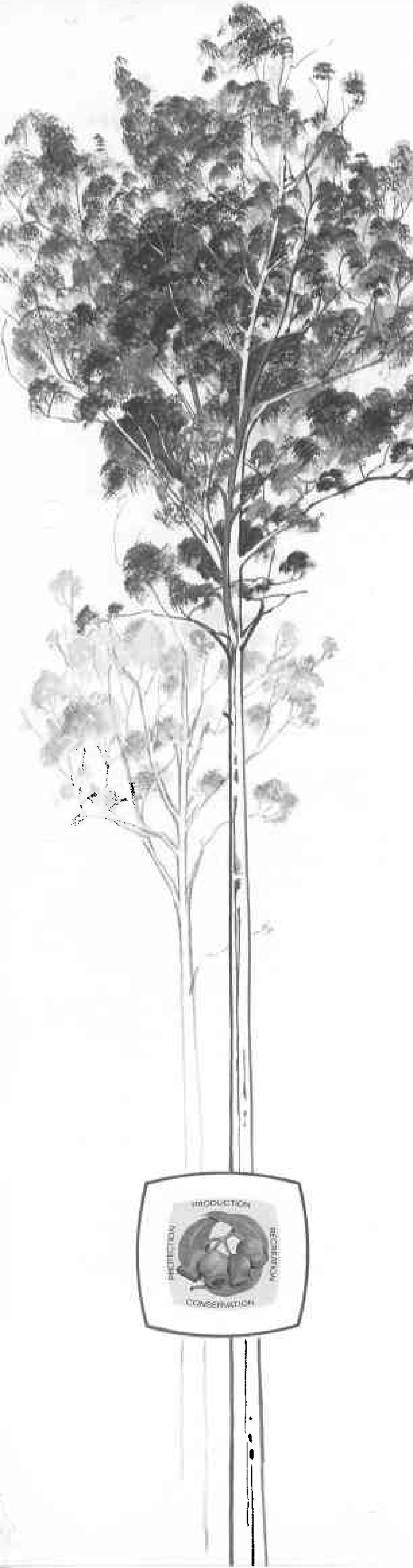

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INVERTEBRATE STUDIES IN DISTURBED AND PRISTINE HABITATS OF DRYANDRA STATE FOREST

by

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SUMMARY

Two surveys of invertebrates were performed in Dryandra State Forest during 1982 and 1983. In 1982 the influence of differing land-uses on the composition of the ant community was investigated, and in 1983 the effect of fire on litter arthropods and ground-surface arthropods was examined.

The number of ants and the variety of species was influenced by past farming practices and, to a lesser extent, the type of native vegetation. The composition and abundance of ground and litter-fauna in general was influenced by site factors such as moisture availability, and also by the length of time since the area was burnt. The influence of fire on litter-fauna still seemed evident four years after the burn.

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INTRODUCTION

Dryandra State Forest is an area of largely native vegetation, surrounded by agricultural land, in the 'wheatbelt' near Narrogin, Western Australia. Current management incorporates a multiple-use system catering for recreation, education, conservation, catchment protection and timber production.

Approximately 7,500ha of the forest were planted to brown mallet (Eucalyptus astringens) in the period 1930 to 1960 to provide a source of tan bark - an industry now superseded by synthetic's technology. The forest also contains Pinus radiata trial plots, some areas of regenerating native vegetation (old farmland), and a number of small sandalwood (Santalum spicatum) trial areas. Large expanses of relatively undisturbed vegetation are open forest woodlands of wandoo (Eucalyptus wandoo) and powder bark wandoo (Eucalyptus accedens), together with some other forest associations. Firebreaks separate blocks of the forest. The Forests Department, in conjunction with the Western Australian Institute of Technology (W.A.I.T.), is studying a range of fire regimes in the area. These are aimed at reducing the fire hazard and promoting understorey growth in order to encourage wildlife.

There are a number of factors which might influence the wildlife in certain parts of Dryandra State Forest: replacement of native vegetation with mallet, sandalwood or pine; fire-break construction; post farming regeneration; and fire.

This paper reports on three investigations of invertebrates undertaken in Dryandra State Forest in order to establish the relevance of these influences:

(1) What is the variation in insect fauna within some of the major vegetation associations?

(2) What is the influence of ploughed firebreak construction, post-farming regeneration, or mallet, pine or sandalwood planting on this fauna?

(3) What is the influence of fire on the ground-surface and litter fauna?

Investigation of questions (1) and (2) concentrated on the ant-community, which is, in itself, a good indication of the species composition of other invertebrates (Majer, 1983), while the investigation of question (3) concentrated on the litter and ground-surface invertebrates in general. This last question is particularly relevant to the problems of invertebrate and insectivorous vertebrate conservation, and the contribution of invertebrates to litter breakdown and nutrient cycling. All data were gathered during W.A.I.T.'s School of Biology student field trips held during March 1982 and 1983. The results of this relatively short study are not necessarily conclusive, but they are presented in order to provide a record of the findings to date.

METHODS

(1) Survey of the ant community in pristine and disturbed areas.

Fourteen plots of approximately 1ha were selected in March 1982 to survey the ant community. (Appendix I).

In each plot, ten pitfall traps (2.5cm diameter, 10cm deep and containing alcohol/glycerol preservative) were sunk at 5m intervals along a transect. Traps were run between 20-26 March 1982.

Daylight hand collections of ants were also performed for 2 person hours in each 1ha plot between 26-29 March 1982.

The collections were then taken to the laboratory for sorting. Where ant species could not be assigned specific names they were coded with Australian National Insect Collection (ANIC) or Western Australian Institute of Technology (JDM) code numbers. Voucher specimens from the study are retained for subsequent study at the Western Australian Institute of Technology and are labelled 'Dryandra Collection'.

The ant data were then subjected to three types of data summary:

(a) The variety of species (S) of each plot was obtained by summing the species obtained by pitfall trapping and hand collection;

(b) The mean number of ant species per pitfall trap was calculated for each plot; and

(c) The plots were then compared in terms of their degree of similarity of species composition by Mountford's (1962) index of similarity. A matrix of these indices of similarity between sites was constructed by the following formula:

$$I = 2j/[2ab - (a + b)j]$$

where 'a' is the number of species in plot A, 'b' is the number in plot B and 'j' is the number of species common to both sites.

The pair of sites with the greatest similarity were grouped as 'super-sites', and the indices of similarity between this group and the remaining sites calculated as described in Southwood (1966). The process was repeated until all sites were linked at some level of similarity.

(2) Influence of fire on invertebrates.

Four plots were selected in March 1983 to investigate the influence of fire on invertebrates. (Appendix II).

In each plot a 100m transect was established. Twenty pitfall traps (4.2cm diameter, 5.7cm deep, containing alcohol/glycerol preservative) were sunk at 5m intervals along the transect. The traps were run between 18-25 March, 1983.

Ten 0.125m^2 quadrats of litter were taken at 10m intervals along the transect between 24-28 March, 1983. Arthropods were extracted immediately after litter collection, using a Berlese funnel run for 22 hours under a 25W incandescant light bulb. The mesh size in the Berlese funnel was 1.1 x 1.8mm, so the catch by this method was entirely confined to the smaller meso-fauna (Wallwork, 1970). The dried litter from each funnel was subsequently weighed in order to provide an estimate of plot litter mass.

Larger arthropods were hand sorted from each of ten 4L bags of litter, also taken at 10m intervals along each transect. This technique obtained animals >5mm in length so the catch was referred to as macro-fauna. In order to correct for differing litter loads in each plot the catch values from this method were multiplied by a weighting factor related to the litter mass in the appropriate plot.

A set of environmental recordings was also taken in each plot. Estimation of litter mass has already been described. Five soil cores were taken from a depth of 10cm and were subsequently oven dried to estimate the degree of moisture. Plant cover was visually estimated from ten 1m^2 quadrats placed equidistantly along the 100m transect. The percentage plant cover in four different strata (0-60cm, 60-120cm, 120-240cm and >240cm) was visually assessed at two points along the 100m transect and the mean taken. Plant species variety was elucidated by surveying the number of plant species found in two 10 x 1m transects of vegetation situated close to each invertebrate survey transect.

RESULTS

(1) Survey of the ant community in pristine and disturbed areas.

The species of ants sampled, and the mean numbers per pitfall trap per plot are shown in Table 1. Fifty-six species were found in the plots and eight additional species were found during the course of the field trip to other parts of the Dryandra area.

Table 1.

List of ants obtained by hand collection (+) or by pitfall trapping in the fourteen 1982 ant study plots. The samples were taken in March 1982, and numbers represent the mean number of individuals caught in ten traps. The total ant species richness per plot is also shown.

PLOT NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PLOT NAME	Wandoo	Dry Creek	Wet Creek	Break-away	Wandoo acacia	Mallee 100m	Mallee 300m	Dense Mallet	Thin Mallet	Gravel Firebreak	Sand Firebreak	Jam Wattle	Pine	Sandalwood
ANT SPECIES														
MYRMECIINAE														
Myrmecia sp. J.D.M.5									+					
M. sp. J.D.M 154									0.3					
PONERINAE														
Anochetus sp. J.D.M.554														+
Brachyponera lutea	+		0.3	+						+			+	+
Cerapachys sp. J.D.M. nov			0.2											
Rhytidoponera inornata	0.1	1.5	+		+	0.2	3.0	0.5	+	0.1		+	0.9	2.3
R.violacea	0.5	0.6		0.1		1.3	0.5	0.3		0.1	0.1		0.2	
R. sp. J.D.M. 121		0.2		0.1	0.5				+					
MYRMICINAE														
Aphaenogaster sp. J.D.M. 224							0.1							
Cardiocondyla nuda												0.1		0.3
Chelaner sp. J.D.M. nov	+							+						
Crematogaster sp. J.D.M. 50		0.1		0.1			0.1		+					+
C. sp. 4 (ANIC)						0.2								
Meranoplus sp. J.D.M. 207			+							0.1				
M. sp. J.D.M. 400			1											
Monomorium sp. 1 (ANIC)				0.2	2.1		7.7	0.3	2.8	0.3	0.5	0.7		+
M. sp. 2 (ANIC)							0.1	1.0						
M. sp. J.D.M. 61								+						
M. sp. J.D.M. 408			1.8											
M. sp. J.D.M. nov						0.9			6.0					
Pheidole latigena		+					0.2			0.8		+		
P. sp. J.D.M. 44		0.1				0.2						0.3	0.1	+
P. sp. J.D.M. nov											0.1	+	+	
Podomyrma sp. J.D.M. 161	+								+	+				
Tetramorium sp. 6 (ANIC)	1.0	0.3		0.3	0.1	0.1	0.1	+			0.2		0.1	+
T. sp. J.D.M. 141					0.1			0.2						
T. sp. J.D.M. nov												+	+	
T. sp. J.D.M. nov								+						
DOLICHODERINAE														
Iridomyrmex purpureus									+			+	0.4	+
I. nitidus								0.2	+				+	
I. sp. 21 (ANIC)			0.3	0.6	1.1	0.2	0.4	+	+		0.4		+	
I. sp. J.D.M. 9									0.3					
I. sp. J.D.M. 200	1.6	37.8	97.8	101.0	32.0	76.9	29.8	5.0	9.0	353.0	17.8	+	2.8	0.6
I. sp. J.D.M. 433				0.1								+		+
I. sp. J.D.M. nov			+											+
I. sp. J.D.M. nov														+
Tapinoma sp. J.D.M 134			0.2	0.1		0.2		+	0.3					
FORMICINAE														
Camponotus sp. J.D.M. 104	1.0	0.4												
C. sp. J.D.M. 110	0.4		+	+		0.1		0.5	0.3	0.1				
C. sp. J.D.M. 182		1.5	+			0.2	0.1		+	0.1				
C. sp. J.D.M. 183	0.1				0.2	0.1	0.1		0.3	0.6				
C. sp. J.D.M. 286					0.1					0.1	0.1			
C. sp. J.D.M. 287	+	+						+	+			+		+
C. sp. J.D.M. 391	+	+		+	+				+					
C. sp. J.D.M. 394						+								
C. sp. J.D.M. 549						+	+							
C. sp. J.D.M. 560												+		
C. sp. J.D.M. nov						0.1	1.5		+					
Melophorus sp. 1 (ANIC)	3.2	0.1	0.3	7.1				0.2		15.5	4.6	+		+
M. sp. J.D.M. 176		1.6	0.5	6.8	4.1	0.4	1.1	0.7	1.3	0.4	0.4			
M. sp. J.D.M. 221	1.5		0.2		0.6	+	0.7	0.8	1.5	14.4	+			0.3
Polyrhachis sp. J.D.M. 372		+												
P. sp. J.D.M. 390	0.1						0.1	0.3						
Stigmacros sp. J.D.M. 115					0.9	0.3	0.1				0.1			
S. sp. J.D.M. 375	+	0.1						0.3						
S. sp. J.D.M. 386								0.8			0.1			
Ant species richness	16	16	15	14	13	18	18	21	22	15	12	13	11	16
Mean ant species per pitfall trap	3.1	3.0	2.8	3.1	4.1	3.8	5.0	5.2	4.0	4.3	3.8	1.3	1.1	1.0

The latter were Myrmecia sp. J.D.M. 1, Tetraponera sp. J.D.M. 81, Meranoplus sp. 11 (ANIC), Epopostruma sp. J.D.M. nov. (Dryandra 75), Notoncus gilberti, Camponotus sp. J.D.M. 284, Camponotus sp. J.D.M. 199 and Camponotus sp. J.D.M. nov. (Dryandra 69).

The total variety of ant species ranged from 11-22 per plot, with low values encountered in the jam wattle (Acacia acuminata) and pine plots and high values in both of the mallet plots. The mallee (Eucalyptus drummondii) plots also revealed moderately high numbers of ant species, while the remaining areas all had between 14-16 species per plot. The mean number of ants per pitfall trap varied from 1.0-5.2 per plot. The trends noted for the number of ant species in each plot were reflected by this parameter, it being significantly positively correlated ($r = 0.54$, $p < 0.025$).

Two sets of plots were grouped at a relatively high similarity index level and were considered to be of interest. The first group contained the jam, pine and sandalwood plots, and the second comprised the two mallee plots. The only other groupings found at relatively high similarity levels were those of the gravel firebreak/wet creek plots and the sand firebreak/wandoo plots. This may reflect the fact that ants spread onto firebreaks from adjacent native vegetation.

(2) Influence of fire on invertebrates.

The mean values of all measured environmental parameters in the unburnt and three burnt plots are shown in Table 2. The percentage soil moisture, litter mass and percentage ground cover (quadrat method) were compared by one-way analysis of variance. The results were further analysed using the Scheffé test, in order to detect any statistical difference between the four plots.

Table 2

Summary of environmental parameter measured in the four 1983 fire study plots. The horizontal bars above the percentage soil moisture, litter mass and percentage ground cover values link those plots which do not statistically differ at the $p<0.50$ level.

	PLOT NAME								
	Unburnt		Old burnt		Autumn Burnt		Spring Burnt		F-ratio from analysis of variance.
PARAMETER	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	
Percentage soil moisture	3.7	0.9	3.4	0.5	2.1	0.6	5.2	2.3	4.62, $p<0.05$
Litter mass (kgm^{-2})	2.00	1.68	1.04	0.66	0.97	0.37	0.75	0.58	3.85, $p<.05$
Percentage ground cover	9.1	12.1	20.8	16.3	13.4	12.7	2.7	5.4	3.43, $p<.05$
Plant species richness	16	–	25	–	6	–	7	–	–
Percentage plant cover(0-60cm)	48	–	72	–	15	–	10	–	–
Percentage plant cover(60-120cm)	10	–	50	–	22	–	7	–	–
Percentage plant cover (120-240cm)	2	–	30	–	7	–	0	–	–
Percentage tree cover (> 240cm)	19	–	23	–	53	–	32	–	–

Percentage soil moisture increased from the autumn burnt (low), through the old burnt to the unburnt plots. This was probably associated with the gradual post-fire restoration of plant and litter cover, both of which would ameliorate the harsh micro-environment of the ground. Soil moisture was highest in the spring burnt plot - probably a consequence of it being a low-lying area, with a creek bed running across the survey transects, rather than due to any post-fire effect. The autumn and spring burnt plots were the only two plots to statistically differ at the 5% level (Table 2).

Litter mass consistently increased from spring burnt (low), through the autumn burnt and old burnt to the unburnt plot. The litter masses of the spring and unburnt plot differed statistically at the 5% level (Table 2). The overall trend in litter mass is consistent with litter accumulation data from jarrah (Eucalyptus marginata) forest (Hatch, 1955).

Percentage ground cover also increased with time after burn. The unburnt plot, however, had lower cover than either the old or spring burnt plots. Plant cover was significantly less in the spring burnt than the old burnt plot, at the 5% level (Table 2). This trend in plant cover was consistent with that exhibited in the 0-60cm, 60-120cm, and 120-240cm strata measurements (Table 2). The peak in plant cover in the old burnt plot probably reflects the temporary post-fire stimulation of fireweeds (Bell and Koch, 1980). These were largely absent in the unburnt plot. In keeping with this fact, there was a progressive increase in the variety of plant species with the post-fire age of the plot, followed by a subsequent decline in the unburnt plot.

The tree (>240cm) strata showed no pre-fire or post-fire density trend. This may reflect site differences in canopy density and the fact that the upper stratum was little affected by cool burns.

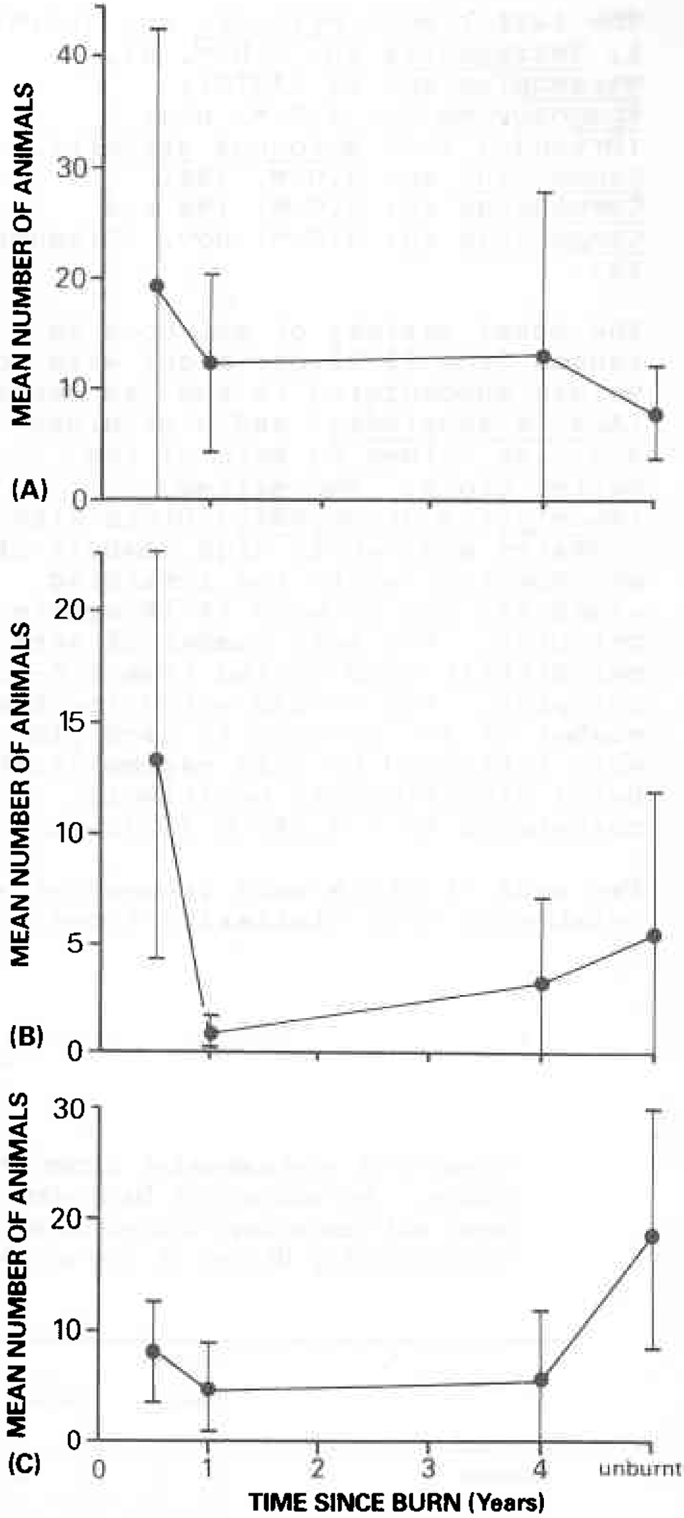

Figure 1: Mean number of invertebrates (excluding ants and, for Berlese funnel samples only, Deptera) per (a) pitfall trap, (b) Berlese funnel and (c) hand sorted litter sample in the four 1983 fire study plots. The standard deviations of each mean are also shown.

Table 3 shows the mean number of invertebrates per pitfall trap, Berlese funnel and litter sample for each of the four plots. In each case the catch revealed high proportions of predacious taxa, such as arachnids and ants, and low proportions of decomposer fauna. This reflected the fact that sampling preceeded the winter rains and that the litter decomposition phase associated with moist conditions had not been entered.

Ants formed a major proportion of the catch by all three methods and Ceratopogonidae flies a major proportion of the Berlese funnel catch. In view of the fact that ant population levels are largely unaffected by cool burns (Majer, 1980), and that the flies appeared to be resting, and not resident in the litter, these two taxa were excluded from the total invertebrate plot counts. The total number of invertebrates per individual sample were used to compare invertebrate levels between plots, using one-way analysis of variance. The Scheffe test was then applied in order to elucidate which plots differed statistically from each other. The results of this analysis are shown in Table 3 and graphed in Figure 1. The plots which exhibited statistical difference are shown at the base of Table 3. Few plots exhibited statistically significant differences as the variance in the data was high. In view of the fact that all three sampling methods revealed similar post-fire trends, however, the results are of interest. Further, more extensive, sampling may confirm these results.

Table 3

Mean number of invertebrates caught by pitfall trap, Berlese funnel and hand sorted litter sample in the four 1983 fire study plots. The hand sorted litter catch has been multiplied by the mean litter mass in each plot to correct for differing litter biomass between plots. The horizontal bar below the total invertebrate means link those plots which do not statistically differ at the p<0.05 level.

SAMPLING METHOD	PITFALL TRAPS				BERLESE FUNNELS				LITTER SORTING			
PLOT	Unburnt	Old burnt	Aut. burnt	Spr. burnt	Unburnt	Old burnt	Aut. burnt	Spr. burnt	Unburnt	Old burnt	Aut. burnt	Spr. burnt
TAXON												
Arachnida Scorpionida			0.1									
Arachnida Pseudoscorpionida	0.1		0.1	0.1					0.6		0.2	
Arachnida Acarina	1.8	2.2	3.5	8.5	2.5	1.1	0.2	0.4	0.6	0.4	0.3	0.3
Arachnida Araneae	1.3	2.1	1.6	0.7	0.4	0.3	0.2	0.2	7.0	1.1	2.2	3.8
Crustacea Isopoda				0.1								
Diplopoda	0.1				0.1	0.1						0.1
Chilopoda			0.1	0.1								
Collembola	0.4	4.2	3.1	13.4	0.2	0.3		0.4				0.2
Insecta Thysanura	0.3	0.4	0.2	0.2	0.4				4.2	0.7	0.9	2.0
Insecta Blattodea	0.3	0.2	0.1	0.2					3.4	0.8	0.4	0.6
Insecta Isoptera		0.5	0.1	0.1						2.3		0.2
Insecta Dermaptera	0.2		0.1	0.1								
Insecta Orthoptera Gryllacridoidea			0.1									
Insecta Orthoptera Grylloidea										0.1		
Insecta Orthoptera Caelifera	0.1	0.2										
Insecta Psocoptera		0.2		0.3	0.1		0.2	0.9				
Insecta Homoptera		0.1	0.3	0.2	0.8	0.2	0.2	0.1			0.1	
Insecta Heteroptera	0.1	2.6	0.1		0.4	0.1			1.4	0.3	0.3	0.5
Insecta Thysanoptera			0.1	0.2				0.2				
Insecta Coleoptera Staphylinidae								0.1				
Insecta Coleoptera Curculionoidea			0.2	0.1		0.4						0.1
Insecta Coleoptera Carabidoidea			0.2	0.2	0.1				1.2		0.1	0.1
Insecta Coleoptera Scarabaeoidea			0.1					0.1				
Insecta Coleoptera Others	0.6		0.1	0.3	0.4	0.5		6.1	0.4			0.1
Insecta Coleoptera larvae	0.7		0.1	0.2	0.2			0.3	0.2			0.1
Insecta Diptera adults	1.6	0.4	1.4	0.9	0.1	3.2	12.8	31.2			0.2	
Insecta Diptera larvae				0.1								
Insecta Lepidoptera adults	0.2		0.2				0.2	4.0				
Insecta Lepidoptera larvae									0.2			
Insecta Hymenoptera ants	14.4	30.9	207.6	36.1	1.1	0.6	1.8	1.8	10.4	5.6	19.4	3.9
Insecta Hymenoptera others	0.5	0.5	0.6	0.4		0.3		0.6				0.1
Total invertebrates (excluding ants)	8.3	13.6	12.5	26.4	5.7	6.5	13.8	44.6	19.2	5.7	4.7	8.2
Total invertebrates (excluding ants and diptera)	–	–	–	–	5.6	3.3	1.0	13.4	–	–	–	–
F- ratio from analysis of variance	2.14, n.s.*				6.63,p<0.05				9.45,p<0.05			

*n.s. not significant

All three sampling methods revealed the highest total invertebrate counts to be in the spring burnt plot (Figure 1). It is unlikely that fire would have stimulated arthropod abundance after such a short period, so the high counts were probably associated with the exceptionally moist nature of this site and the coolness of the burn. The comparatively high levels of desiccation-prone Collembola found in pitfall traps in this plot (Table 3) is consistent with the former explanation.

With one exception, the total invertebrate count from all sampling methods followed the same plot trends. This trend was of highest numbers in the spring burnt plot and least in the autumn burnt plot, followed by an increase in the old burnt plot and a further increase in the unburnt plot. The uncharacteristically low pitfall trap catch in the unburnt plot is probably due to the sampling method because animals are less likely to fall into traps where the litter and shrub layer is dense (Southwood, 1966).

In summary, the numbers of invertebrates in the litter and on the ground were reduced by fire and this reduction was probably still apparent four years later. The atypically high counts in the spring burnt plot have not helped resolve any differences in effect between spring and autumn burning.

DISCUSSION

The results of this work must be considered tentative. They are based on low sampling intensities and should therefore be backed up with follow-on studies. The studies described, however, suggest that the invertebrate fauna of the litter and ground layer of Dryandra State Forest is influenced by a number of past and present management practices. The variety and composition of the ant community appears to be influenced by mallet planting, past farming practices and, to some extent, the type of native vegetation (eg: the distinctive mallee fauna). These results should not be looked at in isolation since the variety and composition of the ant community often reflects the composition of other ground-living invertebrates (Majer, 1983) and these findings may well have relevance for the study of other ground and litter invertebrates.

The 1983 study indicated that the ground and litter-invertebrates were probably influenced by site factors such as moisture availability and by the time since fire. The overall abundance of invertebrates in litter still appeared to be below normal four years after fire, although the results were not statistically significant. The recovery of litter-fauna after burning has been studied in the jarrah forest by others (Springett, 1976; Majer, 1984). It is my impression that the litter fauna has recovered at a slower rate at Dryandra than in the jarrah forest. This may be associated with the fact that the former is a harsher, more arid site with lower vegetation cover. The effects of reduced litter and shrub layers here may have an exceptionally heavy impact on desiccation-prone arthropods.

Further more, vegetation recovery and litter accumulation take longer in dry areas (such as Dryandra) than in the moister jarrah forest region (P. Christensen, personal communication).

Certain litter-arthropods may play a regulatory role in litter decomposition (Kitchell et al., 1979). Any factor which influences the diversity or abundance of litter fauna should therefore be closely monitored. The March 1983 survey covered a period when the decomposer fauna were relatively inactive so this possibility may not be confirmed. A subsequent winter survey of litter-fauna, when decomposer organisms are active, may or may not reveal similar post-fire trends in invertebrate abundance.

An additional consequence of the post-fire depletion of arthropods is that the food source of insectivorous birds and other vertebrates may be inadequate to support resident populations. However, surveys of bird populations in the old burnt plot during 1982 (three years after the burn) suggested that several species of litter-foraging insectivorous bird were just as abundant as in unburnt areas.

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APPENDIX I

Survey of ant fauna in pristine and disturbed areas: Fourteen plots selected in March 1982.

(1) Wandoo plot - Peters Block: an area of wandoo and powder bark wandoo on sandy soil, unburnt for at least 10 years prior to the study. Forests Department Dryandra map grid reference = CU 114.

(2) Dry creek plot - Peters Block: comprising creek bed and margin running through wandoo and powder bark wandoo woodland, unburnt for at least 10 years prior to study. Map grid reference = CU 114.

(3) Wet creek plot - Peters Block: low-lying area with standing water in creek and some fringing flooded gum (Eucalyptus rudis), unburnt for at least 10 years prior to study. Surrounding vegetation was wandoo. Map grid reference = CV 114.

(4) Breakaway plot - Peters Block: lateritic breakaway dominated by Dryandra nobilis and surrounded by wandoo and powder bark wandoo, unburnt for at least 10 years prior to study. Map grid reference = CU 114.

(5) Wandoo/acacia plot - Frank Block: burnt 3 years previously. Wandoo on laterite with dense growth of Acacia pulchella in understorey. Map grid reference = CU 113.

(6) Mallee 100m plot - Frank Block: burnt 3 years previously. Dense stand of Eucalyptus drummondii with Acacia. Map grid reference = CU 113.

(7) Mallee 300m plot - Frank Block: a replicate of plot (6) situated 200m away. Grid reference = CU 113.

(8) Dense mallet plot - Frank Block: area of mallet, with some wandoo and dense understorey of Gastrolobium microcarpum, unburnt for at least 10 years prior to study. This may be a naturally occurring stand of mallet. Map grid reference = CV 113.

(9) Thin mallet plot - Dryandra Block: a mallet plantation with very sparse understorey, unburnt for at least 10 years prior to study. Map grid reference = CX 115.

(10) Gravel firebreak plot - Peters Block: a 20m wide firebreak on lateritic soil, fringed by wandoo either side. Map grid reference = CV 114.

(11) Sand firebreak plot - Peters Block: a 35m wide firebreak on lateritic soil, fringed by mallet plantations to the north and wandoo to the south. Map grid reference = CV 114.

(12) Jam wattle plot - Dryandra Block: an area of abandoned farmland colonized by jam wattle trees (Acacia acuminata) 4-5m high. Map grid reference = CW 115.

(13) Pine plot - Dryandra Block: a small area of an old Pinus radiata plot with sparse native understorey, situated adjacent to plot (12). Map grid reference = CW 115.

(14) Sandalwood plot - Dryandra Block: an area of one year old sandalwood plants grown with Acacia spp. on old farmland. Map grid reference = CW 115.

APPENDIX II

Influence of fire on invertebrates:
Four plots selected in March 1983.

(1) Unburnt block - Peters Block: wandoo woodland on sandy soil, unburnt for at least 10 years prior to study. Map grid reference = CV 115.

) Old burnt plot - Frank Block: wandoo woodland on lateritic soil, burnt 4 years previously. Forests Department observations indicate that this was a warm burn, although its intensity was not measured. Map grid reference = CU 113.

(3) Autumn burnt plot - Peters Block: wandoo woodland on sandy soil, burnt in April 1982. Although fire intensity measurements were not made, the prevailing temperatures in April suggest that this probably was a cool burn. Map grid reference = CU 114.

(4) Spring burnt plot - Peters Block: wandoo woodland on sandy soil, burnt in October 1982. Forests Department observations suggest that this cool burn was probably of lower intensity than the autumn burnt plot (3). Map grid reference = CV 114.

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