ANTS OF A SITE IN ARID SOUTHERN AUSTRALIA

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INTRODUCTION In recent surveys of ants in South Australia, faunas of semi-arid localities (mean rainfall 250-350 mm per annum) have been compared with those of humid localities (rainfall >600 mm per annum). Work is now being extended to the arid zone (rainfall <250 mm per annum) where no previous, detailed studies of ants have been carried out in Australia. Results of humid-semi-arid comparisons (P.J.M. Greenslade, in prep.) show the semi-arid localities to be poorer in the number of genera of ant present, but richer in species, the great majority of which nest in soil and are active on the surface and on vegetation. Diurnal species of the Dolichoderine genus Iridomyrmex, especially members of the Meat ant complex, I. purpureus F. Smith, and allies, are abundant and strongly influence the composition of local assemblages of species, which are integrated, in that they appear to develop towards saturation of space and resources available to ants, but with minimal interspecific competition. The aims of work in the arid zone are to discover whether humid-semi-arid trends in size and composition of ant faunas are continued or reversed, and, eventually, to determine the functional importance of ants, as top-predators, among the soil and surface fauna. This paper describes one set of observations in the arid zone, in summer: the catches of a transect of pitfall traps crossing a soil and vegetation discontinuity.

SITE AND METHODS The site was at Koonamore (described by Carrodus, Specht and Jackman, 1965), 340 km north-northeast of Adelaide in South Australia, mean annual rainfall 190 mm per annum. The transect (Table I) consisted of 33 pitfall traps, mouth diameter 1.8 cm as described by Greenslade and Greenslade (1971), placed in a regular east-west line over a distance of 120 m. They were operated from 24-27 February, 1973: minimum screen temperatures 18-19^{o}C, maxima, 34-38^{o}C. Sixteen westerly traps lay on calcareous loam, 10 cm deep over limestone in the west, increasing to a depth of 1 m in the east, amongst open low scrub of saltbushes (Atriplex vesicaria, Chenopodiaceae) density increasing with soil depth, over a sparse understorey of grasses (Danthonia, Stipa spp.), and Bassia sp. (Chenopodiaceae). The arid-adapted Meat ant, form viridiaeneus Viehmeyer, of unknown taxonomic status, had frequent single-entrance nests here. The 17 easterly traps were on deep sand (in which viridiaeneus does not nest), supporting an open tall scrub of Eucalyptus oleosa, with multiple stems arising from a lignotuber (mallee). Trapping probably covered a period of 'digging-in effects' (Joossee, 1965), of high initial catches in traps close to nests or permanent trails (P.J.M. Greenslade, in prep.). Consequently, results given here may accentuate some distribution patterns. Catches of these traps do not provide population estimates, but they do indicate the relative importance of different species on the soil surface.

RESULTS AND DISCUSSION Catches are summarised in Table I. The

number of species is large, even in relation to comparable samples from the humid tropics where ant faunas are considered to be richest (Wilson, 1959; Room, 1971). Two tropical examples are from transects 15-20 m long that were intensively studied on Guadalcanal in the Solomon Islands in 1966, one in a coconut plantation, the other in lowland rain-forest. They yielded, respectively, 24 ant species in 17 genera, and 53 species in 36 genera. Pitfall traps were used in the forest (90 trapdays) and gave 28 species in 21 genera (Greenslade and Greenslade, unpublished results). A third of the species in both tropical transects were cryptic, foraging within soil and litter, but at Koonamore only one cryptic species, a Solenopsis, is known from the area of the traps (although it did not occur in them). The species in traps here were all surface predators or scavengers; many of them also ascend vegetation, while some species of Monomorium, Pheidole and Melophorus are seed-gatherers as well as predators. With many surface species but few genera these ants from an arid zone resemble a semi-arid fauna. Further similarities, and some differences, are shown by a comparison with a typical, semi-arid collection (right hand columns of Table I), from Cambrai, 300 km south of Koonamore, rainfall 300 mm per annum. Again pitfall traps were used (132 trap-days), in summer (January, Feburary, 1972), divided between deep sand and a heavier soil in which a Meat ant (Iridomyrmex purpureus sens. strict., of regions with higher rainfall) had nests. Here it formed a much larger proportion of the total catch than did viridiaeneus at Koonamore, an arid-zone reversal of the humid-semi-arid trends, since Meat ants have a wet limit in very humid areas. Other groups of ants that were less well developed and less diverse at Koonamore were Formicinae (other than Melophorus). However, continuation of the humid-semi-arid trends is seen in the greater representation at Koonamore of Meranoplus and Melophorus, genera which are not typical of humid areas, and on the evidence of Table I, there is certainly no decline in the size of ant faunas in the arid zone, at least over small areas.

The transect illustrates some habitat factors by which this rich fauna is partitioned in space. First, there are limitations imposed on individual species by their requirements for nest sites, food, etc. A number of species were widely distributed in respect to soil, but others nest in only one type although, like the Meat ant (Table I), they may forage in both. On the sand a few species were positively associated with mallees (e.g. Componotus spp.), or with mallee litter (e.g. a small Monomorium sp.); others were negatively associated with litter and occurred almost entirely on sand (e.g. a fast-running, diurnal Iridomyrmex sp.). Loam species that feed on seeds of grasses and chenopods are probably excluded from sand by a lack of this resource. It may be significant that there is a correlation between the logarithm of the number of species per genus in this sample of the Koonamore fauna, and the percentage of species in each genus (excluding those with only a few captures) which show these restricted spatial distributions: $r = 0.89$, $p<0.001$.

In addition to the patterns of individual species there were differences along the transect in the abundance of ants in traps that reflect variations in the habitat's overall favourability and productivity

for ants. Densities of species and individuals were greater on the sand than on the loam (Table I, bottom) and this agrees with observations in semi-arid areas where richer ant faunas are associated with sands, rather than with heavier soils, and with mallee eucalypts, than with other tree or shrub vegetation. Within the loam there was a gradient of increasing species richness with increasing soil depth. On the shallowest soil (most westerly 11 traps), mean catches were 6.5 species and 20.8 individuals per trap, and on deeper soil (the next five traps), 11 species and 45 individuals. Some of the latter species were non-resident and penetrated the loam area from nests in sand; but, when they are excluded, the deep-soil traps still average 8.5 species. The excess of two species per trap over the shallow soil can be related to the possibility of constructing deep nests in this part of the transect, and to the greater productivity of the denser shrubs here. On the sand, fewest species occurred in bare, open areas (Table I), while litter, apart from reducing catches by impeding movement by ants, is not a valuable resource to them in dry, summer weather, since decomposition is halted, and prey, such as microarthropods, is scarce. This may explain why ants were most numerous in traps adjacent to litter.

These spatial differences in the catches of traps are the product of several processes. This ant fauna is made up of species that are active in hot, dry, conditions ('Summer species' in Table I), and 'Other species' which gave higher catches during cool weather in later, autumn trapping. In terms of individuals in traps the two groups show quite different patterns: 'other species' were more abundant on loam than on sand, and in traps amongst litter and dense shrubs than in open areas. The 'Summer-species' were relatively more numerous on sand and in open situations (Table I). There are implications here of differences between the two groups in temperature relations, phenology and the spatial distribution of their food. Further work may show whether this fauna is integrated in the way that ant faunas of semi-arid areas seem to be, or whether it is more directly governed by climate so that these patterns in the abundance of species are merely the sum of their individual tolerances.

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TABLE I. – SUMMARY OF ANTS TAKEN IN PITFALL TRAPS AT KOONAMORE (ARID), COMPARED WITH THE FAUNA TRAPPED AT CAMBRAI, SOUTH AUSTRALIA (SEMI-ARID)

		Koonamore									Cambrai			
Soil type		Loam				Sand		Total spp.	% catch a	% catch b	Total spp.	% catch a	% catch b
Ground Cover		Open, sparse shrubs	Grasses	Denser shrubs	Mallee litter	Sand, traps adjacent to litter	Open sand						
Number of traps		7	4	5	6	4	7						
Catch: species/individuals													
Ponerinae													
Rhytidoponera		1/3	1/12	1/3	2/9	1/19	1/7	2	3	3	2	1	2
Other Ponerinae		–	–	–	–	–	–	–					
Myrmecinae													
Meranoplus		1/1	2/2	–	6/10	3/22	3/37	12	4	5	2	<1	<1
Monomorium		1/2	3/10	2/37	4/31	4/50	3/72	6					
Xiphomyrmex		3/8	2/6	2/12	2/5	1/2	–	5	23	29	10	20	53
Pheidole		–	1/1	–	1/1	2/5	–	3					
Crematogaster		–	1/2	–	–	–	–	1					
Dolichoderinae													
Meat ants		1/52	1/28	1/48	1/3	1/8	1/17	1	10	–	1	58	–
Other Iridomyrmex		4/20	2/22	4/41	4/21	4/42	6/49	8	14	–	9	6	–
Tapinoma		–	1/1	1/1	–	–	–	1					
Formicinae													
Melophorus		8/47	7/30	8/74	8/90	9/165	7/285	18	43	48	14	12	34
Camponotus		–	3/3	3/7	3/181	2/19	3/5	5					
Polyrachis		–	–	–	1/1	–	–	1	14	15	16	4	11
Stigmacros		1/1	–	–	–	–	–	1					
Other Formicinae		–	–	–	–	–	–	–					
Genera	Total		11			9		12			14		
Species	Total		34			48		65			54		
			7.2			10.3							
	Per trap	6.3	6.7	9.9	10.7	12.7	8.7						
Individuals			29.6			68.0							
Per trap	Total	19.1	29.2	44.6	58.7	84.0	67.4						
	Summer spp.	14.7	18.0	25.4	4.2	74.2	65.0						
	Other spp. c	4.3	11.2	18.8	6.7	4.0	2.0						

a. % Total catch
b. % Catch excluding Dolichoderinae
c Excluding one Camponotus species taken in very large numbers in one trap.

REFERENCES

CARRODUS, B.B., SPECHT, R.L. and JACKMAN, M.E. (1965) The vegetation of Koonamore Station, South Australia. Trans. R. Soc. S. Aust., 89, 45-57

GREENSLADE, Penelope and GREENSLADE, P.J.M. (1971) The use of baits and preservatives in pitfall traps. J. Aust. ent. Soc., 10, 253-260

JOOSSE, E.N.G. (1965) Pitfall-trapping as a method for studying surface dwelling Collembola. Z. Morph Okol. Tiere, 55, 587-596

ROOM, P.M. (1971) The relative distributions of ant species in Ghana's cocoa farms. J. Anim. Ecol., 40, 735-751

WILSON, E.O. (1959) Some ecological characteristics of ants in New Guinea rain forests. Ecology, 40, 437-447