Bull. zool. Surv. India, 4 (3) : 295-307, 1981

QUALITATIVE AND QUANTITATIVE COMPOSITION OF ORIBATEI IN GANGETIC DELTA OF WEST BENGAL IN RELATION TO EDAPHIC FACTORS

A. K. SANYAL

Zoological Survey of India, Calcutta

ABSTRACT

The present work deals with the results of synecological study involving influence of edaphic factors like temperature, moisture, organic carbon, pH, electrical conductivity and available phosphate on soil dwelling oribatid mites extracted by modified Macfadyen expedition funnel at Bakkhali, 24-Parganas, West Bengal.

A total number of 72 soil samples were collected at monthly interval over a period of two consecutive years (January, 1977 to December, 1978). Altogether 707 individuals were extracted belonging to seven genera, viz. *Scheloribates, Lamellobates, Haplochthonius, oppia, Hoplophorella, Hoplophthiracarus* and *Heptacarus.* Among these *Scheloribates* was dominant comprising 38.75% of total population. Season wise analysis of Oribatei showed two peaks, namely in May and November when the factors like moisture and organic carbon content of soil also obtained their respective maximum concentration. Oribatid nymphs were counted only as the total number and maximum was found in May.

The regression, correlation and analysis of variance study was done between different soil factors and oribatid population and their interrelationship are discussed.

INTRODUCTION

Little attention has been paid to the qualitative and quantitative ecology of soil oribatid fauna of Indian subcontinent and no study has hitherto been made of the soil oribatid in gangetic delta of West Bengal. However, of late in India, Bhattacharya (1974), Choudhuri and Banerjee (1975, 1977), Bhattacharya and Raychaudhuri (1977) and Bhattacharya, Joy and Joy (1978) have studied the oribatid population of alluvial and laterite soil. Luxton (1967), Weigmann (1971, 1973) and Polderman (1974) investigated the distribution pattern of oribatids in salt marshes and inland saline areas.

The results of a study of the oribatid fauna of deltaic soil at Bakkhali, 24-Parganas with special reference to different soil factors, are presented in this paper.

SITE DESCRIPTION AND METHODS

The study was carried out in a large uncultivated area which is situated in the extreme south of 24-Parganas and Bay of Bengal is washing its southern part. The area was covered with herbs, shrubs and trees, viz. *Acanthus illicifolius* Linn. (Acanthaceae) ; *Alstonia scholaris* Br. (Apocynaceae) ; *Tylophora* sp. (Asclepiadaceae) ; *Caesalpinia nuga* Ait, *Tamarix dioica* Roxb. (Caesalpinieae) ; *Fimbristylis schoenoides* Vahl. (Cyperaceae) ; *Excoecaria agallocha* Linn., *Mallotus repandus* Nuell. (Euphorbiaceae) ; *Cynodon dactylon* Pers., *Echinochloa colona* Link. (Gramineae) ; *Thespesia populnea* Corr. (Malvaceae) ; *Azadirachta indica* A. Juss. (Meliaceae) ; *Phoenix sylvestris* Roxb. (Palmae) and *Solanum trilobatum* Linn. (Solanaceae). The area also contained debris of fallen leaves and dried twigs from the plants stated above.

For this study three plots, each 5 metre square were selected. Altogether 72 soil samples were drawn from a depth of 5 cm at monthly interval over a period of two consecutive years (from January, 1977 to December, 1978). Soil samples were drawn by stainless steel samplers having 5 cm depth and 17.36 sq cm surface area and these were inverted and placed in an expedition funnel apparatus (Macfadyen, 1953). Soil factors studied were temperature, moisture, organic carbon, pH, electrical conductivity and available phosphate. A colorimetric method for phosphate and an oven-drying method for moisture determination as described by Dowdeswell (1959) were followed. The organic carbon content was estimated by Walkley and Black (1934) method and the pH was determined from soil described by Piper (1942). The electrical conductivity and temperature were measured by electrical conductivity bridge and conductivity cell and soil thermometer respectively.

Observations

Edaphic factors : Soils of these plots are alluvial in nature, grey in colour and loamy in texture. Soil temperature varied from 21.43°c to 37.33°c in January and April respectively. Values of soil moisture, organic carbon, pH, electrical conductivity and available phosphate ranged between 10.1% to 19.55%, 0. 53% to 1.21%, 7.1 to 8.1, 1.04 mmohs/cm to 11.08 mmohs/cm and 18.75 ppm to 35.42 ppm respectively. Comparatively maximum amount of moisture and organic carbon was recorded during May and November in both the years of observation. Other soil factors showed a trend of fluctuation regarding maximum and minimum values. Mean values of soil factors (Table 1) revealed more or less identical edaphic characteristics of plots concerned. Mechanical analysis of soil samples showed more or less equal proportion of sand and silt (Table 2).

Oribatid population : The relative abundance of population was obtained (Table 1) in May and November when soil factors like moisture and organic carbon attained comparatively greater concentration. Altogether 7 genera of oribatid mites were obtained such as *Scheloribates*, *Lamellobates*, *Haplochthonius*, *Oppia*, *Hoplophorella*, *Hoplophthiracarus* and *Heptacarus* (Table 2). Among these *Scheloribates* was dominant representing two species, viz. *Scheloribates rakhali* Sanyal (in press) and *Scheloribates bhadurii* Sanyal (in press) comprising 38.75% of total population. *Lamellobates palustris* Hammer, 1958 came next to *Scheloribates* having 23.90% of total population. *Hoplophorella scapellata* Aoki, 1965 and *Hoplophorella sundarbanensis* Sanyal (in press) came next to *Lamellobates* having 11.03% of total population. The fourth, fifth, sixth and seventh genera/species in order of dominance were *Haplochthonius intermedius* Chakrabarty, Bhaduri and Raychaudhuri, 1977, *Oppia yodai* Aoki, 1965 and *O. orientalis* Sanyal (in press), *Heptacarus supertrichus* Piffl, 1966 and *Hoplophthiracarus siamensis* Aoki, 1965 comprising 5.94%, 2.69%, 1.27% and 0.57% respectively. Oribatid nymphs were counted as the percen-

TABLE 1. Showing oribatid population and mean value of soil factors in different months.

Month	1977 Oribatid (Mean)	1977 Tempera -ture (Oc)	1977 Moisture (%)	1977 Organic carbon (%)	1977 pH	1977 E. Ce. (mmohs/ cm)	1977 Avail- able phosp- hate (ppm)	1978 Oribatid (Mean)	1978 Temper- ature (Oc)	1978 Moisture (%)	1978 Organic carbon (%)	1978 pH	1978 E. Ce. (mmohs/ Cm)	1978 Avail- able phosp- hate (ppm)
Jan.	5	21.43	11.00	0.77	7.30	8.10	33.33	4	22.16	10.10	0.69	7.60	7.47	35.42
Feb.	9	25.90	12.00	1.10	7.20	7.00	31.25	7	28.66	10.95	0.70	7.10	6.09	33.33
Mar.	10	31.26	11.43	1.15	7.30	6.85	27.08	11	33 20	11.00	1.02	7.50	5.26	27.08
Apr.	9	30.83	15.60	0.90	7.50	5.57	27.08	10	37.33	10.50	0.53	7.35	4.57	24.10
May	15	33.83	16.65	1.19	7.10	3.10	31.25	18	35.00	19.00	1.14	7.15	5.26	27.08
Jun.	12	29.93	12.83	0.95	7.50	8.21	24.10	13	34.00	13.10	1.02	7.12	11.08	22.92
Jul.	8	32.00	11.00	0.84	7.85	1.76	24.10	8	32.66	18.30	0.67	7.95	1.30	20.83
Aug.	7	31.50	10.78	0.65	7.70	1.04	22.92	9	31.00	12.50	0.55	8.10	1.13	18.75
Sep.	10	31.13	12.00	0.60	7.85	2.88	18.75	10	33.66	12.20	0.65	7.45	2.46	18.75
Oct.	11	30.83	14.50	0.92	7.80	3.77	18.75	11	28.66	13.00	0.67	7.30	3.87	20.83
Nov.	13	30.76	17.95	1.21	7.40	1.99	22.92	15	28.33	19.55	0.77	7.15	3.60	22.92
Dec.	6	22.50	10.10	0.81	7.70	3.55	29.17	7	21.50	11.00	0.59	7.60	4.84	27.08

TABLE 2. Showing mechanical analysis of soil.

Sand (%)	Silt (%)	Clay (%)	Texture class
39.64	39.80	20.56	Loam

tage of total number (Table 3) because of difficulty in proper taxonomic diagnosis and comprised 15.85% of total oribatid population.

Population fluctuation : Variations in oribatid population with time are shown in Fig. 1.

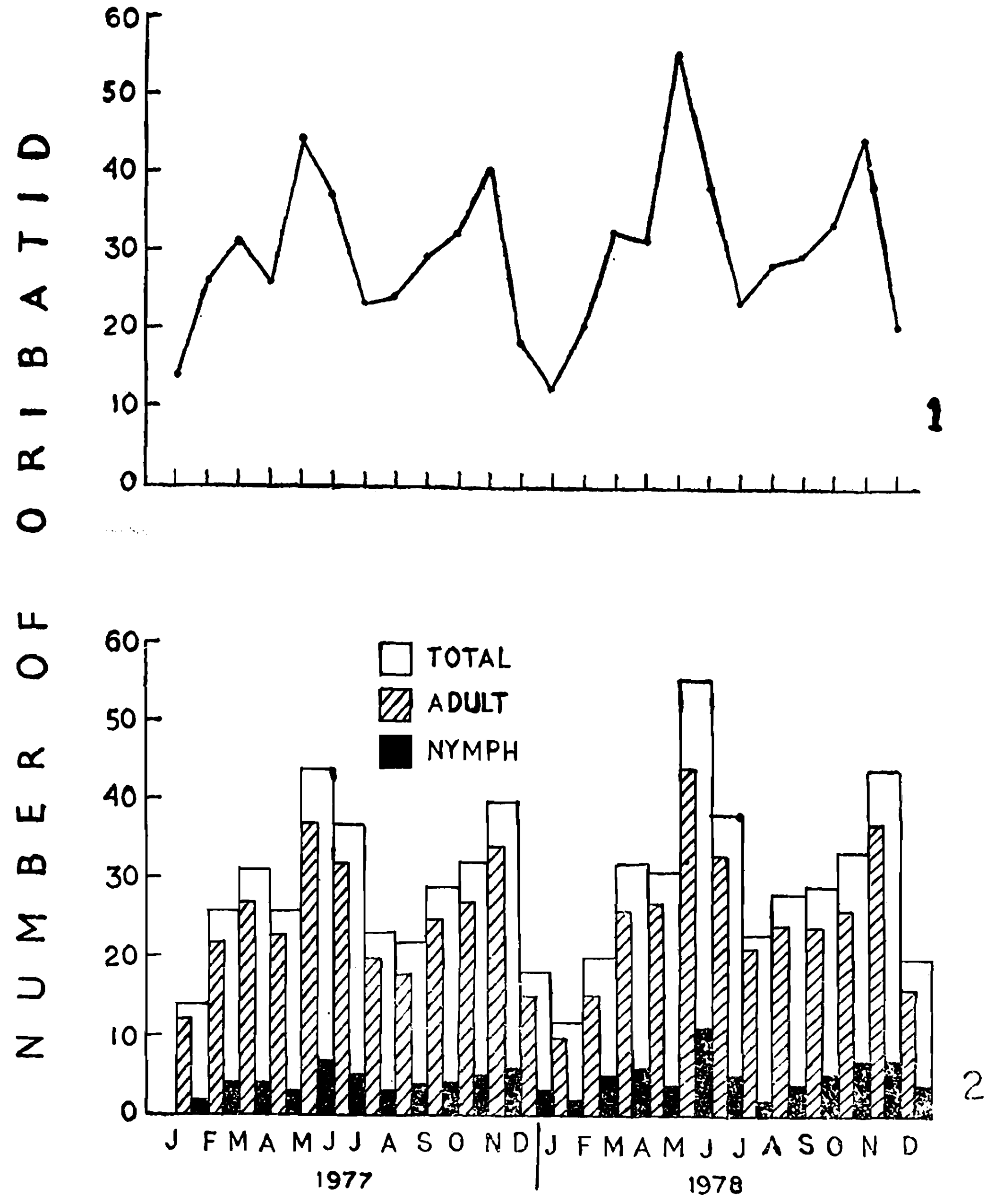


Fig. 1. Seasonal fluctuation of total oribatid mite population.

Fig. 2. Seasonal fluctuation of total, adult and nymphal population of oribatid mite.

The Faunal size as a whole obtained from different sampling sites showed variations at different times of the year during the whole sampling period. The total population showed two peaks, one in May-June (Pre-Monsoon months) and the other in November (Winter month). The fall of population peak was found in December-January (winter months). Seasonal change in the number of oribatid nymphs is shown in Fig. 2. The number raised maximum in the month of May and again in November. Population fluctuation of dominant species of oribatid is shown in

Fig. 3. All the species showed maximum population in May and a second peak in November except *Hoplophorella scapellata* which showed the peak in April. Figure 4 showed the monthly changes in faunal structure.

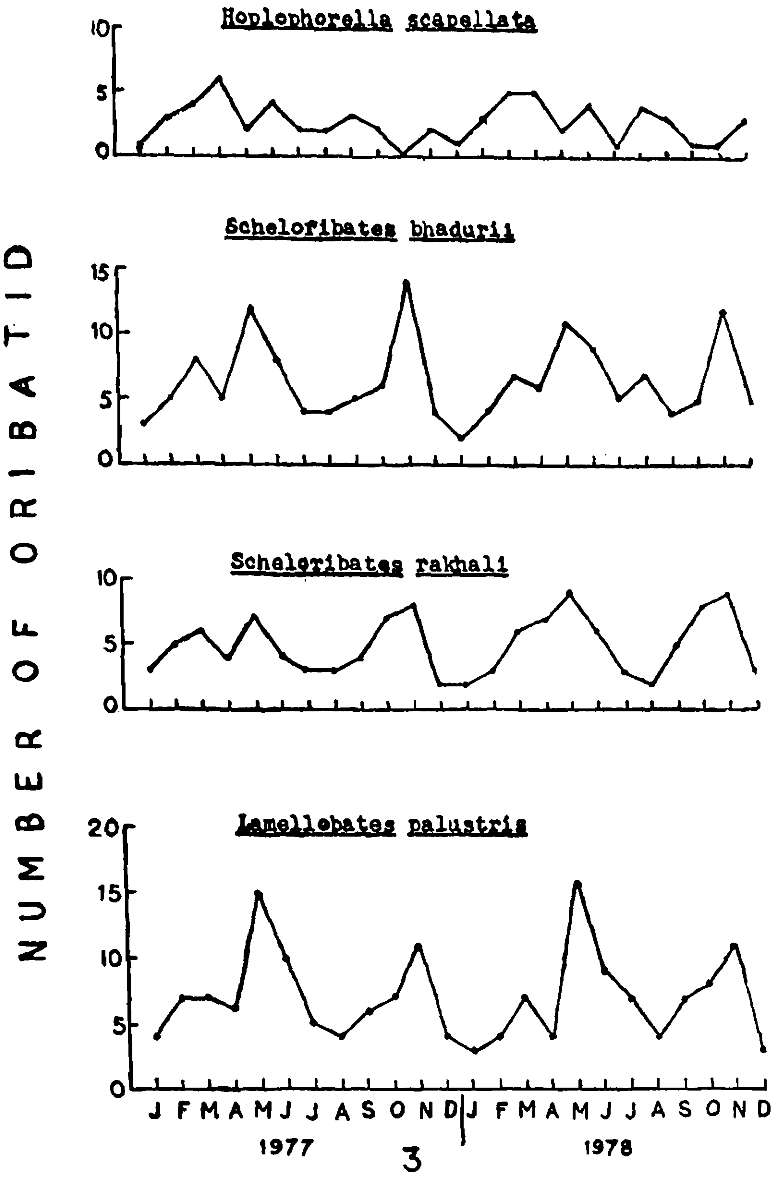
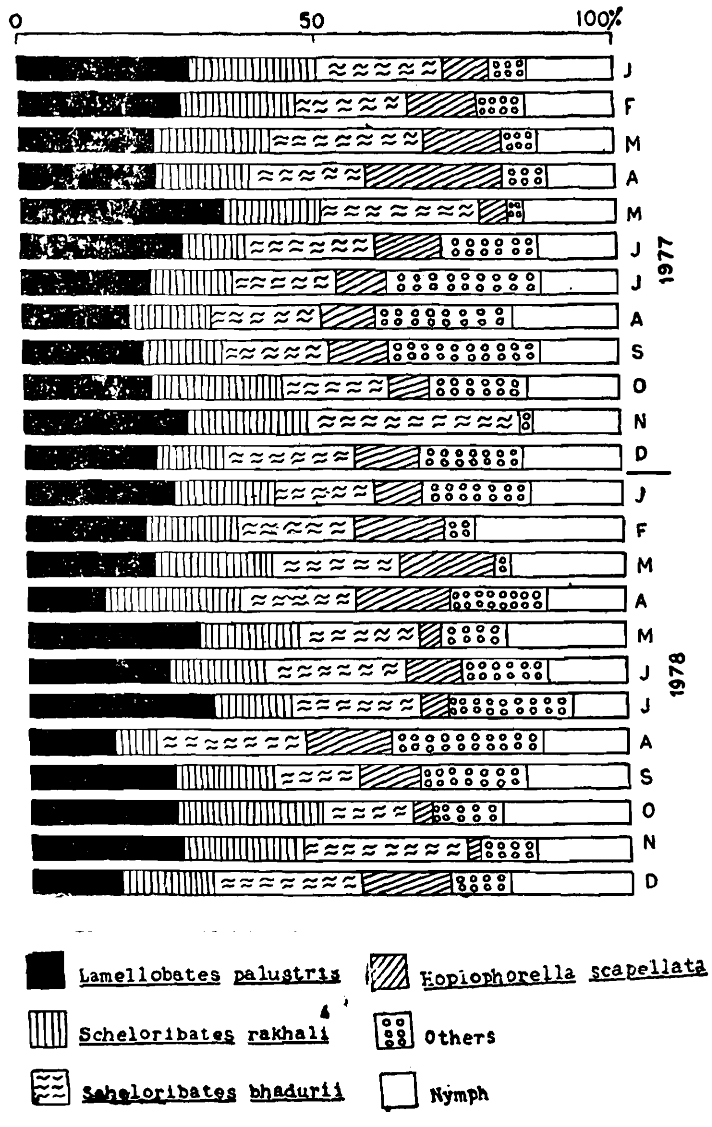


Fig. 3. Seasonal fluctuation of dominant species of oribatid mite.

Correlation between oribatid population and soil factors : The data involving soil factors and the densities of oribatid population were subjected to the statistical analysis to find out possible regressions, correlations and dependence of mean number of oribatid (Y) on each of the six variables (soil factors) considered here. The correlation coefficient data as mentioned in the Table 4 indicated of the six variables, viz. temperature, moisture and organic carbon were significant and positively correlated with the oribatid population. The pH appeared to show significant negative correlation with the oribatid population where as no significant association with electrical conductivity and available phosphate was observed.



4

Fig. 4. Change in percentage of dominant oribatid species and nymphs for each month.

The regression lines were obtained by pulling together the data for the two years.

The combined regression lines drawn along with the respective scattered diagram are shown in the Figs. 5-8.

The analysis of variance study (Table 5) showed that there was a difference between sampling years and between months of a sampling year and the seasonal pattern or monthly variation was significantly constant in both the years.

moisture and organic carbon attained their maximum concentration. The increased population with increased moisture and organic carbon content of soil was reported by Macfadyen (1952), Madge (1964), Loots and Ryke (1966), Fujikawa (1970) and Choudhuri and Banerjee (1977). It may be assumed from the present study that higher pH inhibited the population increase and the negative correlation between pH and oribatid population recorded in the study was supported by Karppinen (1955) and Bhattacharya and Raychaudhuri (1977). It may reasonably be postulated that the oribatid species were capable of withstanding a wide range of temperature. From insignificant correlation between oribatid population and two other soil factors like soil salinity and phosphate it might be suggested that these two factors may not exert sufficient influence on faunal make up but these in combination with other edaphic factors may contribute to the population fluctuation. It may also be assumed from the study that most of the oribatid mites are salt tolerant and able to withstand the higher amount of salt in soil (Weigmann, 1971).

TABLE 5. Showing analysis of variance.

	Year	Month	Error	Total
Degree of freedom	1	11	11	23
Sum of squares	2.66	240.83	10.34	253.83
Mean square	2.66	21.89	0.94	
Frequency	2.8297	23.2872**		

** Significant at 1% level.

DISCUSSION

The population peaks in pre-monsoon and autumn as observed in the present study followed the observations made by Riha (1951), Macfadyen (1952), Sheals (1957), Chiba et al. (1975) and others. Absence of definite winter and autumn peak was reported from gangetic alluvial soils of West Bengal by Choudhuri and Banerjee (1977). This pattern of fluctuation appeared to be a bit different from the works of Wallwork (1959, 1972), Madge (1965a, 1965b) and Usher (1975) who observed a winter maxima. The consideration of climatic and edaphic factors as well as population fluctuation of oribatid fauna leads to the conclusion that high amount of rainfall during May (early monsoon is observed in deltaic region) sets up favourable conditions for the upward migration of soil oribatid and eclosion of juveniles from eggs as peak population of nymph is found during May when factors like

It may be that the biotic and abiotic factors considered here and also those components not analysed in this study collectively contribute to the population fluctuation of

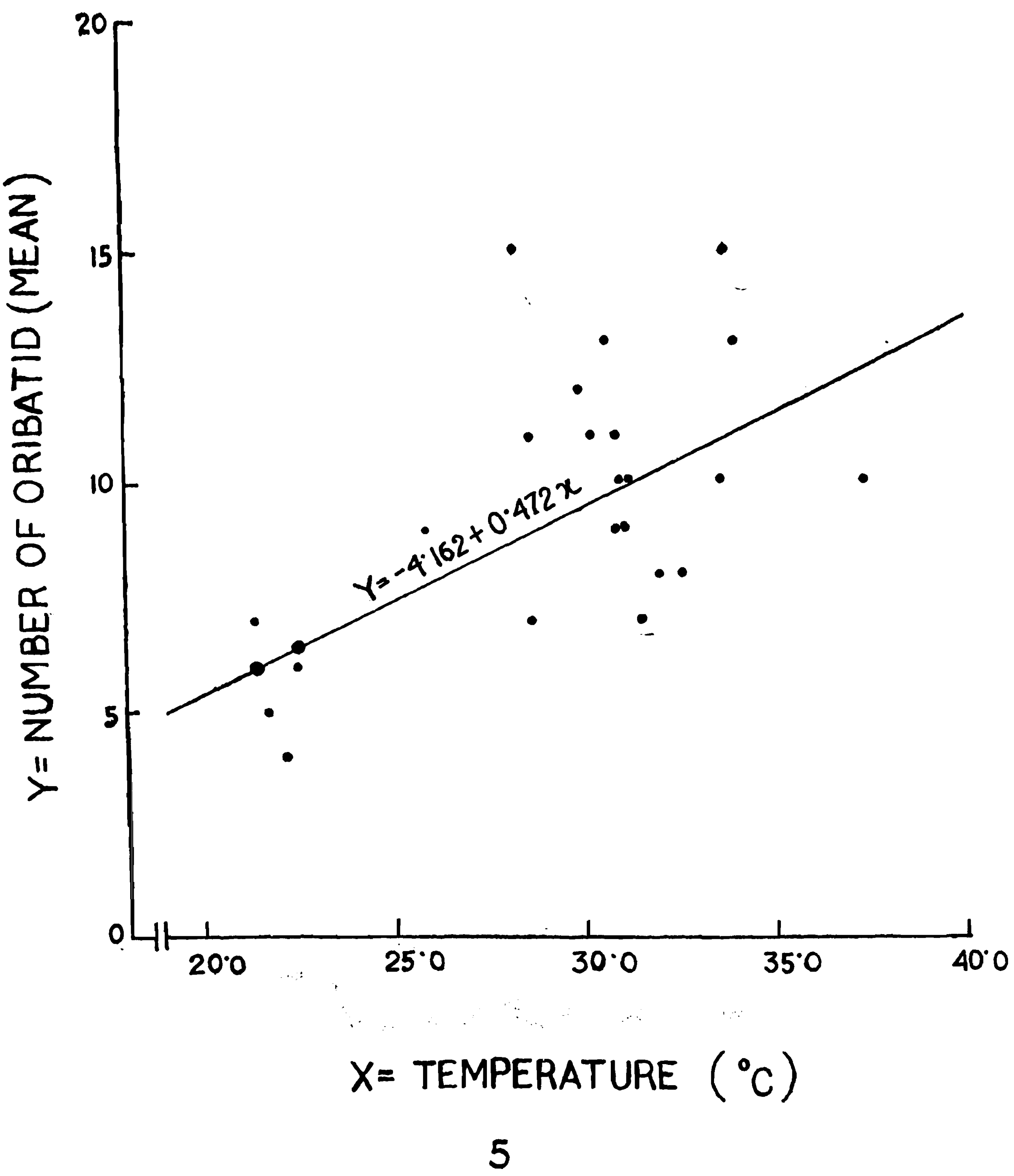


Fig. 5. Regression line with scattered diagram of Oribatei on temperature (°c).

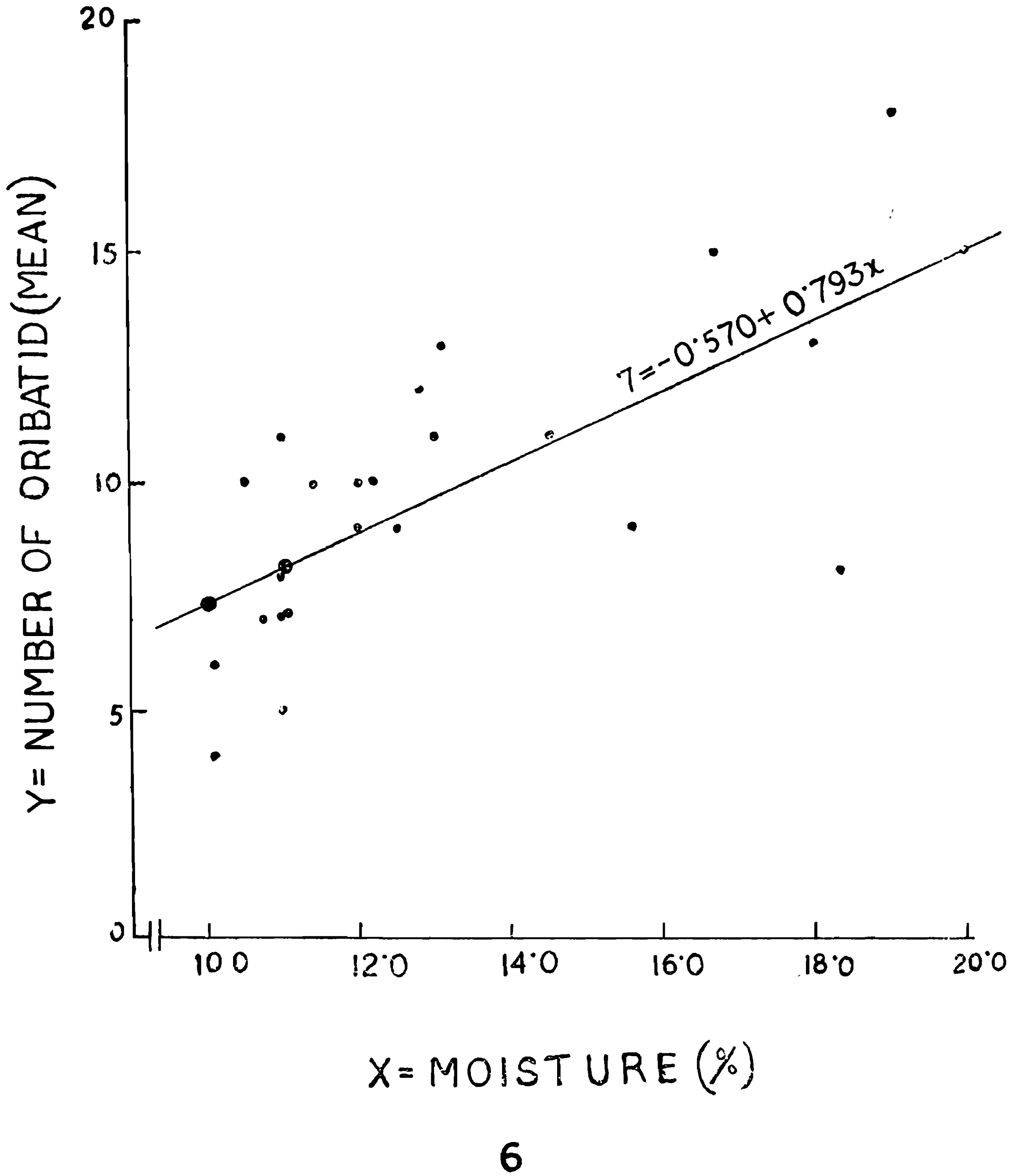


Fig. 6. Regression line with scattered diagram of Oribatei on moisture (%).

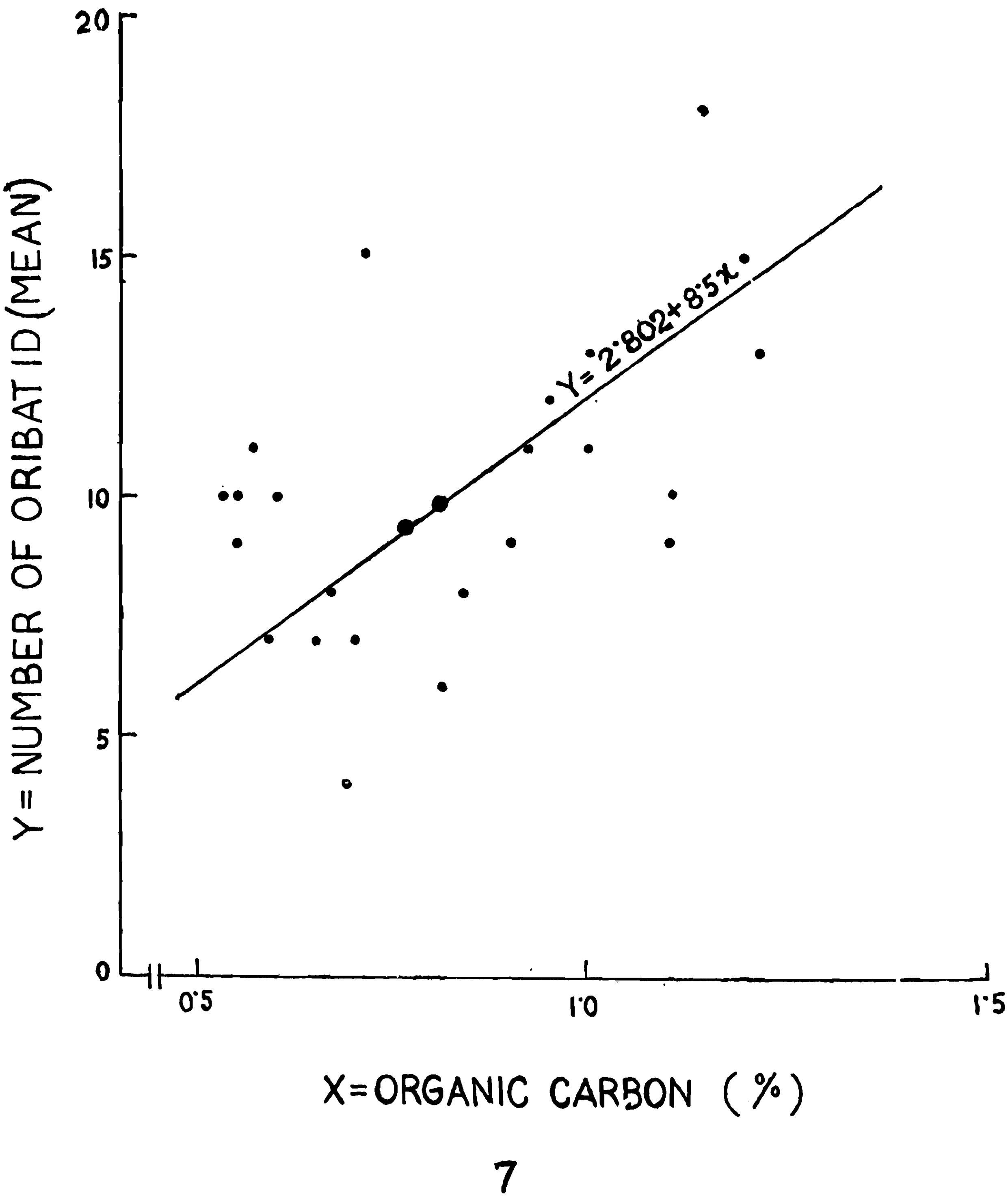


Fig. 7. Regression line with scattered diagram of Oribatei on organic matter (%).

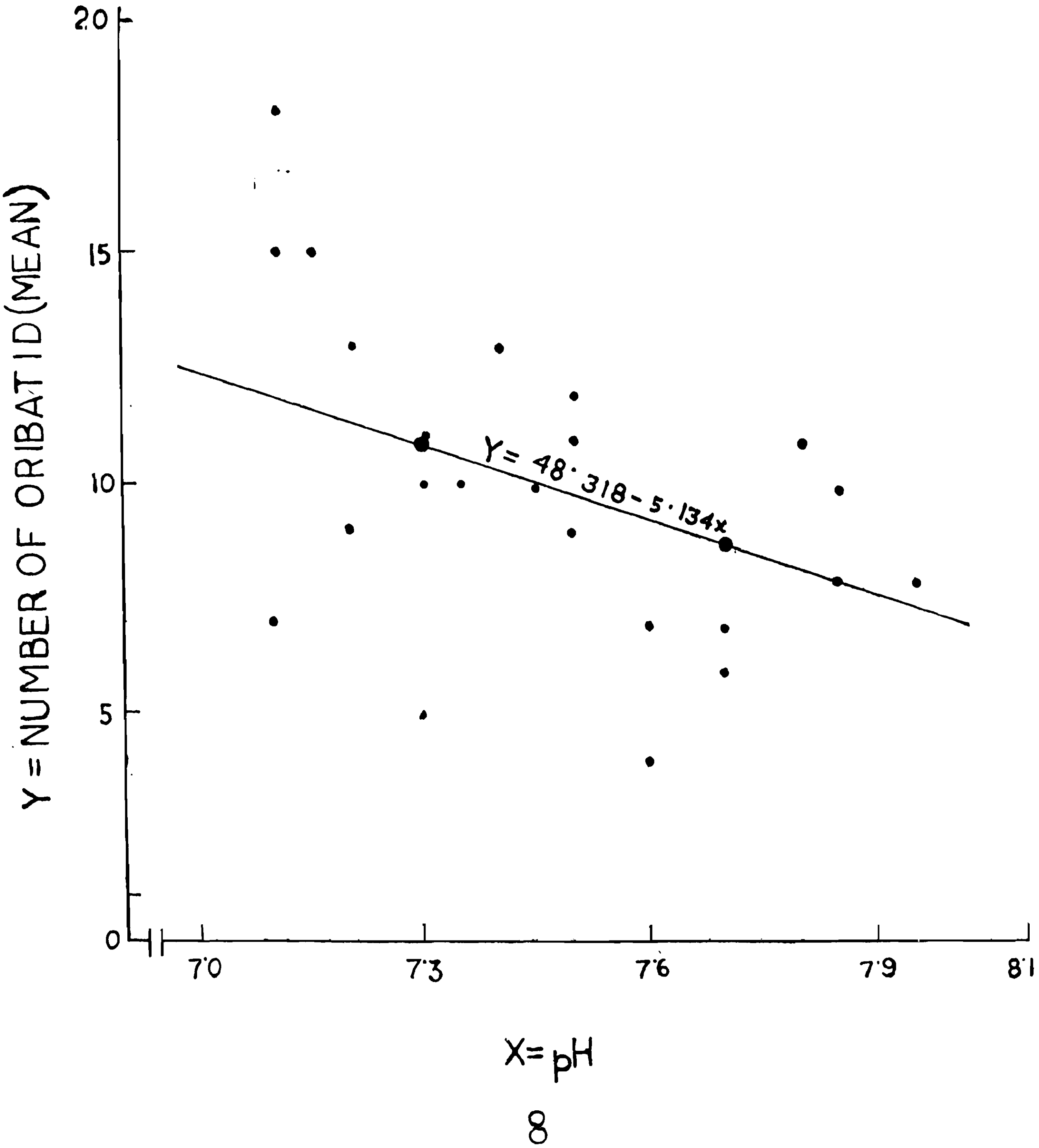


Fig. 8. Regression line with scattered diagram of Oribatei on pH.

oribatid mites in the deltaic soil of West Bengal.

ACKNOWLEDGEMENTS

The author is grateful to Prof. T N. Ananthakrishnan, Jawharlal Nehru Fellow, for suggesting the problem and inspiring with his assiduous guidance and constant supervision and to Prof. D. N. Raychaudhuri, Ex-Head of the Department of Zoology, University of Calcutta of extending untiring help and inspiration. Heartfelt thanks are also due to Dr. A. K. Bhaduri, Vidyasagar College, Calcutta for confirming identity of all the specimens.

REFERENCES

BHATTACHARYA, T. 1974. An ecological study of soil microarthropods with special reference to oribatid mites of Santiniketan and surrounding areas, West Bengal, Ph. D. thesis, Calcutta University.

BHATTACHARYA, T., JOY, S. AND JOY, V.C. 1978. Cryptostigmatid population of some cultivated and uncultivated soils (Acarina). In : Abstracts, Symposium on 'Ecology of Animal populations', Calcutta, 72-73.

BHATTACARYA, T. AND RAYCHAUDHURI, D. N. 1977. Monthly variation in the density of the soil microarthropods in a wasteland of Santiniketan in relation to some climatic and edaphic factors. In : Proc. Second Oriental Entomol. Symp., Madras, 57.

CHIBA, S., ABE, T., AOKI, J., IMADATÉ, G., ISHIKAWA, K., KONDOH, M., SHIBA, M. AND WATANABE, H. 1975. Studies on the productivity of soil animals in Pasoh forest reserve, West Malaysia I. Seasonal change in the density of soil mesofauna : Acari, Collembola and others. *Sci. Rep. Hirosaki Univ.*, **22** : 87-124.

CHOUDHURI, D. K. AND BANERJEE, S. 1975. Qualitative and quantitative composition of Acari and Collembola in relation to soil organic mattermicrobes complex. *Oriental Ins.*, **9** (3) : 313-316.

CHOUDHURI, D. K. AND BANERJEE, S. 1977. Soil factors and oribatid mites under conditions of West Bengal. The University of Burdwan Publication, 1-88.

DOWDESWELL, W. H. 1959. *Practical animal ecology*. Methuen and Co., London.

DRIFT, J. VAN DER, 1951. Analysis of the animal community in a beach forest floor. *Tijdschr. Ent.*, **94** : 1-168.

FUJIKAWA, T. 1970. Relation between oribatid fauna and some environments of Nopporo National Forest in Hokkaido (Acarina : Cryptostigmata) II. Oribatid fauna in soils under four different vegetations. *Appl. Ent. Zool.*, **5** : 69-83.

KARPPINEN, E. 1955. Ecological and transect survey studies of Finnish Camisiids. *Ann. Zool. Soc. Vanamo*, **17** : 1-80.

LOOTS, G. C. AND RYKE, P. A. J. 1966. The ratio Oribatei : Trombidiformes with reference to organic matter content in soils. *Pedobiologia*, **7** : 121-124.

LUXTON, M. 1967. The ecology of saltmarsh Acarina *J. Anim. Ecol.*, **36** (2) : 257-277.

MACFADYEN, A. 1952. The small arthropods of a Molinia Fen at Cothill. *J. Anim. Ecol.*, **21** : 87-117.

MACFADYEN, A. 1953. Notes on methods for the extraction of small soil arthropods. *J. Anim. Ecol.*, **22** : 65-67.

MADGE, D. S. 1964. The humidity reactions of oribatid mites. *Acarologia*, **6** : 566-591.

MADGE, D. S. 1965a. The effects of lethal temperatures on oribatid mites. *Acarologia*, **7** : 121-130.

MADGE, D. S. 1965b. The behaviour of *Belba geniculosa* Oudms. and certain other species of oribatid mites in controlled temperature gradients. *Acarologia*, **7** : 389-406.

PIPER, C. S. 1942. *Soil and plant analysis*. Hans Publishers.

POLDERMAN, P. J. G. 1974. The oribatida of saline areas in the western part of the Dutch Wadden Sea. *Neth. J. Sea Res.*, **8** (1) : 49-72.

RIHA, G. 1951. Zur Ökologie der Oribatiden in Kalkstein—boden. *Zool. Jb.* (*Syst.*), **80** : 407-450.

SANYAL, A. K. Some Oribatid mites (Acarina : Cryptostigmata) from West Bengal, India. *Indian J. Acar.* (In press).

SHEALS, J.G. 1957. The Collembola and Acarina of uncultivated soil. *J. Anim. Ecol.*, **26** : 125-134.

USHER, M. B. 1975. Seasonal and vertical distribution of population of soil arthropods : Cryptostigmata. *Pedobiologia*, **15** (5) : 364-374.

WALKLEY, A. AND BLACK, I. A. 1934. An examination of the Deg-Jareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Sci.*, **37** : 29-38.

WALLWORK, J. A. 1959. The distribution and dynamics of some forest soil mites. *Ecology*, **40** : 557-563.

WALLWORK, J. A. 1972. Distribution patterns and population dynamics of the microarthropods of a desert soil in Southern California. *J. Anim. Ecol.*, **41** (2) : 291-310.

WEIGMANN, G. 1971. Collembolen und Oribatiden in Salzwiesen der Ostseekiiste und des Binnenlandes von Norddeutschland (Insecta : Collembola—Acari : Oribatei). *Faun. Ökal. Mitt.*, **4** : 11-20.

WEIGMANN, G. 1973. Zur Ökologie der Collembolen und Oribatiden im Grenzbereich Land-Meer (Collembola, Insecta —Oribatei, Acari). *Z. Wiss. Zool.*, **186** (314) : 295-391.