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POPULATION ABUNDANCE, SEASONAL FLUCTUATION OF ANTS (HYMENOPTERA : FORMICIDAE) IN AUTOMOBILE EXHAUST FED ROAD SIDE SOIL OF CALCUTTA

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INTRODUCTION

Ants are, insects of the family Formicidae, available in soil and contribute largely to the formation of the soil arthropod community. They appear in dense population groups both in rich and poor soils. Normally they tend to avoid the habitats intensively managed by man (Petal, 1976). However, many ant species do not leave man-transformed habitat, such as urbanised areas, industrial lands. Moreover they react to habitat changes by mobilising habitat-modifying reactions and altering certain parameters of their societies and populations (Petal, 1994). It is established that insects as well as arthropod fauna, exposed to the action of pollutants, respond suitably and undergo qualitative and quantitative changes to maintain their existence in a changing environment (Krzysztofiak, 1991; Migula and Binkowska, 1993; Przybylski, 1979). Ants are greatly resistant to environmental pollution (Brower, 1966; De Witt and George, 1960; Petal, 1978, 1980). The ants in the soil habitat along the traffic arteries of Calcutta are expected to experience the pollution load, the automobile exhausts in particular. It may be mentioned that the automobile exhaust is at the highest in Calcutta in comparison to other big cities of India (Central Pollution Control Board, 1988—89).

The ant species encountered here are mostly common amongst the species so far reported from Calcutta (Tiwari et al., 1993).

The role of soil-ants in the soil building process and as an integrated part on the soil arthropod community is well-studied in many countries. However, no such effort has yet known from India. Therefore, the present study has been undertaken to make a comprehensive account of the ant population structure in the road side soil of Calcutta which are exhaust fed by automobile exhausts regularly. This has also been taken to study the effects of various edaphic factors and to find out the possibility of establishing an index species, which will provide a base line data for further works.

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MATERIAL AND METHOD

Two different areas of Calcutta were taken under study. (i) The eastern fringe of the city adjacent to Eastern Metropoliton Bypass, characterised by vegetal growth, some water-bodies and less automobile density. (ii) The centre of the city and is adjacent to Red Road and is characterised by vegetal cover and more automobile density on the road.

In each experimental site three plots, measuring 2mt x 5mt and horizontal to the respective roads, were selected and denoted as plot A, B and C respectively from nearer the road and away. Ten random samples of soil, each measuring about 20 cm square from 0—5 cm layer, were collected from each plot and each site at monthly intervals. The study was carried out from August, 1995 to December, 1996.

The ant samples were extracted following the standard soil extraction method of Macfadyen, 1953.

RESULT AND DISCUSSION

During the survey period altogether 24570 number of ant-samples were obtained of which 13940 were from the East Calcutta zone and 10630 were from Central Calcutta zone.

The month-wise mean number of ants obtained from each sample (20 cm x 20 cm) is shown in Table-1. A comparison of the total population between those two survey sites is shown in Fig. 1. The month-wise variations of the total population (mean number) of ants are plotted in Fig. 2. The ant species composition, percentage wise, in different plots are produced in Table 2. The percentage wise population distribution of different ant species in both the sites are shown in Fig. 3.

The total population of ants at Central Calcutta site varied in different seasons. The population exhibits two higher peaks; one in January (winter period) and the other in June (pre monsoon period), where the population mean values being 58.00 and 45.33 respectively. Two intermediary peaks were also found during October—November.

At East Calcutta similar population peaks were also observed during January and June with population means 53.33 and 48.66 respectively. A population peak of the magnitude of 67.33 was, however, observed in the month of September. The population was found to be low in the month of August and in the month of November.

The percentile distribution of collected species of Formicidae at Central Calcutta shows a composition of *Solenopsis geminata* (Fabricius) (39.04%), *Meranoplus bicolor* (Guer.) (18.60%), *Pheidole* sp. (17.50%), *Technomyrmex* sp. (9.32%) and *Prenolepis* sp. (8.18%); which were of common occurrence. Whereas *Camponotus compressus* (Fabricius) (2.65%), *Carebara* sp. (1.32%), *Tetramorium* sp. (0.85%), *Tetraponera* sp. (0.85%), *Ponera* sp. (0.66%), *Cardiocondyla* sp. (0.56%) and *Crematogaster* sp. (0.47%) were found to be poorly represented and with discrete distribution.

On the other hand, at East Calcutta the species which are mostly common had a composition of *Solenopsis geminata* (Fabricius) (41.12%), *Technomyrmex* sp. (15.32%), *Prenolepis* sp. (13.00%) and *Pheidole* sp. (10.36%). The other species such as *Dorylus* sp. (5.33%), *Camponotus compressus* (Fabricius) (3.29%), *Meranoplus bicolor* (Guer.) (2.81%), *Tetramorium sp.* (2.30%), *Crematogaster* sp. (1.88%), *Bothroponera* sp. (1.58%). *Carebara* sp. (1.51%), *Diacamma* sp. (0.56%), *Syscia* sp. (0.36%), *Anochetus* sp. (0.36%) and *Stigmatomma* sp. (0.28%) were found to be poor and discretely distributed.

Plotwise analysis of distribution of ant population exhibits a maximum concentration of 42.43% at plot A (0—1.5m) and a minimum of 25.90% at plot C (3—4.5m) at Central Calcutta site with a median concentration of 31.67% at plot B (1.5—3m) (Table 2).

Plotwise percentage composition of total ants at East Calcutta also exhibits a maximum concentration of 47.34% at plot A, however, the minimum concentration of 22.23% is found at plot B, with median concentration of 30.43% at plot C (Table 2).

Comparative study of the total ant population in both the sites exhibits a major concentration (56.74%) at East Calcutta, while it is low (43.26%) at Central Calcutta site. (Fig. 1).

The result of this study clearly shows that the total population of ants is more at East Calcutta site (56.74%) than at Central Calcutta site (43.26%). This difference is attributed due to various ecological factors which may also include variation in the concentration of automobile exhausts experienced at these sites.

The total ant population is found at its peak in both the sites during January and June, which concur with the observation of the earlier workers (Petal, 1978).

A third population peak in the month of September at East Calcutta site is somewhat abnormal and may be due to the presence of some population growth stimulating factors or due to sampling error and aggregation of the juveniles.

Plotwise distribution reveals that the soils adjacent to the roadways had more concentration of total ant population, which were found as 47.34% and 42.43% at plot A at East Calcutta and Central Calcutta sites respectively. It has also been observed that among the ant members *Solenopsis geminata* Fabricius in plot A of both the sites is maximum, which were 17.50% and 25.21% respectively. The overall contribution of this dominent species was found to be more at East Calcutta than at Central Calcutta, the concentrations being 41.12% and 39.04% respectively.

The density of vehicular movement at Central Calcutta is much more than East Calcutta. Therefore the soil in plot A at Central Calcutta is supposed to have a more concentration of lead from the automobile exhausts in comparison to the East Calcutta site. More concentration of *Solenopsis geminata* (Fabricius) in plot A of Central Calcutta is therefore suggestive to its higher tolerance of degraded environment. Existence of such tolerant species have also been found by Krzysztofiak (1991) and Petal (1978).

Table 2 : Percentage wise distribution of different species of Formicidae in different plotes at two sites under study [E C—East Calcutta : C C—Central Calcutta]

Species	Plot A		Plot B		Plot C		Total	
	EC	CC	EC	CC	EC	CC	EC	CC
Solenopsis geminata (F.)	17.50	25.21	11.41	6.96	12.21	6.87	41.12	39.04
Technomyrmex sp.	3.02	5.54	3.66		8.64	3.78	15.32	9.32
Prenolepis sp.	12.30	3.10	0.70	3.76	-	1.32	13.00	8.18
Pheidole sp.	4.61	7.62	1.79	4.79	3.96	5.09	10.36	17.50
Meranoplus bicolor (G.)	2.06	-	0.50	15.03	0.25	3.57	2.81	18.60
Camponotus compressus (F.)	-	0.11	1.51	-	1.78	2.54	3.29	2.65
Dorylus sp.	5.33	-	-	-	-	-	5.33	-
Tetramorium sp.	1.58	-	-	-	0.72	0.85	2.30	0.85
Crematogaster sp.	0.94	-	-	-	0.94	0.47	1.88	0.47
Bothroponera sp.	-	-	1.15	-	0.43	-	1.58	-
Carebara sp.	-	-	1.51	0.57	-	0.57	1.51	1.32
Diacamma sp.	-	-	-	-	0.50	-	0.50	-
Syscia sp.	-	-	-	-	0.36	-	0.36	-
Anochetus sp.	-	-	-	-	0.36	-	0.36	-
Stigmatomma sp.	-	-	-	-	0.28	-	0.28	-
Tetraponera sp.	-	0.85	-	-		-	-	0.85
Ponera sp.	-	-	-	-	-	0.66		0.66
Cardiocondyla sp.	-	-		0.56	-	-		0.56
Total	47.34	42.43	22.23	31.67	30.43	25.90	100	100

The discrete distribution of other species suggests the cumulative effects of automobile exhausts and other ecological factors on their population structures.

It may therefore be said that automobile exhausts along with other soil factors have influences on the population structure of the soil-dwelling ants on road side soils of Calcutta.

SUMMARY

Altogether 24570 number of ant samples were collected from the road side soil of two busy roads of Calcutta at three different plots of each, denoted as A, B and C from nearer to the road and away respectively, in the period of August, 1995 to December, 1996. Population density was found higher at the site (road) of less automobile density and lower at the site (road) of more automobile density.

In both the sites population of ants showed higher peaks in January and in June.

Table 1. Monthwise mean number of ants per sample of soil in different plots at two sites under study

Plot	Aug. '95	Sep.	Oct.	Nov.	Dec.	Jan. '96	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
A	2.03	38.46	20.11	37.24	55.00	55.08	20.06	46.97	31.00	51.91	64.72	22.05	40.03	150,34	9.96	3.02	12.02
B	7.96	7.82	8.94	47.82	1.00	0.52	60.94	18.00	14.12	3.94	42.81	12.03	2.00	38.04	8.01	2.00	34.05
C	4.01	0.72	27.95	7.94	2.20	104.40	7.00	40.03	23.88	3.15	38.47	29.92	64.97	13.62	41.03	2.98	11.93
Total ($\bar{X}$)	4.66	15.66	19.00	31.00	19.33	53.33	29.33	35.00	23.00	19.66	48.66	21.33	35.66	67.33	19.66	2.66	19.33

East Calcutta

Plot	Aug. '95	Sep.	Oct.	Nov.	Dec. '96	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
A	6.24	13.35	18.17	32.43	5.14	89.23	14.11	16.08	19.04	23.08	24.11	9.02	34.01	14.97	62.05	49.96	20.01
B	38.91	4.93	7.87	9.84	2.00	0.86	10.95	3.94	11.94	21.00	49.86	19.94	5.01	13.07	4.97	7.98	1.96
C	31.85	8.72	12.96	14.73	0.86	83.91	7.97	7.98	4.02	9.92	62.03	3.04	19.98	13.96	49.98	25.06	30.03
Total ($\bar{X}$)	25.66	9.00	13.00	19.00	2.66	58.00	11.00	9.33	15.00	18.00	45.33	10.66	19.66	14.00	39.00	27.66	17.33

Central Calcutta

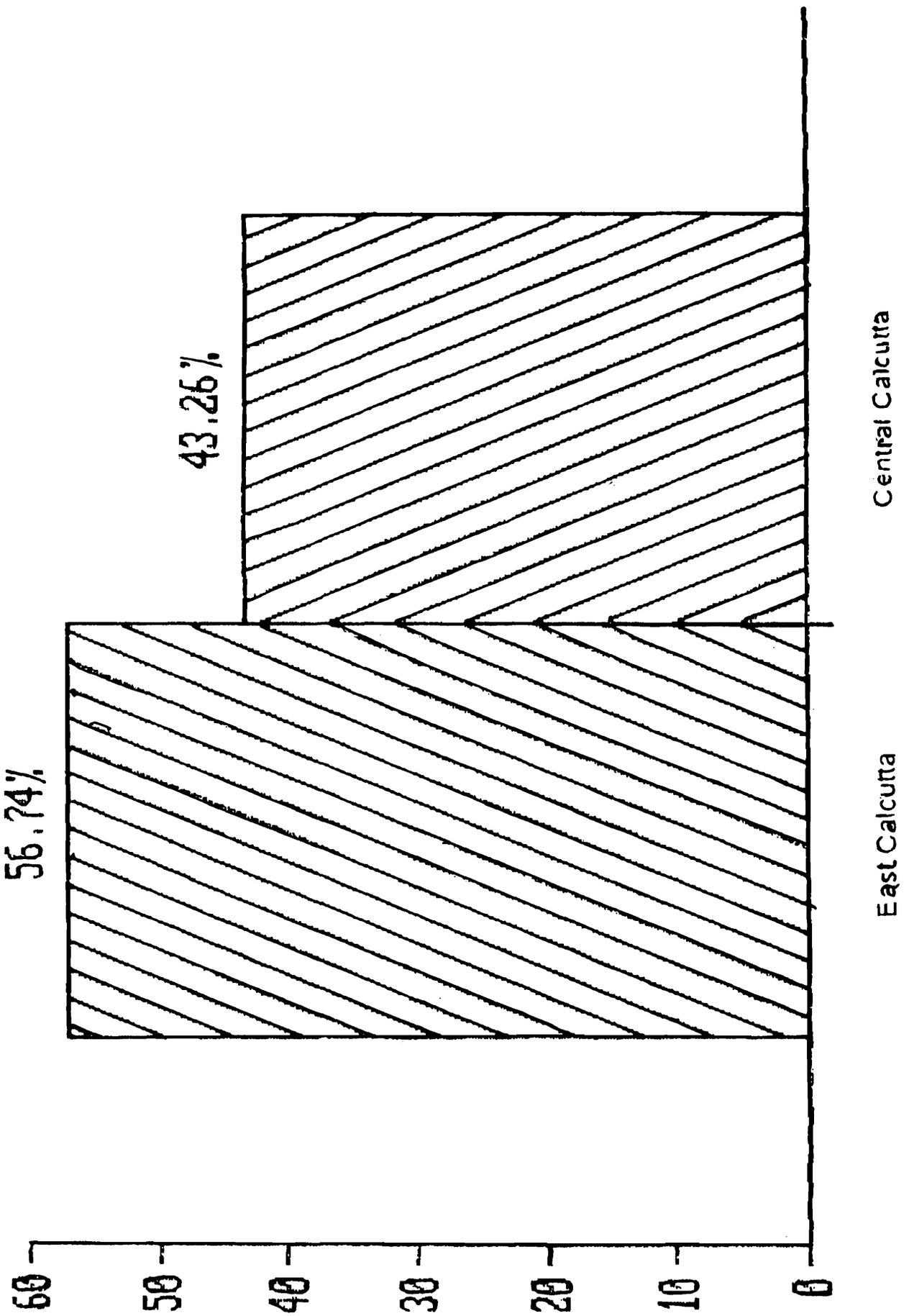

Fig. 1. Comparison of the total population of Formicidae between two sites under study.

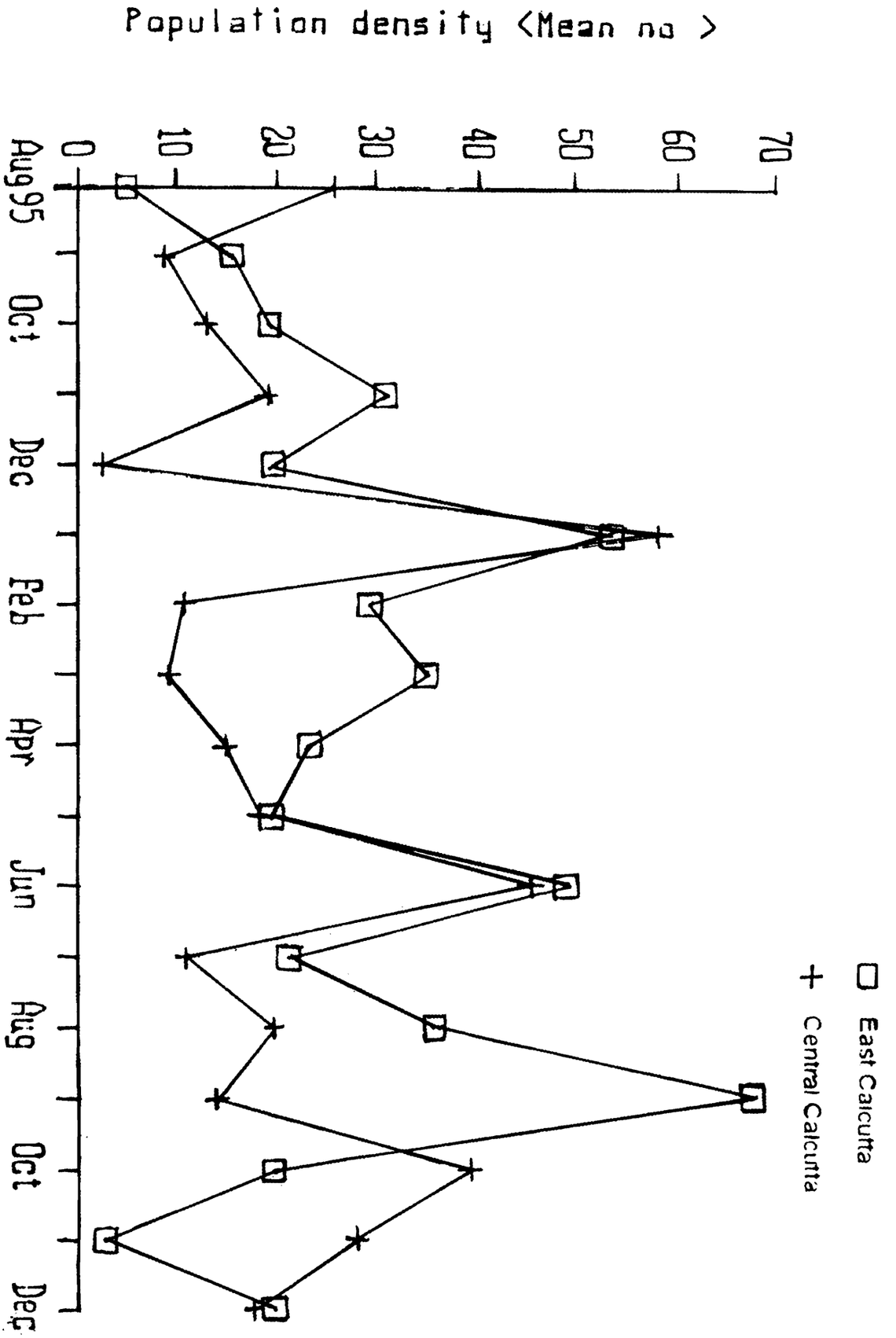

Fig. 2. Seasonal fluctuation of total population density (mean no.), per sample, of Formicidae at the two sites under study.

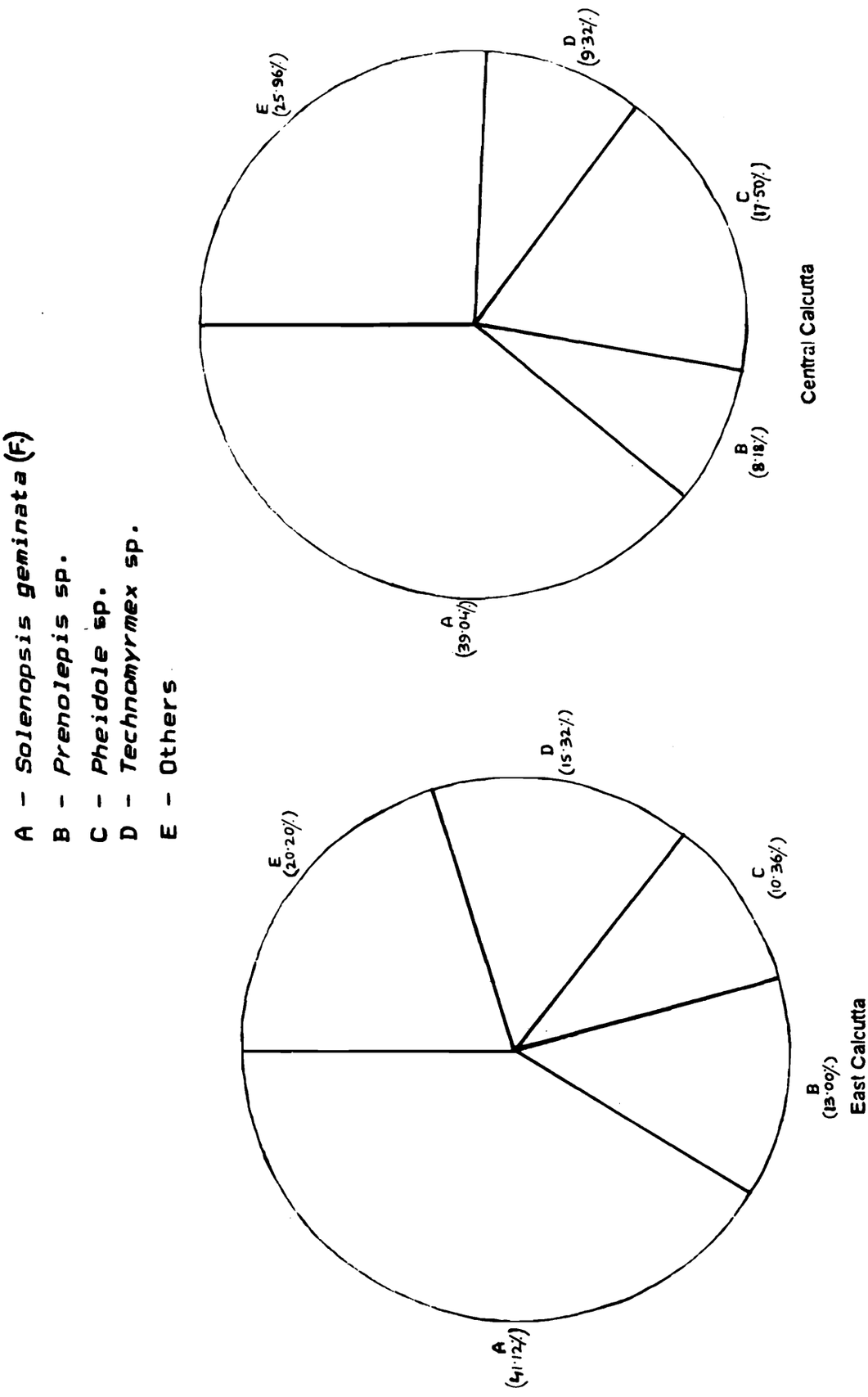

Fig. 3. Pie chart showing percentage wise population distribution of different taxa of Formicidae.

Mostly encountered species found in this population were *Solenopsis geminata* (Fabricius), ***Pheidole*** sp., *Technomyrmex* sp. and *Prenolepis* sp.

Among the three different plots of each site population density was found to be higher at plot A, i.e. nearer to the road, at both the sites.

It is also found that *Solenopsis geminata* (Fabricius) has the higher tolerance to degraded environment.

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