

As mentioned, the rate of leaf litter accumulation was found to be best described by a function of tree basal area and age since last burnt (for both native forest and mallet plantation). This relationship is graphed below in figure 6.

FIGURE 6: Leaf litter accumulation rates for various forest types.



Cumulative frequency dist. of litter weight for all Blocks.



trees would suggest that wildfires are not likely to be as intense nor as difficult to control in Dryandra as they would be under the same weather conditions, in jarrah forest to the west.

Narrogin Division conducted a survey of the condition of the boundary between private property and the main Dryandra block. The results are still being analysed, but it is apparent that a considerable portion of the boundary needs immediate attention if it is to be in any way effective for fire control. Measures such as clearing up breaks, widening breaks, spraying grass, felling stags, moving logs etc. are necessary. Many of the internal breaks around mallet plantations are in a dangerously flammable state. The mallet plantations carry the heaviest fuel loadings and are the greatest fire hazard within Dryandra. The extreme sensitivity of mallet to fire precludes burning these plantations.

## CONCLUSION

The nature and distribution of fuels in Dryandra forest are unlike those in higher rainfall forest. Generally, fuels are light and patchy although there are localised heavy accumulations. Very few wildfires have started in Dryandra. Historical evidence suggests that most wildfires are likely to start in nearby farmland. In the past, these fires have been quickly suppressed on entering Dryandra. Broadacre burning is unnecessary. Frequent burning (less than 20 year cycles) will lead to deterioration of thickets. It is recommended that immediate action be taken to clean up fire breaks adjacent to private property and around mallet plantations. Edge burning off major access roads and near areas of heavy recreational use may be necessary.

A more detailed report on the habitat requirements of several species of animals and of the role of fire will be submitted in September. There is no need to undertake any "habitat burns" for the moment.