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Summary

The present investigation was undertaken to study the effects of excessive land use on soil faunal dynamics. Particularly aspects of recycling, succession and stablisation of soil fauna in lands left fallow after intensive agriculture for a number of years were considered. The uniqueness of the situation was that these fallow lands were the results of shifting cultivation and in these regions is referred to as 'Jhumming" where farmers move their homes and settlements as well as their fields they cultivate at frequent intervals. The present investigation was taken up in such abandoned fallows of different periods ranging from one year to twenty years. The study was aimed at understanding the general population dynamics of various groups of soil fauna in relation to the age of these fallows and to identify their colonisation and successional trend in relation to the general physical factors of the environment and chemical nature of the soil. The study though was aimed at the academic understanding of such disturbed ecosystems, it was also to formulate recommendations of land use practice to the regional government.

Some of the major aspects observed from the present study was that with the immediate abandonment of land after agriculture there was an increase in the soil animal population levels and in particular the mesofaunal levels as seen in the youngest abandoned fallow. There was a drop in the subsequent aged sites while again in the oldest abandoned fallow it reached to the levels of the youngest fallow. A definite successional pattern was seen in the case of macrofaunal levels where the maximum was recorded in the oldest fallow indicating thereby that the colonisation of macrofauna is the deciding factor for relating to soil fertility in such abandoned fallows. It was seen that though some soil fauna get destroyed after shifting cultivation, the species density decreases within 4-5 years and stabilises after only 20 years. From the present study it appeared that the right environment for vertical migration of soil fauna is the moisture gradient of the soil, while temperature was only secondary, thereby permiting the annual cycle to be partitioned by different faunal groups. It was seen that in particular Collembola and Acarina increased in numbers and then stabilized. The density increases of mesofaunal groups could be attributed to active migration, wind dispersal and the life cycle being relatively short and therefore adapted for colonisation and their production being more than one generation per year. All this revealed that land within a year of reclamation does support a larger and varied soil fauna while it may take several years for bigger groups like macrofauna to become established. This supports the view that co-active patterns as resulting from competitive interaction where the stochaistic influences of the soil acting on its microenvironments is always balanced. Moreover, for any one species liable to interact with a mosaic of others at differing densities and in a number of permutations and combinations, fugitive species could co-exist with superior competitors by migrating to temporarily unexploited patches in the habitat. In the formation of soil it is certain groups of soil invertebrates like micro, meso-, and macro fauna which are responsible by way of their metabolic activities for accumulation of organic matter in and on the soil. Therefore, several dominant species capable of reproducing and surviving for long periods at below optimum levels of environmental factors like pH, salinity and temperature would likely to be encountered in the early stages of soil recovery. However, though some soil fauna are capable of living under extreme conditions there is a threshold level beyond the damage of the soil where population dynamics becomes irreversible. It is, therefore, the whole community which is a good indicator of the impact of Jhumming and the outcome of colonisation in such lands left fallow after agriculture.

GENERAL INTRODUCTION

Soil fauna and its studies are a relatively recent field in biology, not only in the temperate latitudes but more so in tropics. Other than the initial general studies today the interaction and interrelationships of soil fauna and its habitats is seen from the Anthropogenic gradient. This relates to the study, taking "natural" as baseline ecosystems, the measurements of dynamic aspects of soil faunal variables, in systems which are subjected to either agricultural activities or to degrees of manipulation and perturbation by the impact of man. This is what was referred to as "rule of the zonal change of strata" (Ghilyarov, 1964). Studies on the ecology of the soil invertebrates, though have been undertaken in the humid tropics (Dammerman, 1945; Williams, 1947; Beak, 1962; Maldague and Hilger, 1963; Toye, 1967; Madge, 1969; Fittkau and Klinge, 1973), yet only that of Lasebikan (1975) is directly concerned with the impact of agricultural practices on on the soil fauna. Other than the above studies on the immediate effects on land usage, interest in the restoration of severely damaged landscape is of very recent time, primarily due to increasing human populations.

With this background in mind the present study was undertaken to see the effects of excessive land use on soil faunal dynamics in tropical environments of this part of the world, particularly for aspects of recycling, succession and stabilization of soil fauna in lands left fallow after intensive agriculture for a number of years. The uniqueness of the situation was that these fallow lands were the results of shifting cultivation, as practiced in many regions of the world. Shifting cultivation, though is regarded as the primitive agricultural systems of the tropics, it is not only confined to tropics, but elsewhere also in the world. In these regions of North-Eastern India, shifting cultivation is referred to as "Jhumming" where farmers move their homes and settlements as well as the fields they cultivate, at frequent intervals (UNESCO, 1952). Jhumming, as for general shifting cultivation involves a similar clearing of the forest by felling, logging and finally burning the undergrowth, then ploughed for agriculture. Hence it is frequently called as "Slash and burn" agriculture referred to as Swidden farming (Ekwall, 1955). Many studies have existed on the immediate effects of disturbing the ecosystem by either burning, logging or agriculturing (Nye and Greenland, 1960). However very little if at all exist on the land after such usage and the agricultural yield falls well below the inputs when it is left abandoned or fallow for a number of years. It is with this reason, that we were interested in such fallows left abandoned for a considerable time, to investigate the influences of soil fauna and soil each other on an ecological approach. This was primarily due to the fact that land after cultivation, when abandoned, the life forms pass through several secondary successional stages with acute competition of elimination of undesirable species all directly correlated to the length of the fallow period.

The present investigation was taken up therefore on abandoned fallows of different ages from a period of one year to twenty years. It was to see in these fallows the general population dynamics of various groups of soil fauna in relation to the age of these fallows and to identify the colonization and successional trend if existing in relation to the general physical factors of the environment and chemical nature of the soil.

The study though was aimed at the academic understanding of such disturbed ecosystems, yet it was thought to bring a recommendation of land use practice based on such studies to the regional government.

STUDY AREA

Location

Byrnihat (Meghalaya State) at 100 m asl; (Latitude 26°02' and 30"; Longitude 91°52'), situated approximately 90 kms from Shillong and 14 kms from Gauhati on the main Gauhati-Shillong trunk road (Fig. 1) was chosen as the main study area. Four different study sites from this region were taken up. These were fallows left after Jhumming cultivation was over for a specific period of time. In this respect the study sites in the general study area was chosen on the basis of one year fallow till 20 year fallows (1 yr, 5 yr, 10 yr and 20 yr).

Origin

Physiogeographically the Assam divisions are the narrow Brahmaputra valley behind the Arunachal-Himalayan area in the North and North-eastern region, Patkai-Naga Hills in the East and the Lushai Hills and Shillong plateau in the South. The Surma river is led by the numerous small tributaries from Shillong plateau and North Cachar Hills. The Surma valley occupies a triangular area between Meghalaya on the West, North Cachar and Manipuri Hills to the East and Tripura Hills on the South. The valley is peculiarly low lying with swamps and perfected level of aluvial flats stretching upto the base of the steep rocky enscapment of the Shillong Plateau. The river and tributaries only for a short distance have a steep fall in shallow and variable beds over the coarse debris brought down by them. they lose all perceptible falls and became tortuous anastomosing water channels. The drainage pattern over the Mikir Hills is similar to that over the Shillong Plateau.

The present changes of the Brahmaputra valley is the result of uplift and subsidence of different blocks of the precambian crystalline, the remnant of which is now represented by the Mikir Hills (Assam) and Shillong Plateau (Meghalaya).

The Soil Environment

Soil is lateritic brown or orange brown in colour. It is generally acidic. The characteristic of soil in the different sites are shown in Table-I for all the four sites.

Vegetation

At all the experimental sites mostly *Dendrocalamus hamiltonii* was found. Table-II presents the vegetation in the different sites with a comparison of dominance of each species.

Climate

The region experiences a sub-tropical monsoon climate, the summer temperatures reaching 35°C and mean winter temperatures falling to 15°C. The frost was observed sometimes in winter early in the morning. The maximum precipitation was observed from May to August ranging from 70.0 to 355.0 cm, showing an average of 125 cms monthly.

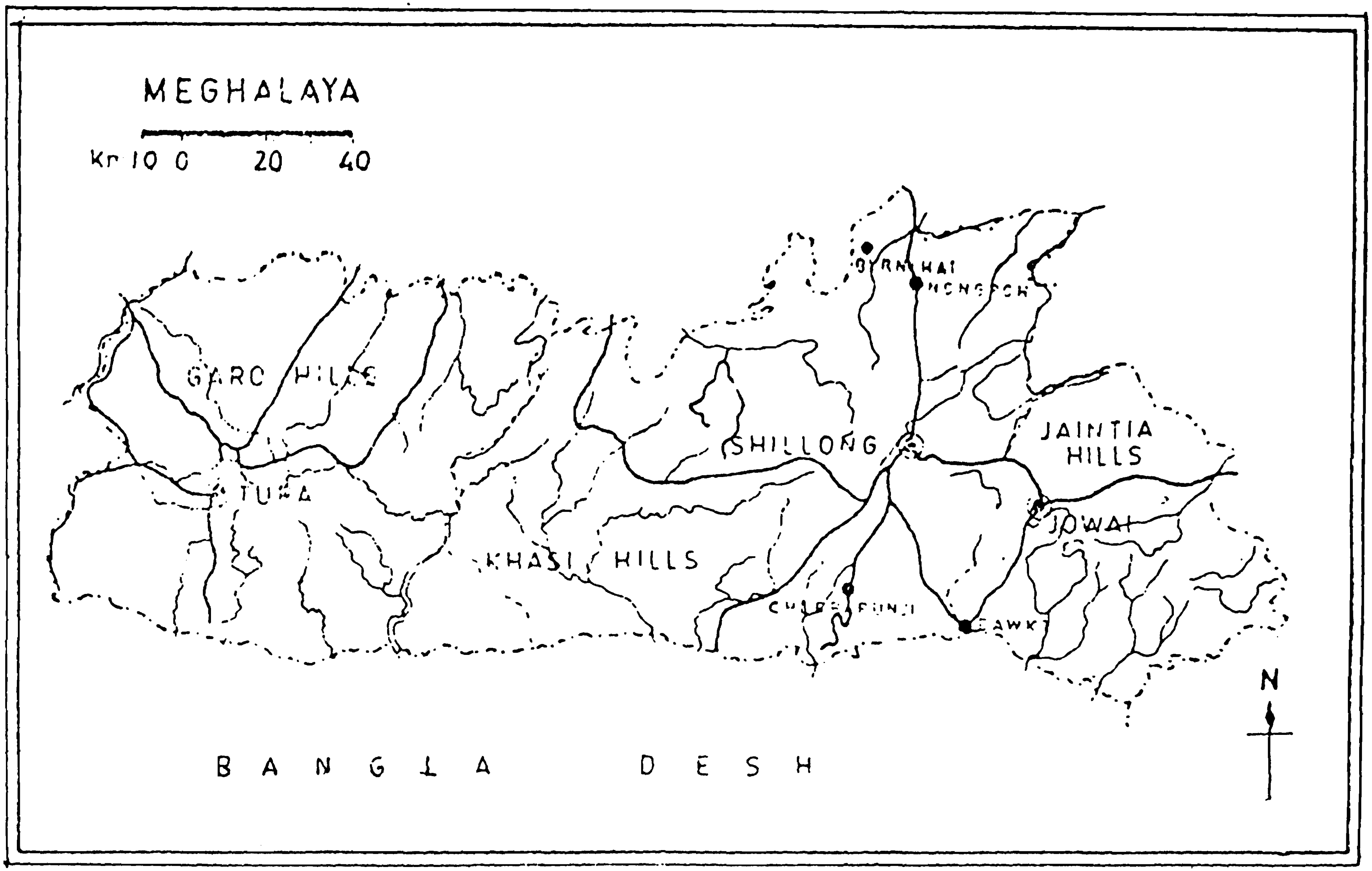

Fig. 1. Physiographical map of Meghalaya and Study site.

TABLE I

The soil types and texture in the four different study sites

Morphology	Site A	Site B	Site C	Site D
Type	Lateritic	Lateritic	Lateritic	Lateritic
Colour	Yellowish brown	Brown	Reddish brown	Dark brown
Texture	Sandy loam	Sandy loam	Coarse sandy loam	Fine sandy loam
Structure	Nutty	Blocky	Granular	Granular
Gravity	Higher	Lower	Lower	Lower
Porosity	More	More	Less	Less
pH	Mostly acidic occassionally alkaline	Acidic	Acidic	Acidic

TABLE II

The vegetation at the four different study sites and their dominance

Species	Site A	Site B	Site C	Site D
Ageratum conyzoides Linn.	+++	—	—	—
Arundinella bengalensis (Spreng.) Druce	++	+++	—	—
Bauhinia variegata Linn.	++++	—	—	—
Borreria hispida (Linn) K. Schum	+	++	++++	—
Cyperus globosus Allioni	++	+++	++++	++++
Carex cruciata Nees	—	++	++++	++++
Careya arborea Rox.	++	—	++++	++++
Callicarpa toona Roxb.	+	++	+++	++++
Combretum decandrium Roxb.	+	+	++	++
Desmodium triguetrum DC.	++	++++	++++	++++
Dendrocalamus hamiltonii Nees & Am.	++	++++	++++	++++
Dillenia indica Linn.	+	+++	—	++++
Eupatorium odoratum Linn.	++++	++++	++	++
Eugenia tetragona Wight	+	++	++	+++
Ficus hispida Linn.	++	—	++++	++++
Gregia elastica Royle	++	—	—	—

Species	Site A	Site B	Site C	Site D
Litsala assmica H.R.F.	+	—	++	—
Mikania micrantha H.B. & SK.	+	—	++	—
Imperata cylindrica (L.) Beaure	++++	++++	—	—
Macaranga denticulata Muell.	++	+++	—	++++
Melia azadirachta Linn.	—	+	+	—
Machillus khasyana Meissn.	+	—	—	++
Maesa indica Wall.	+	++	++	—
Osbeckia crinita Benth.	++	—	—	—
Panicum maximum Jacq.	++	+++	++++	++++
P. khasianum Munro	++	+++	—	—
Setaria tessellata Willd.	—	++	++++	++++
Schima wallichii Chois	++	—	++++	++++
Sapium buccatum Roxb.	+	—	++	+++
Thysanolaena maxima Kuntze	++	+++	—	—
Vitex peduncularis Wall	++	+++	++++	—
V. glabrata Br.	++	+++	++++	++++

++++ = highly dominant; +++ = dominant; ++ = poorly dominant; + = present; — = absent

REVIEW OF LITERATURE

The purpose of the present work was primarily directed towards the understanding of the nature and biology of soil-fauna in these regions where land pressure and usage is very high. At the outset it is advisable to indicate that soil fauna as implied by us, are those soil animals which pass one or more active stages wholly or largely either in soil or litter (Drift, 1951). Though our studies have been confined to the soil layers, it is understood that the faunal elements are those which more either between the litter and the soil layers or within the soil layers themselves.

For the sake of convenience, though several methods exist, for the classification of soil fauna, other than their systematic arrangements (Haarlov, 1960; Kevan, 1962), we have followed the body size as the main criteria after Wallwork (1970). Hence those soil fauna which range between 20 μ and 200 μ as microfauna, those between 200 μ and 1 cm as mesofauna and finally those greater than 1 cm as macrofauna. Microfauna included Protozoa and prostigmatid mites, mesofauna comprised of mesostigmata, cryptostigmata, astigmata, collembola, araneida, chelonethi and isopoda, while macrofauna included all the soil insects (Dermaptera, Coleoptera, Hymenoptera, Hemiptera, Lepidoptera, Diptera, Orthoptera and Thysanoptera), Myriapods (Symphyla, Chilopoda and Diplopoda), Mollusca and Annelida.

Soil fauna and their scientific studies was developed as a discipline very recently though general observations on them have been in existence since White (1789) who did throw some light on earthworms and mole-crickets. The earliest foundations laid towards the understanding of soil fauna were those of Darwin (1840, 1881) and of Miller (1879, 1884), though they had restricted themselves primarily to the role of earthworms in humus formation. The place of honour as the pioneer in the general study of soil fauna goes to Diem (1903) when he worked with certain Swiss alpine soils.

It was not until the first half of the present century that far reaching results based on the general studies of soil fauna was available. The earliest of these were those of Bornebusch (1930); Frenzel (1936); Joffe (1936); Forsslund (1945) and Kubiena (1948). A treatise by Gilyarov (1949) appeared at the end of the present half century. The discreet discipline of soil zoology took shape perhaps from the beginning of the second half of the present century. It was in fact at the beginning of the second half century when Kuhnelt (1950) published what was known about soils animals in a single volume, Bodenbiologie, and Franz (1950) whose publications emphasized the practical implications of the study of soil fauna again in a single volume, Bodenzoologie. A year later Delamore Deboutteville (1951), Hartmann (1951) and Drift (1951) brought out works on tropical soils, classification of forest soils, and in the tradition of Bornebusch respectively. All were based on the influence and activity of soil animals. Ever since, soil fauna and its research has been persued by a logarithmic increasing number of investigators with vigour as had not existed earlier exclusively in this field of study.

It was in the next ten to fifteen years when soil biology as a distinct discipline was available in text-book form. Landmarks in this maturation process were symposia denoted entirely to soil animals held in a number of places. The major works and the coming in of the reviews were done in the years around 1952 to 1967. Those which take the pride of place were Lawrence (1953), Eglitis (1954), Kevan (1955a, 1960, 1961, 1962), Kuhnelt (1957, 1961, 1963), Nosek (1957), Farb (1959), Kipenvarlitz (1961), Murphy (1962), Schaller (1962), Delamare Debotteville and Rapoport (1962, 1963), Doeksen and Van der Drift (1963), Dunger (1964), Gilyarov (1964), Burges and Raw (1967) and Graff and Satchell (1967). It was again during this period that the creation of International Journal of Soil Biology, Pedobiologia in 1961 which served as an important media of exchange of ideas was brought out.

All the above, though are collections of research reports and extremely valuable reference works, they do not qualify as textbooks in the conventional sense. Those which came out with increasing recognition to the soil fauna were also during the fifties and middle sixties such as Kubiena (1953), Sharma and Kevan (1953b, c), Handley (1954), Wilde (1954), Tischler (1955), Macfadyen (1957, 1963), Russell (1957), Balogh (1958), Wallwork (1958), Takeda (1979) and Wiggin *et al.* (1979). The relative increase in publication during this period could be traced to the availability and improved techniques of soil arthropod sampling. some of the important techniques were those of Murphy (1952, 1955), Haarlov and Weisfogh (1953), Macfadyen (1953, 1955, 1961), Alexander and Jackson (1955), Schuster (1956), O'Connor (1957), Heydemann (1958), Averback and Crossley (1960a, 1960b), Tribe (1960, 1961), though most were the improvement and modifications of Tullgren (1918).

In addition to those which have been mentioned above on general soil fauna, literature exists for micro, meso and macro soil fauna separately. Those of importance for microfauna are the works of Carpenter (1897, 1906, 1907, 1908, 1911, 1913), Halbert (1915, 1920, 1923). Lawrence (1961). Those who studied the vertical distribution of microfauna and attributed its occurrence to the upper layers of the soil were Drift (1951), Riha (1951), Macfadyen (1952), Wallwork (1959), Haarlov (1960), Lebrun (1965) and Anderson (1971). Microfauna and its relation to abiotic factors affecting their distribution seasonally have been studied by Ford (1937), Strickland (1947), Drift (1951), Lawrence (1953), Karppinen (1955), Belfield (1956, 1957), Sheals (1957), Wallwork (1959, 1967, 1970), Haarlov (1960), Hale (1967), Tarras-Wahlberg (1961), Aucamp and Ryke (1956), Di Castri, (1973), Price (1973, 1975) and Mitchell (1977). Correlations of soil microfauna with that of soil fertility and their impact on soil formation indicative of soil quality have been studied by workers like Bornebusch (1930), Edwards and Heath (1963), Balogh (1963), Gilyarov (1965), Burges (1967), Karg (1968) and Fizikawa (1970a, 1970b).

However, most of the work in soil fauna have been largely confined to studies on soil mesofauna, in general and Collembola and Acarina in particular. Some of the important works on Collembola and studies in relation to their population density, seasonal fluctuation and in particular their abundance as related to soil moisture content are those of Agrell (1941), Gisin (1943, 1952, 1960), Hammer (1934, 1937, 1953), Stach (1947), Strenzke (1949a, 1949b), Salmon (1951, 1956), Maynard (1951), Nosek (1952), Salt (1952, 1955), Macfadyen (1954, 1963), Murphy (1955), Kitazawa (1962), Milne (1962), Pitelka (1964), Kevan (1962), Mina (1962), Drift (1963), Di Castri (1963a), Castri (1963a), Christiansen (1964), Dunger (1964), Torne (1965), Ogino *et al.* (1965), Witkamp and Crossley (1966), Hale (1966a, b), Naglitsch (1966), Hermosilla and Murua (1966), Poinsot (1968), Wise (1967), Choudhury and Roy (1967), Stebaeva (1967), Greenslade and Greenslade (1968), Joosse (1968, 1969b), Usher *et al.* (1970), Marcuzzi *et al.* (1970), Wood (1970), Di Castri *et al.* (1971), Niijima (1971, 1973), Kaczmarek (1973) and Davidson (1979).

Work on Acari and in particular most of the mites either free living in soil or litter inhabiting have been done by Baker and Wharton (1952), Dunger (1956, 1958), Stockli (1957), Stammer (1957, 1959, 1963), Hirschmann (1957), Schuster (1958), Baker *et al.* (1958), Hughes (1959), Evans *et al.* (1961), Poole (1961), Kevan (1965), Wallwork (1967, 1976), Usher (1967, 1975), Fuzikawa (1970 a, b, c), Butcher *et al.* (1971), Price (1973, 1975), Webb and Eimes (1973), Pande and Berthet (1975), Price and Benham (1977) and Aitchen (1979).

Among the less represented groups of mesofauna are those of Spiders, Chelonethi, Diplura, Protura and Isopoda, have been shown in many of the general soil fauna papers in relation either to their abundance or seasonal variations and there exist literature on the works of some of these lesser represented mesofauna like Diplura, Protura. Work on their taxonomy and ecological studies in relation to species density and distribution have been done by Godfrey (1910), Tuxen (1949), Browney (1954), Paclt (1956), Raw (1956), Ressl and Beier (1958), Sturm (1959), Engelmann (1961), Gasdorf and Goodnight (1963), Gabbutt and Vachan (1963, 1965, 1967) and Gabbutt (1967).

Macrofauna as has already been mentioned earlier are those which are greater than 1 cm body size. Though the present study includes almost all insect orders available, myriapods (Symphyla, Chilopoda and Diplopoda), mollusca and annelids, yet even some mammals could be included (Wallwork, 1970). Extensive work in macrofauna have been on annelida and ants, followed closely by Hymenoptera. Taxonomical work on soil macrofauna, their sampling techniques and ecological studies in particular to earthworms have been done by Nielsen, 1955a, 1955b), Peachey (1962, 1963), Satchell (1963, 1967), Gerard (1964, 1967), O'Connor (1957, 1958,1967) and Huhta (1979). Important work on termites have been done by Gilyarov (1949, 1964), Snider (1949, 1956,1961). Soil inhabiting diptera have been described by Drift (1951), Brauns (1954, 1955), Schuster (1958), Thiele (1959), Kuhnelt (1961), Freeman (1967), Altmuller (1979) and Coleoptera by Coiffait (1958) and Raw (1967). The distribution of slugs and snails in the soil have been done by Drift (1951), Quick (1960), Lozek (1962), Janus (1965) and Newell (1967). The taxonomy and ecology of Isopoda and their seasonal fluctuations and distributional patterns can be found in the works of Hatchett (1947), Palmen (1951), Edney (1953, 1968), Dunger (1958) and Frankel (1979). Similar works on Chilopoda and Diplopoda have been by Verhoeff (1928, 1932, 1934a), Manton (1954), Blower (1955), Eason (1964) and Loksiva and Golovatch (1979). Works on ants are probably only second to those available on Collembola and Acari. Most ecological studies in relation to mark-recapture methods and estimation of population density along with their seasonal fluctuations have been done by Holt (1955), Odum and Pontin (1961), Baroni-Urbani (1965, 1969), Abe (1971), Petal (1972, 1974), Galle (1972), Nielsen (1972), Hemmingsen (1973) and Hunt (1974). The larvae of Lepidoptera and their effect on vegetation have been shown by Brenchley (1955, 1969) and Williams (1974).

In contrast to the abundant literature available for the temperate regions of the world very little is available to the extent one would like to have for tropical conditions. Some of the relevant works of South-Africa include those by Den Heyer and Ryke (1966), Loots and Ryke (1967), Van der Berg and Ryke (1967, 1968), Greenslade and Greenslade (1968), Greenslade (1969) and Theron and Ryke (1969). Drift (1963), has made far reaching results by providing data to prove that very little significant differences exist between tropical and temperate regions after his work in Surinam. Some of the early tropical ground fauna density have been studied by Beebe (1961), Dammerman (1925, 1937), Williams (1941), Strickland (1945, 1947). Salt (1952, 1955) along with Drift (1963) and Raw (1967) have the recent figures for soil faunal densities under tropical conditions.

With this in background it can be seen that even much less work has been done on soils from the Indian sub-continent. Though the first work in India can be traced to Trehan (1945) where he related the seasonal fluctuations of soil-microfauna with some abiotic factors in Lyallpur now in West Pakistan. It was not until nearly two decades after Trehan's work that Indian scientists had contributed to our understanding of the soil fauna and its relationship to the environment. These include works of Choudhuri and Roy (1967, 1970, 1971a, 1972), Baduri Raychoudhury (1968), Mukerjee and Singh (1967, 1970, 1976), Singh and Mukerjee (1971, 1973), Prabhoo (1971, 1972, 1976), Singh and Pillai (1975a), Singh and Singh (1975), Gupta and Mukerjee (1976a, 1976b) and Veeresh (1974, 1977, 1979). All these have been confined primarily to the Peninsular India and there has not been any work in existence till the late seventies for the North-Eastern Regions of India and in particular to the hilly terraces. The works of Reddy and Alfred (1977a, 1977b, 1978), were probably the first of its kind for these regions though confined to pine-forest floors. Therefore, rather than a typical tropical condition their work was more of a subtropical nature, or more so in an ecotone-belt between the temperate and tropical conditions. The only available work under real tropical conditions for North-East India is that Vatsauliya and Alfred (1980) for bamboo forest floors and Darlong and Alfred (1981) for different altitudes in the same regions.

The aim of our present work was not only to identify the ecological characteristics of the soil faunal elements in this region of the world but also to find out the successional pattern of these soil faunal elements under stress due to the pressure on the land. In addition, our aim was to identify the exact time for the total colonization of the original soil fauna, after the land has been allowed to lie fallow for recuperation, after jhum cultivation. Though literature abounds in slash burning and shifting cultivation very little exist on the understanding of the soil fauna under these peculiar conditions. The nearest to such conditions like the effect of fire on soil fauna have been studied by Pearse (1934), Heyward and Tissot (1936), Macfadyen (1952), Terrant (1956), Ahlgren and Ahlgren (1960), Bennet (1960), Smith (1962), Berthet (1963), Moritz (1965), Williams (1966), Buffington (1967), Huhta *et al.* (1967, 1969), Metz and Farrier (1971, 1973) and Critchley *et al.* (1979). However, the practical implication of shifting cultivation on soil fauna was done by Strickland as early as 1947. The next work was available only in the context of logging and slash-burning affecting the soil Acari and Collembola populations in coastal British Columbia (Vlug and Borden, 1973). A similar work under tropical conditions at the foothills of Meghalaya (N. E. India) is available from our study (Vatsauliya and Alfred, 1980).

MATERIALS AND METHODS

Soil samples were regularly collected for a period of 24 months (January, 1978 to December, 1979) at monthly intervals from each site in the four different age fallows (Sites A, B, C, D). In each site, 96 sub-plots of 1 × 5 m^2 were demarcated and each time replicate samples were taken. Soil from each sub-plot was removed with a rectangular iron sampler (5 × 5 × 10 cms). Such samples were taken from four different depths of 0-10 cm, 10-20 cm, 20-30 cm and 30-40 cm from each sub-plot at each site. Hence each soil sample was 250 cu. cm from each site and comprised of four soil-layers with a total of 384 soil samples collected from each site, throughout the study period. Therefore, a total of 1536 soil samples were collected from all the four different sites throughout the period of investigation.

All the soil samples were collected during the morning hours between 0800 and 1100 hrs. On collection of soil samples from the field, they were immediately transferred into individual polythene bags, labelled and packed to prevent loss of moisture as far as possible. Such labelled soil samples were transferred to the laboratory from the field within four hours. Two samples out of the replicate soil collections were pooled and extracted under large modified dry Tullgren Funnel series at 40°C (Macfadyen, 1955; Southwood, 1966) with 100 W lamps for seven days. The third soil sample was used for protozoa by the Berlese flotation techniques (Berlese, 1905). The fourth soil sample was used for the moisture content, measured by dry weight method (Niijima, 1971), pH by pH meter (Toshniwal No. CE.43), conductivity by Conductivity Bridge (Elico CM-82), the latter two by the help of soil suspensions. Bulk density and soil porosity were measured after Keen (1931), and finally the chemical factors like organic carbon, nitrogen, phosphorus and potassium after Walkey and Black (1934). These were done for all the four different soil layers in four different sites in duplicate and the mean values were converted for the soil fauna into an area of m^2.

Further at the time of collection in the field both air temperature and soil temperature were recorded. Air temperature was recorded at each site at about 1 m above each sub-plot using an ordinary mercury thermometer. The soil temperature was measured by placing the soil thermometer a few centimeters into each soil layer in different sub-plots at the different sites.

RESULTS

Population Structure

The present work was carried out for a period of two years beginning January, 1978. The results obtained in the different fallows of one, five, ten and twenty year old, at the time of the initiation of collection. These are, therefore, referred to hereinafter for sake of convenience and easy interpretation as sites A, B, C and D in accordance to the age of the fallows, with four depth layers of soil at each site (I, II, III, IV).

On a general comparison between the four sites (Table-III), it revealed that there was a consistency of total soil fauna present in each site for both the years under study. There was however a definite pattern in their abundance during both the years, in that, site B recorded the lowest (17,584 × $10^2/m^2$ and site D the highest (22,448 × $10^2/m^2$). A similar pattern as seen in the total soil fauna was observed for total mesofauna, when a categorization was made into micro, meso and macrofauna. This is understandable, the abundance of total mesofauna (nearly 60%) affects the total soil-fauna.

TABLE III

The total number mean of soil fauna, microfauna, mesofauna and macrofauna and their percentages in parenthesis for an annual cycle

Site	Total microfauna	Total mesofauna	Total macrofauna	Total soilfauna
A	1080 (5.26)	13498 (65.72)	5960 (29.01)	20538
B	840 (4.78)	10756 (61.17)	5988 (34.05)	17584
C	1092 (5.50)	12108 (60.97)	6660 (33.53)	19860
D	1136 (5.06)	13524 (60.25)	7788 (34.69)	22448

While considering the different major groups among total soil fauna, it was seen that microfauna in both the years was nearly consistent in their number for each site undertaken. However, they revealed a minimum number in site B and maximum in site D. But when their relative percentage abundance was considered it was seen that though the lowest was again recorded in site B, the highest, however, was seen to be in site C. As in case of microfauna the numbers recorded for mesofauna were also similar during both the years of investigation for each site considered, recording minimum again in site B and maximum in site D. However, unlike microfauna, while the relative percentage abundance of mesofauna was considered, it was seen that their maximum relative abundance was in site A and minimum in site D. The third and last major group, the macro-fauna unlike the other two earlier groups did not show a consistency in their numbers for the two years under study in any of the sites. In fact they revealed an increase in their numbers of nearly 800 to 900 × 10^2/m2 during the second year of study. The minimum numbers recorded for macrofauna was seen to be in site A for both the years of study, while the maximum was recorded in site D. A similar pattern was also seen when the relative percentage abundance was considered. Moreover the increase in numbers from the first to second year was nearly 3% increase in all the sites for total macrofauna (Table-III).

While considering the different depths as the different sites, it was seen that there was steady decrease in the total soil fauna as one goes from the top to the bottom layers of the soil. This was seen in all the sites for both the years. Further, it was seen that, though there existed minor variations in the total numbers present, while considering the two annual cycles at the different depths in all the sites, there was a clear consistency in their percentage composition for all the depths in all the sites for both the years when each depth and each site was compared with one another. While analysing the break-up of soil-fauna into micro, meso and macrofauna, it was seen that there was a steady decrease in numbers only in the case of mesofauna for both years in all the sites from the top to the bottom layers. However, when microfauna was considered, a similar trend as in mesofauna was seen only in site D. The microfauna in site A though decreasing till the third layer (20-30 cm), increased slightly by about 3% in the bottom most fourth soil layer, whereas in site B though there was a decrease in the second layer, the third layer increased to a level nearly as the first layer with only a small fall of 3% in last layer. In site C there was an immediate increase in the second layer of about 3%, which thereafter fell steadily till the bottom layer. An observation similar to mesofauna was also seen for total macrofauna in all the sites except in site A where the maximum was recorded in the second (10-20 cm) layer of the soil, which thereafter decreased steadily (Table IV).

Though this trend was seen in the different depths when compared among themselves as actual numbers, it was felt also to find out if a similar trend existed, if and when the micro, meso and macro-fauna were compared as percentages of the total soil fauna for all the soil layers in all the sites. When so considered it was seen for microfauna that except for a similar pattern in site A in all the layers there was a different pattern in the remaining sites. In site B the last layer which should have been lower than the third layer, however revealed an increase in percentages of nearly 0.5% between the third and fourth layer when actually among the vertical distribution in site B, the microfauna decreased by 3% for the same layer under consideration. A similar phenomenon was seen in site C except that in this case the two layers were the first and second layers, where the increase from first to second layer was nearly 1% when compared with the total soil-fauna, when they actually reduced in the second layer by nearly 3%. Another interesting observation in site C was in the third and fourth layers, where the decrease from third to fourth layer was nearly 3%, while the percentages were more or less constant for both these layers when compared with the total soil-fauna for the same site. When site D was considered for total microfauna and its relation to total soil fauna for different layers, the first two layers had a similar phenomenon as was seen for site C, except that the percentage variation of increase in the reverse was very negligible (0.55 to 1.0%) (Table-IV).

If the total mesofauna and their relationship in terms of their relative percentages for all the layers, for all the sites were compared with the total soil fauna, it was seen that in sites A and D there was an increase of nearly 2% in the abundance of total microfauna for the last two bottom layers of soil, when actually in their vertical distribution they had steadily decreased by nearly 3%. However, in the case of site B and site C, the rise of about nearly 1.0% was seen between the second and third layers when among themselves they were nearly the same percentages in their vertical distribution for these layers.

The total macrofauna as mentioned earlier had a decreasing phenomenon from top to the bottom layers of soil in all the sites except site A where the second layer recorded maximum. But on a comparison of their numbers with that of the total soil fauna, it was seen that for site A, the maximum percentage was seen in the third layer with an increase of about nearly 4%. In case of sites B and C the second and the third layers registered an increase of nearly 2% when the actual vertical distribution had a decrease of nearly 3% for these layers. In site D, during the first year of study it followed the similar pattern as for its vertical distribution when either compared among itself or when compared with the total soil fauna. Surprisingly enough, it was not so for the same site D during the second annual cycle. Here, though the decreasing trend was observed when compared among themselves, yet when their numbers at the different layers were compared with the total soil fauna for the same period, it was seen that there was an increase in their percentages in the second and third layers with only a slight fall in the fourth layer. In fact the percentages were more or less constant for all the layers when they were nearly recording a difference of 5% decrease from top to the bottom layers (Table-IV).

Though the major trends have been seen among the broader divisions of soil-fauna, it was to see the intricate relationships, when each of the three major groups were broken down into the possible sub-groups. It was ideal to go upto species level, but due to the great lacuna of taxonomic work in this region the sub-groups thereafter described were the only possible levels in classification which permitted us, due to limitations. Therefore among microfauna, the division was broadly categorized into Prostigmatid mites and Protozoa and the latter being further subdivided into Flagellata, Ciliata and Amoebae.

While considering the Prostigmatid mites it was seen that there was a steady decrease in numbers from top to bottom layers in only sites C and D. In site A, though it decreased till the third layer, an increase by nearly 4% in the fourth bottom soil layer and in site B in the third layer. However, while analyzing their relative percentage of abundance among microfauna it was seen that only in site C, they followed a similar pattern as for their own vertical distribution, while in sites A and D, they recorded an increase of 0.5% to 1.0%, from the first to second layer, they actually decreased by nearly 2% and 1% respectively. In site B though the increase observed from second to third layer was nearly 4%, yet their relative percentage of increase among total microfauna was only 1%. When the prostigmatid mites as percentages of the total soil fauna was observed it was seen that only in site A they followed a trend similar to their own vertical distribution. In site B however, though the trend was similar to their vertical distribution till the third layer, with a increase in the fourth layer by about 0.20%, they had actually recorded a decrease of nearly 3% for the same layers. In sites C and D their percentages among the total soil-fauna increased from the first to the second layer by nearly 0.5%, when actually they had decreased by about 4% and 1% in both the sites respectively (Table-V).

The second major sub-group was total Protozoa within micro-fauna. This group was seen to have the same numbers of abundance in both the years of study in all the sites, though the minimum was seen to be in site A and the maximum was in site B with site D and site C following close behind with only a difference of 4 × $10^2/m^2$. Their vertical distribution in the different depths in different sites revealed a highly erratic phenomena, in that in site A, though it decreased in the second layer, increased to a level of exactly that of the first layer, which decreased again in the fourth layer exactly similar as in the second layer. In site B the first and second layers have the same numbers and increased to nearly 3% with the same numbers of increase in the third and fourth layers, both of these being similar. as was seen in site B, in site C, the first two layers were the same in numbers except that they dropped by nearly 3% in the third layer, to rise drastically by 9% in the fourth layer. In site D a totally different phenomenon was seen, in that, though there was a decrease in the second, third and fourth layer, the second and third layers revealed the same numbers. While observing the protozoan relative abundances with total microfauna it was seen that in site A though the first and third, second and fourth had the same numbers of protozoa, yet their range of difference among microfauna was nearly 13% for the first and third layer and nearly 7% for the second and fourth layers on the increasing side. In site B though there was difference of nearly 3% between depths first, second and third-fourth, yet the second, third and fourth layers revealed the same relative percentages among the microfauna. In site C though there was a decrease in third layer by nearly 3% from the first and second layers, the latter two being constant, there was an increase of nearly 1% in the third layer. In site D, though the second and third layers had the same numbers, they revealed an increase of nearly 7% from second to the third layer, and while they dropped nearly 3% in their own vertical distribution from the the third to the fourth layer, yet they showed an increase of nearly 3% when compared with total microfauna. While considering their relative percentages among the total soil fauna it was seen that they nearly followed the same pattern as in total microfauna except that the range of difference was negligible (Table-VI).

When Protozoa was further broken down, it was seen that flagellata comprised of 55-80% of the total protozoa. The total flagellata showed a consistency in their numbers among the different depths as seen in site B and a decreasing phenomenon with consistency in depth (first, second and third) as in site A, and second, third and fourth in site D. Only in site C did they reveal a reverse trend in that they were consistent in the first three layers and increased suddenly by nearly 13% in the fourth layer. However, they were consistent in all the layers in site B, yet, when they were compared with total Protozoa, it was seen that the first two layers had nearly 7% more than in the bottom two layers. Similarly though the first three layers in site A had the same numbers yet the second layer revealed nearly 10% increase among total Protozoa, as was also seen for the second and third layer in site C except that it was in the reverse. In site D, a similar observation was seen in that though the numbers for the second, third and fourth layers were same yet the fourth layer showed an increase of about 10% as was seen for the first layer when considered among the Protozoa, while the second, third and fourth layers were nearly 13% lower than the first layer. When the total flagellata and its relative percentages among the total micro-fauna was considered, it was seen with minor fluctuation in their ranges to be nearly similar to their own vertical distribution in sites B and C. However, in site A they revealed an increase of 8% in the third layer, while actually they were consistent from the first to the third in their numbers and though they decreased by 5% in the fourth layer, however they had increased by nearly 3% from the first two layers, though their numbers were similar. In site D, a more or less similar observation was seen except that it was in the reverse. While considering the total flagellates among the total soil fauna, they had a similar pattern as for their vertical distribution with only a variation of 0.2% in their fluctuation among the depths, in different sites (Table-VIII).

The next dominant group after flagellata among Protozoa were the total ciliata, which comprised of 15-33% of the total Protozoa. The total ciliata either had the same numbers in all the depths as in sites C and D or they had an increase in numbers from third to fourth as in sites A and B, except that in the former there was a drop in the second layer by nearly 50%. The similarity between their vertical distribution among themselves was also seen when they were compared with the total Protozoa in site B. In site C, though the numbers present in all the depts were the same, yet their relative percentage among Protozoa increased by 3% in the third layer to drop by nearly 8% in the fourth layer. In site D as in site C though the number of ciliata present in all the depths were the same, yet they showed an increasing trend from first to the fourth layer by nearly 10%, while their relative percentage among the total Protozoa when considered were nearly 3% increase from third to fourth soil layer. a similar observation as the latter phenomenon in site D was also observed in site A. While considering the total ciliata among the group microfauna, it was seen that there was a steady increase in their relative percentage from the top to the bottom layers in sites C and D for both the years of study, when the numbers were constant. In site A though the numbers in first, third and fourth layers were same, yet they increased in the third layer by nearly 2% and fell by 1% in the fourth layer, when their relative percentages among the total microfauna were considered. In site B they more or less followed their own trend among the different layers. When the total ciliata were compared with the total soil fauna, it was seen that their relative percentages for the different layers in all sites had a similar pattern as was seen for the total ciliata and its relative percentages among the total microfauna (Table-VII).

The last group among Protozoa were the amoebae, which ranged from 0-14% of the total Protozoa. The relative percentages among the Protozoa were seen to differ by nearly 2% even though the numbers remained constant. Similarly there was 1% and 0.2% differences when the total amoebae relative percentages were compared either with total microfauna or total soil fauna respectively. As there were very minor variations we anticipate a very negligible effect on the total study (Table-IX).

The next major group of soil fauna, mesofauna was broadly divided into Collembola, Acarina, Araneida, Diplura, Protura, Isopoda and Chelonethi. The first three of these sub-groups were further categorised into either families or sub-orders.

While considering Collembola it was seen that there was a steady decrease in their numbers at the different soil layers in all the sites for both the years. Moreover in both the years, the numbers were very consistent for each site, at all the layers. However, when a comparison was made on their relative abundance among mesofauna, it was seen that a decreasing trend as for their vertical distribution was only observed in sites B and C. In site A there was an increase by nearly 1% in the second and third layer and nearly 10% in the fourth layer as compared to the two top layers. Site D, though revealed a drop in the second layer, rose in the third layer to 5% more than in the first layer, but dropped by 3% in the last layer. Similarly, when Collembola was seen as a percentage of total soil fauna except for sites B and C, where it showed a steady decrease in trend from top to the bottom layers, in sites A and D they dropped in second layer though insignificantly but rose in the third layer to nearly 1% and 3% respectively. The difference however in these two sites (A and D) was in the fourth layer where in site A it rose 1 to 6% more than in the third layer, while it dropped by 1% in site D (Table-X).

The families under Collembola which occurred in the present investigation were Entomobryidae, Hypogastruridae, Sminthuridae and Isotomidae in that order of abundance. Entomobryidae comprised of 40-42% of Collembola. As in Collembola the numbers in the different layers for both the years were consistent in all the sites, and there was a steady decrease from the top to the bottom layers. When their relative percentage among Collembola was considered, it was seen that in sites A, C and D they dropped in the second soil layer but rose quite drastically in the third layer to fall again in the fourth layer. In site B, it nearly rose to 5% in the second to fall steadily thereafter. When their relative percentages among mesofauna was taken into consideration it was seen that a steady decrease from top to bottom layers for both the years was observed only in sites B and C. In case of sites A and D though it fell in the second layer, it rose in the third layer and continued steadily in case of site A, whereas fell again in site D. While considering the relative percentages of Entomobryidae among the total soil fauna it was seen to drop steadily from top to the bottom layers in sites B and C only (Table-XI).

The next abundant family among Collembola recorded was the family Hypogastruridae. Hypogastruridae which formed 26 to 30% of Collembola, was not seen to decrease steadily in any of the sites during both the years of study. Sites A and B showed an immediate increase in second and third layers and though dropped in the fourth layer, yet they were 1% more than the first layer. In sites C and D, there was an increase only till the second layer which dropped in the third layer to again rise in the fourth layer to levels nearly as the second layer. The percentage of Hypogastruridae as a percentage of total mesofauna showed a trend in reverse in sites A and D, the former being significant. In site B it dropped in the second layer, rose in third to drop further in fourth layer, while in site C it increased in the second layer to steadily decrease thereafter. A phenomenon as seen for their relative percentages among total mesofauna, was also seen when the percentages was considered as for the total soil fauna in the same sites A and D except that it was significant in latter than the former. Site C however showed a steady decrease while site B had a similar situation as for the percentages among the mesofauna (Table-XII).

The third family of dominance among Collembola was Sminthuridae which formed 14 to 27% of Collembola. There was not only consistent number present in both the years at the different soil layers in all the sites, the decrease in the different soil layers was also seen though not very significantly, when this family was taken as the percentage of Collembola, in sites A, C and D. However, in site B, the trend was in the reverse when Sminthuridae was considered as a percentage of total mesofauna. The phenomenon of decrease from top to the bottom soil layers was seen only in sites B and C, while it was in reverse in site A and in site D, it dropped in second layer, rose in third, to the levels higher than the first layer and dropped in fourth layer again. As was their presence among total mesofauna, it was also true when this family was considered as the percentage of total soil fauna (Table-XII).

The fourth and last family among the Collembola was the family Isotomidae which was 9 to 15% of Collembola. This family however had one departure from others and Collembola, in that though the numbers were consistent for both the years for the different soil layers, yet the steady decrease from top to the bottom layers was seen only in sites C and D. Here too, the decrease was seen only till the third layer which increased in fourth layer, in site A there was an increase of 1% in the second layer which fell by 5% in the third layer but rose quite significantly by nearly 20% of the third layer and fourth layer, in site B, though there was a steady decrease upto third layer, yet it rose in fourth to the levels as in the second layer. When their percentages were considered among Collembola, it followed a pattern of their own vertical distribution in sites A and B. The trend was in the reverse in sites C and D from the top to the bottom layers, the latter recording the highest with a difference of nearly 4% between itself and in the third layer, though the actual numbers present were same. Whatever was seen among Collembola the same pattern was observed when their percentages were considered, either as of total mesofauna or of total soil fauna in sites A, B and C. However in site D, their percentages among the total mesofauna and the total soil fauna was seen to increase for top to the bottom layers (Table-XIV).

The major sub-group after Collembola among the mesofauna was Acarina which comprised of 25 to 38% of the total mesofauna. As in Collembola, so also in Acarina the number present in different soil layers for both the years were the same. This was seen to be true in all the sites. However, the steady decrease in number from top to the bottom layers was seen only in the third layer in sites A, C and D, while in site B it fell in the second layer by nearly 8%, but rose to nearly 5% in third and fourth soil layers. When their percentage of abundance in total mesofauna was observed they followed the pattern similar to their vertical distribution only in site A, while in site B though similar till the third layer, yet in the fourth when they actually should have dropped, they rose nearly by 6% in site C. The percentage of abundance in the total mesofauna was seen to increase from top to the bottom layers when actually their numbers decreased. In site D, it rose and fell in the alternative layers, though they did show a steady decrease in their actual numbers. A trend as observed for relative percentages of total mesofauna was also seen to be very similar to the trend when Acarina was considered as percentages of the total soil fauna (Table-XV).

The major sub-division of Acarina comprised of sub-orders Mesostigmata, Cryptostigmata and Astigmata in that order of abundance in the present investigation. The sub-order Mesostigmata made up nearly 40 to 60% of Acarina and their numbers were constant for both the years in all the layers for all the sites. However, they did not show a trend of decreasing order from the top to the bottom soil layers in any of the sites except in site A. In the other three sites they dropped till the third layer but rose to nearly 1% in the fourth layer. Their relative percentage in Acarina was seen to follow a trend in the reverse in site A, while they rose in the alternate even layers in sites B and C while they fell in the second layer in site D, to rise steadily thereafter till the fourth layer. This pattern was also seen to be similar when Mesostigmata was taken as a percentage of either mesofauna or total soil fauna in all the sites except in site B where their percentage abundance of total soil fauna showed a steady increase from top to the bottom layers (Table-XVI).

The sub-order Cryptostigmata came second in terms of abundance in Acarina comprising of 23-48%. Their numbers of occurrence were the same for both the years in different soil layers in all the sites. Except in site D, none of the other sites revealed a steady fall in their numbers from the top to the bottom layers. In the three other sites A, B and C, the numbers fell and rose in the alternate layers. When the sub-order Cryptostigmata was considered as the percentage of Acarina, it was seen that they followed a trend of their actual numbers more or less in the sites A and B, while in site C they steadily increased from top to the bottom layers and in site D there was an inverse pattern till the third layer and a sudden fall in the fourth. This trend was also true when this sub-order Cryptostigmata was considered either as the percentage of mesofauna or total soil fauna (Table-XVII).

The last sub-order among Acarina was Astigmata which comprised of 7% to 23%. As in the other cases they also showed the consistency in numbers in both the years in different layers in all the sites. However no one site showed a steady decrease in their numbers form top to the bottom layers. Sites B and C fell and rose in the alternate layers, while in site A, there was a steady decrease in their numbers till the third layer but rose significantly in the fourth layer. In site D it rose and fell in the alternate layers in contrast to sites B and C. This trend in different layers in different sites for both the years was similar also in the case of relative abundances of the sub-order Astigmata in Acarina, mesofauna and total soil fauna, except that in site B their percentages among total mesofauna and total soil fauna increased from third to fourth layer (Table-XVIII).

The third major group under mesofauna comprised of Araneida which formed 13 to 22% of the total soil fauna. As in the earlier cases the numbers were consistent in different layers for both the years in the various sites. However, the steady decrease from top to the bottom layers was seen only in site D. Sites A and C revealed a fall and rise in the alternate layers, while in site B there was a rise in second layer which thereafter fell steadily till the fourth layer. When their percentages of abundance as in total mesofauna was considered it was seen that in site D that the trend was in the reverse, while in sites A and B they more or less followed the trend as for their vertical distribution numbers. In site C though they fell and rose as their numbers till the third layer, yet they continued to rise in the fourth layer though their actual numbers fell. Their percentage of abundance as of the total soil fauna when considered were seen to be similar to that of their percentages among total mesofauna (Table-XIX).

The largest family among Araneida was the family Clubionidae forming 44 to 56% of Araneida. Their numbers in the different layers for both the years were nearly the same in different sites with very little differences, as in site B fourth layer recorded a little less than in first annual cycle, while in site D the first layer recorded a little more and second layer recorded a little less in the second annual cycle. The steady decrease in numbers was again seen to be in only site D. In sites A and C, they fell and rose in the alternate layers, while in site B they fell steadily till the third layer to rise though insignificantly in the fourth layer. When Clubionidae was seen as the percentage of abundance of Araneida, mesofauna or total soil fauna, it followed more or less the same trend as the sites except site

D where the trend was in reverse. However, in site A, the first and second layer where the numbers were the same, yet a slight increase was recorded among those relative percentages (Table-XX).

The next family among Araneida was the Lycocidae which formed 16-39% of Araneida. Their numbers in different layers were consistent for both the years in the various sites under consideration. The only site where there was a steady decrease from top to bottom layers was site A, while there was steady decrease till the third layer in site D with a sudden increase in the fourth. Site B recorded the increase in the second layer which fell thereafter till the fourth, while site C fell and rose alternatively. This pattern was also seen similar when Lycocidae was considered as the percentage of Araneida. However when it was taken as the percentage of either total mesofauna or total soil fauna, it followed a trend of its own in both the cases though similar to each other in sites A and D, the third layer in sites B and C, the fourth recorded an increase while actually their numbers and their relative percentages of Araneida decreased (Table -XXI).

The third and last family under Araneida was Linyphidae which comprised of 13 to 35% of Araneida. As in earlier cases the numbers in different layers for both the annual cycles were nearly consistent for various sites, except that it recorded a negligible decrease in the second annual cycle for the fourth layer at site B and an increase in the second layer for site D. The decrease from top to the bottom layers in numbers was again seen in site D only, while in site C there was steady decrease till the third layer which rose by 4% in the fourth layer. Sites A and B had a significant rise in the second layer and fell steadily till the fourth layer. However, while the relative percentages of abundance in Araneida was considered, they seemed to follow the trend as their vertical distribution numbers only in sites C and D. The fourth layer in site A and the third layer in site B recorded a significant increase in their relative percentages of Araneida when actual numbers decreased. A similar trend was also seen as in the case of relative percentage of abundance in Araneida, total mesofauna and total soil fauna in sites A, C and D. In site B however, the relative percentages of abundance in total mesofauna and in total soil fauna followed a pattern of the family's own vertical distributional numbers (Table-XXII).

The remaining four groups under total mesofauna in the present investigation were with very little percentages of abundance. They were Protura, Diplura, Chelonethi and Isopoda in order of dominance.

The group Protura formed 2.5 to 7% of the total mesofauna. The consistency of their numbers for both the annual cycles in different layers was seen in sites B and D only. The steady decrease in numbers from top to the bottom layers was seen in sites A and C, while in site D though there was a decrease till the third layer, with an insignificant increase in fourth. In site B there was a slight increase in second layer which fell thereafter in subsequent layers. When the group Protura was considered as the percentage of either mesofauna or the soil fauna, it was seen that both followed a trend similar to the vertical distributional numbers only in site B. In site A however, though the trend was similar to the third layer, there was an increase in the fourth layer in the first annual cycle while in the third layer in the second annual cycle. In site C, though a steady decrease in numbers was observed from top to the bottom layers, yet Protura percentage of either the mesofauna or total soil fauna recorded an increase in the second and fourth layer in contrast to the first and third layer where the actual numbers were more (Table-XXIII).

The group Diplura comprised of 2.5 to 6% of the total mesofauna, their numbers recorded in different layers in various sites for the two annual cycles were not consistent except in the case of the fourth layer in site A, the second and third layer in site B, first, second and third layer in site C and second, third and fourth layer in site D. However this group revealed a decrease in numbers from top to the bottom layers in all the sites in both the years of study. This trend of decrease from top to bottom layers was also seen when Diplura was taken as percentage of either the total mesofauna or total soil fauna in sites C and D for both annual cycles and in site A for second annual cycle only. The first annual cycle in site A revealed a sudden increase in the third layer, while in site B the increase was seen in the second layer though in both the cases only very insignificantly (Table-XXIV).

The last two groups under mesofauna comprised of Chelonethi and Isopoda. The former was 2%, while the latter only 1%, of the total mesofauna respectively. The numbers of Chelonethi were more or less similar for all the layers in all the sites. So also it was true for the group Isopoda. As their percentage of abundance either among total mesofauna or total soil fauna was very negligible, nothing further can be said about them (Tables-XXV, XXVI).

The third and last major group under total soil fauna was macrofauna, and the large sub-divisions under this group were total Insecta, Myriapoda, Annelida and Mollusca. The total Insecta was categorised into its major orders namely, Coleoptera, Diptera, Hemiptera, Hymenoptera, Trichoptera, Thysanoptera, Dermaptera, Lepidoptera and Orthoptera. The order Hymenoptera excludes the total ants which is presented not only separately but also upto family levels.

The total Insecta, their numbers when considered in the vertical distribution of different soil layers for the two annual cycles, was found to be always more in the second annual cycle not only in the different layers but also in different sites. Further there was a steady decrease in their numbers from top to the bottom layers in all the sites during both the annual cycle except in site A where they rose by nearly 3% in the second layer but fell steadily thereafter. The total insects formed nearly 70 to 80% of the total macrofauna. This percentage of macrofauna was however seen to be nearly the same for different layers at different sites, even though as mentioned above, the actual numbers of the total insects present increased in the second annual cycle in the different layers of the soil in all the sites studied. Their relative percentages of the total macrofauna was seen to be in the reverse in site D in relation to the actual numbers, though in the second annual cycle they decreased at the fourth layer very insignificantly. In site A the third layer registered the maximum percentage and though it decreased in the fourth layer the levels were much greater than the first. In sites B and C there was an increase in the third and fourth layer for both the annual cycles. When the total insects were considered as the percentage of the total soil fauna, it revealed a pattern very similar to those of the percentages as in macro-fauna (Table-XXVII).

Among the total insects the major group was the order Hymenoptera. However for the sake of convenience we separated the total ants from this order Hymenoptera as it formed a major portion. When so considered the total ant numbers for the different layers in both the annual cycles were nearly the same in all the sites. The decrease in numbers from top to the bottom layers was seen only in sites C and D, while in sites A and B they fell and rose alternatively in different layers. The total ants comprised of 45 to 62% of the total insects and 30 to 50% of the total macrofauna and when these percentages were considered for different layers in different sites during two annual cycles, the trend was in reverse again in site D. They however followed a similar trend in sites A and B, but in site C they registered an increase in third layer. When total ants as percentages of total soil fauna were calculated, the percentage distributional pattern in the different layers for different sites during the period of study followed nearly a very similar trend as for the relative percentage of total ants under insects and macrofuana (Table-XXVIII).

The ants were subdivided further into its families, Myrmicinae, Ponerinae, Pseudomyrmioinae, Dorylinae and Dolichoderinae in that order of abundance. The family Myrmicinae was 30 to 40% of the total ants. Their numbers for the different layers in the different sites were consistent during the second annual cycle. Their actual numbers present in different layers decreased steadily for both the annual cycles from top to the bottom only in sites C and D. In site A there was a sudden increase in the second layer which fell thereafter till the bottom layer, while in site B there was an increase in third layer to levels as for the first layer. As the percentage of their occurrence in total ants they were seen to follow as in earlier cases a trend in the reverse with increasing percentages from top to the bottom layers in site D during both the annual cycles. In case of sites A, B and C these percentages were seen to be on the higher side at the bottom most fourth layer for both annual cycles when in all the sites the number registered were the least. When the family Myrmicinae was considered as the percentage of either the total insecta, macrofauna or the total soil fauna it was seen that they followed a trend in different layers as the family's own vertical distributional number for both the annual cycles in sites A, B and C. As usual in site D, these percentages were in reverse trend of increase from top to the bottom layers (Table-XXIX).

The next family in terms of abundance among ants was the family Ponerinae. This family also revealed a consistency of the number present in different layers for both the annual cycles in all the sites undertaken. In their vertical distribution, it was seen that in sites A and C the numbers fell and rose alternatively, while in site B there was a steady increase till the third layer with a drastic fall in the fourth. In site D there was an increase in the second layer though insignificant, it fell steadily thereafter. Ponerinae formed 7-14% of the total insecta and 20 to 30% of the total ants. These percentages when considered for different layers were seen to follow a trend similar to the actual numbers only in site B. In sites A and C a significant increase in the percentages was seen in the fourth layer only in case of their abundance in total macrofauna for both the annual cycles, when their abundance in total macrofauna for both the annual cycles when their numbers actually were the least. In site D there was slight increase in percentage for the third layer when their actual numbers were less than nearly 6% from the second layer. When this family Ponerinae was considered either as percentages of total insects, macrofauna and total soil fauna the trend in different layers in the different sites for both the annual cycles followed a similar pattern to the vertical distributional numbers in all the sites except in site D as usual, where the trend was in the reverse (Table-XXX).

The third family of abundance among ants was the family Pseudomyrmioinae which comprised 5-18% of the total insecta and 12-28% of the total ants. Their numbers in different layers were consistent for the second annual cycle as in the first annual cycle at the various sites except for sites A and C, where there was a fall and rise in the alternate layers in the vertical distribution of their numbers, the remaining two sites B and D showed a steady decrease from top to bottom layers for both the annual cycles. A trend similar to their vertical distributional numbers was also seen for relative percentage of this family either for total ants, total insects, macrofauna or total soil fauna in sites A and C only for both the annual cycles. In site B all these relative percentages showed an increase in the second layer and the fourth layer when the actual numbers were either less or same respectively in both the annual cycles. In site D, there was a usual trend in the reverse though significant after the second layer (Table-XXXI).

The family Dorylinae came next in importance after the family Pseudomyrmioinae and comprised of 3 to 8% of the insects and 3 to 4% of the total ants. The steady decrease in their numbers from top to the bottom layers in both the annual cycles were seen only in sites C and D. Site A showed an increase in second layer, which fell steadily thereafter while site B showed a fall and rise till the fourth layer. The relative percentages of this family Dorylinae either among total insects, total ants, macrofauna or total soil fauna revealed a trend in different layers similar to actual numbers present in all the sites except for the fourth layer of sites B, C and D where they registered a slight increase when the actual numbers were the same as in the third layer (Table-XXXII).

The family Dolichoderinae came last in importance among the ants and comprised of 3 to 10% of the total ants and 2 to 5% of the total insects. The numbers in the different soil layers fell steadily for top to the bottom layers in both the annual cycles only in site D, while in site C for the first annual cycle only. The increase in the second and third layers and a fall in the fourth layer was seen in the first annual cycle in site A and for the second annual cycle in site C. The fall and rise in the alternate layers was seen for both the annual cycles in site B and for the second annual cycle in site A. When this family's relative percentage of the total ants were considered, it was seen that they followed a trend of their vertical distributional numbers for the first annual cycle in all the four sites and in the second annual cycle only in sites C and D. In site A the fourth layer registered the maximum percentage as also in site B except that in the latter, the total trend was in the reverse for the second annual cycle. A trend similar to these relative percentages was nearly the same when Dolichoderinae relative percentage among macrofauna and total soil fauna was considered, except in site D where they revealed a trend in the reverse as usual. However, when the relative percentage was seen among the total insecta they showed the same trend as the other percentages in the first annual cycle and for the second annual cycle only in sites B and C, while in site A they followed the pattern as of the vertical distribution (Table-XXXIII).

Among the orders of insects, the order Coleoptera, comprised of 4 to 12%. The numbers in the different layers were found to be the same in the second annual cycle for the various sites. Further, there was a steady decrease in numbers from top to the bottom layers in all the sites. When their relative percentage of abundance in total insects, macrofauna and total soil fauna was considered the phenomenon of steady decrease in the different layers was seen only in second annual cycle in site B. In site A though there was a steady decrease till the third layer, there was a slight increase in the fourth layer, in their percentages for both the annual cycles, while in site D the trend was more or less

The order Diptera came next in terms of abundance after Coleoptera, forming 6-10% of the total insects. The steady decrease in numbers from top to the bottom layers was seen for all the sites for both the annual cycles except for the first annual cycle in site A. Further, again with the exception of the first annual cycle in site A, all the other sites revealed nearly the same numbers for the top two layers and also similar numbers for next two bottom layers. However, the relative percentage of the abundance of Diptera in the total insects, macrofauna and total soil fauna always registered an increase in percentage in the second layer in all sites for both the annual cycles, though the actual numbers present were nearly the same. This phenomenon was also true for the fourth layer when compared with the third and in most cases registering nearly the same or more than the first layer (Table-XXXV).

The order Hemiptera comprised 2 to 11% of the total insects. All the sites showed a decrease in numbers from top to the bottom layers for both the annual cycles except site A where there was a drastic increase in the second layer which though decreased steadily till the fourth, maintained a level far higher than the first layer. Moreover, the first and second layers for both the annual cycles registered nearly the same numbers in sites A, B and C. When the order Hemiptera was observed as the relative percentage abundance among total insects, macrofauna and total soil fauna, it was seen that they followed a trend similar to actual vertical distributional numbers except in the second and third layer in both the annual cycles in all the sites where they revealed an increase (Table-XXXVI).

The order Hymenoptera , are those recorded under this order except the ants. They formed 2 to 10% of the total insects. A steady decrease in their numbers from top to the bottom layers was seen for both the annual cycles, only in sites C and D while they increased in the second layer to fall in subsequent layers in sites A and B for both the annual cycles. When the relative percentage of abundance among total insects, macrofauna and total soil fauna were considered, it was seen that they followed a pattern similar to the distributional numbers except in the fourth layer for sites A, B and C, where they registered an increase for both the annual cycles. Moreover they showed an increase.in the second layer for site B for both the annual cycles also (Table-XXXVII).

The order Thysanoptera comprised of 3 to 7% of total insects. There was a steady decrease in their vertical numbers from top to the bottom in all the sites for both the annual cycles. However, when their relative percentages of abundance in total insects, macrofauna and total soil fauna were considered, it was seen that they revealed an increase in the fourth layer in all the sites for both the annual cycles and an increase in second layer in sites A, B and C. Further there was a steady decrease in the percentage from top to the bottom layers in contrast to their actual numbers (Table-XXXVIII).

The order Lepidoptera comprised of 2 to 7% of the total insects. The steady decrease in numbers from top to the bottom layers was seen only in site D. In sites A and B, though there was a decrease till the third layer for the first annual cycle in the former and for the both the annual cycles in the latter, there was a sudden increase in the fourth layer. In site A during the second annual cycle the increase was seen from third layer onward, while in site C there was an increase for the second layer which fell thereafter till the fourth layer in the second annual cycle, but showed a slight increase in the fourth layer during the first annual cycle. When the relative percentage of this order Lepidoptera was considered among the total insects, macrofauna and total soil fauna, they followed a trend similar to their actual numbers only in site A, while an increase was seen for the second layer in sites B and D for both the annual cycles and in the fourth layer in site D (Table-XXXIX).

Trichoptera came next in importance to Lepidoptera, comprising of 3 to 6% to the total insects. The steady decrease in numbers from top to the bottom layers was seen only in sites C and D for both the annual cycles. Site A showed an increase in second layer which fell after, while in site B there was an increase in the fourth layer. When their relative percentage of abundance as in total insects, macrofauna and total soil fauna was seen, they followed a trend similar to the vertical distributional numbers except for the fourth layer in all the sites in both annual cycles. While they registered an increase in third layer in sites B, C and D their numbers were more or less the same as for the second layer in both the annual cycles (Table-XL).

The order Orthoptera comprised of 1.5 to 6% of the total insects. The steady decrease or similar numbers from top to bottom layers as the vertical distributional numbers was seen for the first annual cycle in sites B, C and D, while an increase from top to the bottom layers was seen for both the annual cycles in site A, while there was a fall and rise in alternate layers during the second annual cycle in sites C and D. When the order Orthoptera was compared as the percentages of total insects, macrofauna or the total soil fauna, it was seen that there was a steady increase in their percentages from top to the bottom layers in all the sites for both the years (Table-XLI).

Order Dermaptera came last, comprising of 2 to 5% of the total insects. A steady decrease in their numbers from top to the bottom layers for both the annual cycles was seen only in sites C and D. In site A they showed an increase in second layer maintained it in third layer and fell in fourth, while in site B though there was a steady decrease till the third layer, an increase was registered in the fourth in both the annual cycles. When their relative percentage among total insects, macrofauna and total soil fauna was considered, it was seen that they followed a trend similar to their vertical distributional numbers, only in site B and that too quite obvious in the first annual cycle. These percentages registered an increased an increase in the third layer for both the annual cycles in sites A, C and D and for the second annual cycle in site B. Further, the fourth layer in sites B and D showed an increase in the second annual cycle (Table-XLII).

The major sub-division after insecta under macrofauna was made up of total myriapoda comprising of 12 to 22% of the total macrofauna. This group Myriapoda was further divided into Diplopoda, Symphyla and Chilopoda in that order of abundance. When considering total myriapoda, it was seen that their numbers in different soil layers at different sites decreased steadily from top to the bottom layers for both the annual cycles in all the sites except in site A. In site A, second layer registered an increase which fell thereafter. The same trend as their vertical distribution numbers was seen for the relative percentages of Myriapoda in macrofauna and in the total soil fauna in sites C and D for both the annual cycles and for the second annual cycle in site A. The latter site showed an increase in the fourth layer for the first annual cycle as also was seen for the fourth layer for both the annual cycles for site C (Table-XLIII).

TABLE IV

The total number mean of soil fauna, microfauna, mesofauna and macrofauna and their relative percentages annual mean for the total study period in the four different study sites at four different depths

Sites	Layers	Total Microfauna		Total Mesofauna		Total Macrofauna		Total Soil fauna
		a	b	a	b	a	b	a
A	I	388 (35.90)	6.53	3996 (29.60)	67.18	1564 (26.25)	26.29	5948 (28.96)
	II	364 (33.70)	6.34	3640 (26.97)	63.46	1732 (29.06)	30.20	2736 (27.93)
	III	148 (13.70)	3.08	3130 (23.19)	65.07	1532 (25.70)	31.85	4810 (23.42)
	IV	180 (16.67)	4.45	2732 (20.24)	67.56	1132 (18.99)	27.99	4044 (19.69)
B	I	236 (28.10)	4.43	3320 (30.86)	62.41	1764 (29.46)	33.15	5320 (30.25)
	II	184 (21.90)	4.19	2648 (24.62)	60.29	1560 (26.05)	35.52	4392 (24.98)
	III	220 (26.19)	5.14	2636 (24.51)	61.65	1420 (23.72)	33.21	4276 (24.32)
	IV	200 (23.81)	5.56	2152 (20.01)	59.84	1244 (20.77)	34.59	3596 (20.45)
C	I	344 (31.50)	5.33	3932 (32.47)	60.98	2172 (32.61)	33.68	6448 (32.47)
	II	308 (28.21)	6.08	3016 (24.91)	59.51	1744 (26.19)	34.41	5068 (25.52)
	III	240 (21.97)	5.25	2820 (23.29)	61.90	1496 (22.46)	32.84	4556 (22.94)
	IV	200 (18.32)	5.27	2340 (19.33)	61.77	1248 (18.74)	32.95	3788 (19.07)
D	I	396 (34.86)	5.31	4424 (32.71)	59.30	2640 (33.90)	35.39	7460 (33.23)
	II	380 (33.45)	5.99	3736 (27.62)	58.89	2228 (28.61)	35.12	6344 (28.26)
	III	208 (18.31)	4.43	2860 (21.15)	61.00	1620 (20.80)	34.60	4688 (20.89)
	IV	152 (13.38)	3.84	2504 (18.52)	63.30	1300 (16.69)	32.86	3956 (17.62)

a : Numbers and percentages among themselves
b : Percentages in total soil fauna
I : 0-10 cms Soil layer
II : 10-20 cms Soil layer
III : 20-30 cms Soil layer
IV : 30-40 cms Soil layer

TABLE V

The total number of Prostigmata and its relative percentages annual mean for the study period in the four different study sites at four different depths.

TABLE VI

The total number of Protozoa and its relative percentages annual mean for the study period in the four different study sites at four different depths.

a	b	c	Sites	a	b	c
356 (37.08)	91.75	5.99	A	32 (26.67)	8.25	0.54
336 (35.00)	92.30	5.85		28 (23.33)	7.70	0.49
116 (12.08)	78.38	2.41		32 (26.67)	21.62	0.67
152 (15.84)	84.44	3.76		28 (23.33)	15.56	0.69
204 (28.98)	86.44	3.83	B	32 (23.53)	13.57	0.60
152 (21.59)	82.61	3.46		32 (23.53)	17.39	0.73
184 (26.14)	83.64	4.30		36 (26.47)	16.36	0.84
164 (23.30)	82.00	4.56		36 (26.47)	18.00	1.00
312 (32.50)	90.70	4.84	C	32 (24.24)	9.30	0.49
276 (28.75)	89.61	5.45		32 (24.24)	10.39	0.63
212 (22.08)	88.33	4.64		28 (21.21)	11.67	0.61
160 (16.67)	88.00	4.22		40 (30.30)	20.00	1.05
352 (35.20)	88.89	4.72	D	44 (32.35)	11.11	0.59
348 (34.80)	91.58	5.49		32 (23.53)	8.42	0.50
176 (17.60)	84.61	3.75		32 (23.53)	15.38	0.68
124 (12.40)	81.58	3.13		28 (20.59)	18.42	0.71

a : Numbers and Percentages among themselves
b : Percentages in microfauna
c : Percentages in total soil fauna

TABLE VII

The total number of Flagellate and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE VIII

The total number of Ciliate. and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
20 (26.32)	62.50	5.16	0.34	A	8 (28.57)	25.00	2.06	0.13
20 (26.32)	71.42	5.49	0.35		4 (14.29)	14.29	1.11	0.07
20 (26.32)	62.50	13.51	0.42		8 (28.57)	25.00	5.41	0.17
16 (21.05)	57.14	8.90	0.40		8 (28.57)	28.57	4.40	0.20
20 (25.00)	62.50	8.47	0.37	B	8 (20.00)	25.00	3.39	0.15
20 (25.00)	62.50	10.87	0.46		8 (20.00)	25.00	4.35	0.18
20 (25.00)	55.56	9.09	0.47		12 (30.00)	33.33	5.45	0.28
20 (25.00)	55.56	10.00	0.56		12 (30.00)	33.33	6.00	0.33
20 (21.74)	62.50	5.81	0.31	C	8 (25.00)	25.00	2.33	0.12
20 (21.74)	62.50	6.49	0.39		8 (25.00)	25.00	2.60	0.16
20 (21.74)	71.47	8.33	0.44		8 (25.00)	28.57	3.33	0.18
32 (34.78)	80.00	16.00	0.84		8 (25.00)	20.07	4.00	0.21
32 (34.78)	72.73	8.08	0.43	D	8 (25.00)	18.18	2.02	0.11
20 (21.74)	62.50	5.26	0.31		8 (25.00)	25.00	2.11	0.13
20 (21.74)	62.50	9.62	0.43		8 (25.00)	25.00	3.85	0.17
20 (21.74)	71.43	13.16	0.51		8 (25.00)	28.57	5.26	0.20

a : Number and percentages among themselves

b : Percentages in Protozoa

c : Percentages in Microfauna

d : Percentages in Total soil fauna

TABLE IX

The total number of Amoebae and its relative percentage annual mean for the total study period in the four different sites at four diffenret depths.

TABLE X

The total number of Collembola and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c
4 (25.00)	12.50	1.03	0.07	A	1700 (27.87)	42.54	28.58
4 (25.00)	14.29	1.10	0.07		1604 (26.30)	44.06	27.96
4 (25.00)	12.50	2.70	0.08		1400 (22.95)	44.73	29.11
4 (25.00)	14.29	2.22	0.10		1396 (22.88)	51.09	34.52
4 (25.00)	12.50	1.69	0.08	B	1392 (35.51)	41.93	26.17
4 (25.00)	12.50	2.17	0.09		940 (23.98)	35.50	21.40
4 (25.00)	11.11	1.82	0.09		916 (23.37)	34.75	21.42
4 (25.00)	11.11	2.00	0.11		672 (17.14)	31.23	18.69
4 (50.00)	12.50	1.16	0.06	C	1580 (34.61)	40.18	24.50
4 (50.00)	12.50	1.30	0.09		1192 (26.12)	39.52	23.52
0 (00.00)	00.00	0.00	0.00		1008 (22.09)	35.74	22.12
0 (00.00)	00.00	0.00	0.00		784 (17.18)	33.50	20.70
4 (33.33)	9.09	1.01	0.05	D	1664 (31.88)	37.61	22.31
4 (33.33)	12.50	1.05	0.06		1368 (26.20)	36.61	21.56
4 (33.33)	12.50	1.92	0.08		1212 (23.22)	42.38	25.85
0 (00.00)	00.00	0.00	0.00		976 (18.70)	38.98	24.67

a : Number and percentages among themselves
b : Percentages in Protozoa
c : Percentages in Microfauna
d : Percentages in Total soil fauna

a : Number and percentages among themselves
b : Percentages in Mesofauna
c : Percentages in Total fauna

TABLE XI

The total number of Family Entomobryidae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XII

The total number of Family Hypogastruidae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
748 (29.40)	44.00	18.72	12.58	A	488 (26.87)	28.71	12.20	8.20
660 (25.94)	41.15	18.13	11.51		488 (26.87)	30.42	13.41	8.51
592 (23.28)	42.29	18.91	12.31		428 (23.57)	30.57	13.67	8.00
544 (25.44)	38.97	19.91	12.39		412 (22.69)	29.51	15.08	10.20
556 (34.24)	39.94	16.75	10.45	B	376 (34.06)	27.01	11.33	7.07
424 (26.10)	45.11	16.01	9.65		260 (23.55)	27.66	9.82	5.92
384 (23.65)	41.92	14.57	8.98		272 (24.64)	29.69	10.32	6.36
260 (16.01)	38.69	12.08	7.23		196 (17.75)	29.17	9.11	5.45
656 (34.53)	41.52	16.68	10.17	C	428 (34.08)	27.09	10.89	6.64
488 (25.68)	40.94	16.18	9.63		332 (26.43)	27.85	11.00	6.05
428 (22.53)	42.46	15.18	9.39		272 (21.66)	26.98	9.64	5.97
328 (17.26)	41.83	14.02	8.66		224 (17.82)	28.57	9.57	5.91
668 (32.36)	40.15	15.10	8.95	D	432 (30.77)	25.96	9.76	5.79
536 (25.97)	39.18	14.35	8.45		380 (27.07)	27.77	10.17	5.99
484 (23.45)	39.94	16.92	10.32		320 (22.79)	26.40	11.19	6.83
376 (18.22)	38.53	15.02	9.50		272 (19.37)	27.87	10.86	6.88

a : Numbers and percentages among themselves

b : Percentages in Collembola

c : Percentages in Mesofauna

d : Percentages in Total soil fauna

TABLE XIII

The total number of Family Sminthuridae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XIV

The total number of Family Isotomidae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
304 (28.15)	17.88	7.61	5.11	A	160 (21.05)	9.41	4.00	2.69
288 (26.67)	17.96	7.91	5.02		168 (22.11)	10.47	4.62	2.93
244 (22.59)	17.43	7.80	5.07		136 (38.95)	9.71	4.35	2.82
244 (22.59)	17.48	8.93	6.04		196 (38.95)	14.04	7.17	4.85
248 (33.33)	17.82	7.47	4.66	B	212 (47.32)	15.23	6.39	3.98
176 (23.66)	18.72	6.65	4.01		80 (17.86)	8.51	3.02	1.82
184 (24.73)	20.09	6.98	4.00		76 (16.96)	8.30	2.88	1.78
136 (18.28)	20.24	6.32	3.78		80 (17.86)	11.90	3.72	2.22
304 (36.71)	19.24	7.73	4.71	C	192 (33.10)	12.15	4.88	2.98
224 (27.05)	18.79	7.43	4.42		148 (25.52)	12.42	4.91	2.92
188 (22.71)	18.65	6.66	4.13		120 (20.69)	11.91	4.26	2.63
112 (13.53)	14.29	4.79	2.96		120 (20.69)	15.31	5.13	3.17
352 (34.78)	21.15	7.96	4.72	D	212 (28.65)	12.74	4.79	2.84
260 (25.69)	19.01	6.96	4.10		192 (25.95)	14.04	5.14	3.03
240 (23.72)	19.80	8.39	5.12		168 (22.70)	13.86	5.87	3.58
160 (15.81)	16.39	6.39	4.04		168 (22.70)	17.21	6.71	4.25

a : Numbers and percentages among themselves

b : Percentage in Collembola

c : Percentage in Mesofauna

d : Percentage in Total soil fauna

TABLE XV

The total number of Acarina and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XVI

The total number of Mesostigmata and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c	d
1364 (32.64)	34.13	22.93	A	592 (30.02)	43.40	14.81	9.95
1208 (28.64)	33.19	21.06		520 (26.37)	43.05	14.29	9.07
954 (22.62)	30.48	19.83		436 (22.11)	45.70	13.93	9.06
692 (16.40)	25.33	17.11		424 (21.50)	61.27	15.52	10.50
928 (28.12)	27.95	17.44	B	404 (28.29)	43.53	12.17	7.59
692 (20.97)	26.13	15.76		340 (23.81)	49.13	12.84	7.74
852 (25.82)	32.32	19.93		336 (23.53)	39.44	12.75	7.86
838 (25.09)	38.48	23.03		348 (24.37)	42.03	16.17	9.68
1069 (29.02)	27.87	17.00	C	524 (30.04)	47.81	13.13	8.13
956 (25.32)	31.70	18.86		464 (26.60)	48.52	13.38	9.16
916 (24.26)	32.48	20.11		376 (21.56)	41.05	13.33	8.52
808 (21.40)	34.53	21.33		380 (21.79)	47.03	16.24	10.03
1180 (32.31)	26.67	15.82	D	532 (31.89)	45.08	12.03	7.13
1040 (28.48)	27.84	16.39		408 (24.47)	39.23	10.92	6.43
720 (19.72)	25.17	15.36		360 (21.58)	50.00	12.59	7.68
712 (19.49)	28.43	18.00		368 (22.06)	51.69	14.70	9.30

a : Numbers and percentages among themselves
b : Percentages in mesofauna
c : Percentages in Total soil fauna

a : Numbers and percentages among themselves
b : Percentages in Acari
c : Percentages in mesofauna
d : Percentages in Total soil fauna

TABLE XVII

The total number of Cryptostigmata and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XVIII

The total number of Astigmata and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
460 (30.96)	33.73	11.51	7.73	A	312 (41.06)	22.87	7.81	5.25
408 (27.46)	33.77	11.21	7.11		280 (36.84)	23.18	7.69	4.88
458 (30.82)	48.01	14.63	9.52		60 (7.89)	6.29	1.92	1.25
160 (10.76)	23.12	5.86	3.96		108 (14.21)	15.61	3.95	2.67
352 (25.43)	37.93	10.60	6.62	B	172 (35.25)	18.53	5.18	3.23
280 (20.23)	40.46	10.57	6.38		72 (14.75)	10.40	2.72	1.64
392 (28.33)	46.10	14.87	9.17		124 (25.41)	14.55	4.70	2.90
360 (26.01)	43.48	16.73	10.01		120 (24.59)	14.49	5.58	3.34
364 (27.00)	33.21	9.26	5.65	C	208 (30.42)	18.98	5.29	3.23
316 (23.44)	33.05	10.48	6.24		176 (25.73)	18.41	5.84	3.47
344 (25.52)	37.55	12.20	7.55		196 (28.65)	21.40	6.95	4.30
324 (24.04)	40.10	13.85	8.55		104 (15.20)	12.87	4.44	2.75
472 (33.24)	40.00	10.67	6.33	D	176 (31.21)	14.92	3.98	2.36
416 (29.30)	40.00	11.13	6.56		216 (38.29)	20.77	5.78	2.40
308 (21.69)	42.77	10.77	6.57		52 (9.22)	7.22	1.82	1.11
224 (15.77)	31.46	8.95	5.66		120 (21.28)	16.85	4.79	3.03

a : Numbers and percentages among themselves

b : Percentages in Acari

c : Percentages in mesofauna

d : Percentages in Total soil fauna

TABLE XIX

The total number of Araneida and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XX

The total number of Family Clubionidae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c	d
532 (27.77)	13.31	8.94	A	248 (25.94)	46.62	6.21	4.17
488 (25.47)	13.41	8.51		248 (25.94)	50.82	6.81	4.32
492 (25.68)	15.72	10.23		256 (26.78)	52.03	8.18	5.32
404 (21.08)	14.79	9.99		204 (21.34)	50.50	7.47	5.04
572 (26.93)	17.23	10.75	B	308 (28.10)	55.85	9.28	5.79
596 (78.11)	22.51	13.57		288 (26.28)	48.32	10.88	6.56
500 (23.58)	18.97	11.69		244 (22.26)	48.80	9.26	5.71
452 (21.33)	21.00	12.57		256 (23.36)	56.64	11.90	7.12
772 (32.28)	19.63	11.97	C	388 (32.33)	50.26	9.87	6.02
528 (22.07)	17.51	10.42		248 (20.67)	46.97	8.22	4.89
576 (24.08)	20.43	12.64		320 (26.67)	55.56	11.35	7.02
516 (21.57)	22.05	13.62		244 (20.33)	47.29	10.43	6.44
936 (33.14)	22.16	12.55	D	412 (30.56)	44.02	9.31	5.52
768 (27.20)	20.56	12.11		372 (27.60)	48.44	9.96	5.86
596 (21.10)	20.84	12.74		296 (21.96)	49.66	10.35	6.31
524 (18.56)	20.93	13.25		268 (19.88)	51.15	10.70	6.77

a : Number and percentages among themselves
b : Percentages in total mesofauna
c : Percentages in total soil fauna

a : Number and percentages among themselves
b : Percentages in Araneida
c : Percentages in total mesofauna
d : Percentage in Total soil fauna

TABLE XXI

The total number of family Lycocidae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XXII

The total number of family Linyphidae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
212 (43.80)	39.85	5.31	3.56	A	72 (15.13)	13.53	1.80	1.21
104 (21.49)	21.31	2.86	1.81		136 (28.57)	27.87	3.74	2.37
100 (20.66)	20.33	3.19	2.08		136 (28.57)	27.64	4.35	2.83
68 (14.05)	16.83	2.49	1.68		132 (27.73)	32.67	4.83	3.27
104 (26.80)	18.18	3.13	1.95	B	160 (25.16)	27.97	4.82	3.01
128 (32.99)	21.48	4.83	2.91		180 (28.30)	30.20	6.80	4.10
84 (21.65)	16.80	3.19	1.96		172 (27.04)	34.40	6.53	4.02
72 (18.56)	15.93	3.35	2.00		124 (19.50)	27.43	5.76	3.45
168 (36.84)	21.76	4.27	2.61	C	216 (29.35)	27.98	5.49	3.35
92 (20.18)	17.42	3.05	1.82		188 (25.54)	35.61	6.23	3.71
104 (22.80)	18.06	3.69	2.28		152 (20.65)	26.39	5.39	3.34
92 (20.18)	17.83	3.93	2.43		180 (24.46)	34.88	7.69	4.75
200 (37.59)	21.37	4.52	2.68	D	324 (36.99)	34.62	7.32	4.34
128 (24.06)	16.67	3.32	1.95		268 (27.24)	34.90	7.17	4.22
96 (18.05)	16.11	3.36	2.05		204 (20.73)	34.23	7.13	4.35
108 (20.30)	20.61	4.31	2.73		148 (15.04)	28.24	5.91	3.74

a : Number and percentage among themselves
b : Percentages in Araneida
c : Percentages in total mesofauna
d : Percentages in Total soil fauna

TABLE XXIII

The total number of Protura and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XXIV

The total number of Diplura and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c
176 (34.11)	4.40	2.96	A	140 (33.65)	3.50	2.35
152 (29.46)	4.18	2.65		108 (25.96)	2.97	1.88
100 (19.38)	3.19	2.08		100 (24.04)	3.19	2.08
88 (17.05)	3.22	2.18		68 (16.35)	2.49	1.68
180 (32.61)	5.42	3.38	B	164 (31.54)	4.94	3.08
184 (33.33)	6.95	4.19		148 (28.46)	5.59	3.37
136 (24.69)	5.16	3.18		144 (27.69)	5.46	3.37
52 (9.42)	2.42	1.45		64 (12.31)	2.97	1.78
220 (40.44)	5.60	3.41	C	180 (35.72)	4.58	2.79
124 (22.79)	4.11	2.45		136 (26.98)	4.51	2.68
120 (22.06)	4.26	2.63		120 (23.81)	4.26	2.63
80 (14.71)	3.42	2.11		68 (13.49)	2.91	1.80
308 (38.12)	6.96	4.13	D	256 (36.36)	5.79	3.43
264 (32.67)	7.07	4.16		216 (30.68)	5.78	3.40
116 (14.36)	4.06	2.47		136 (19.32)	4.76	2.90
120 (14.85)	4.79	3.03		96 (13.64)	3.83	2.43

a : Numbers and percentages among themselves
b : Percentages in mesofauna
c : Percentages in Total soil fauna

TABLE XXV

The total number of Chelonethii and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XXVI

The total number of Isopoda and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c
60 (25.42)	1.52	1.01	A	24 (25.00)	0.60	0.40
56 (23.74)	1.54	0.98		24 (25.00)	0.66	0.42
60 (25.42)	1.92	1.25		24 (25.00)	0.77	0.50
60 (25.42)	2.20	1.48		24 (25.00)	0.88	0.59
60 (24.19)	1.81	1.13	B	24 (25.00)	0.72	0.45
64 (25.81)	2.42	1.46		24 (25.00)	0.91	0.55
64 (25.81)	2.43	1.50		24 (25.00)	0.91	0.56
60 (24.19)	2.79	1.67		24 (25.00)	1.12	0.67
60 (25.86)	1.53	0.93	C	24 (25.00)	0.61	0.37
56 (24.13)	1.86	1.10		24 (25.00)	0.80	0.47
56 (24.14)	1.99	1.23		24 (25.00)	0.85	0.53
60 (25.86)	2.56	1.58		24 (25.00)	1.03	0.63
60 (25.00)	1.36	0.80	D	20 (26.30)	0.45	0.27
60 (25.00)	1.61	0.95		20 (26.30)	0.54	0.32
60 (25.00)	2.10	1.28		20 (26.32)	0.70	0.43
60 (25.00)	2.40	1.52		16 (21.05)	0.64	0.40

a : Number and percentages among themselves

b : Percentages in mesofauna

c : Percentages in Total soil fauna

TABLE XXVII

The total number of insects its relative percentages annual mean for the total study period in the four different depths.

TABLE XXVIII

The total number of ants and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c	d
1168 (25.17)	74.68	19.64	A	632 (27.15)	54.11	40.41	10.63
1324 (28.53)	76.44	23.08		628 (26.98)	47.43	36.26	10.95
1260 (27.16)	82.25	26.20		704 (30.24)	55.87	45.95	14.64
888 (19.14)	78.45	21.96		364 (15.63)	40.99	32.16	9.00
1300 (29.44)	73.70	24.44	B	640 (29.63)	49.23	36.28	12.03
1140 (25.82)	73.08	25.96		532 (24.63)	46.67	34.10	12.11
1060 (24.00)	74.65	24.79		572 (26.48)	53.96	40.28	13.38
916 (20.74)	73.63	25.47		416 (19.26)	45.41	33.44	11.57
1680 (32.92)	77.35	26.05	C	972 (33.20)	57.86	44.75	15.07
1324 (25.94)	75.92	26.12		716 (24.45)	54.08	41.06	14.12
1132 (22.18)	75.67	24.85		692 (23.63)	61.13	46.26	15.19
968 (18.97)	77.56	25.55		548 (18.72)	56.61	43.91	14.47
2048 (33.20)	77.58	27.45	D	1196 (32.60)	58.40	45.30	16.03
1732 (28.08)	77.74	27.30		1024 (27.92)	59.12	45.96	16.14
1312 (21.27)	80.99	27.99		772 (21.05)	58.85	47.65	16.47
1076 (17.44)	82.77	27.20		676 (18.43)	62.83	52.00	17.08

a : Number and percentages among themselves
b : Percentages in total macrofauna
c : Percentages in total soil fauna

a : Number and percentages among themselves
b : Percentages in total insects
c : Percentages in macrofauna
d : Percentages in total soil fauna

TABLE XXIX

The total number of family Myrmicinae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

Sites	a	b	c	d	e
A	228 (25.79)	36.08	19.52	14.58	3.83
	276 (31.22)	43.95	20.85	15.94	4.81
	236 (26.70)	33.52	18.73	15.40	4.91
	114 (16.29)	39.56	16.22	12.72	3.56
B	240 (27.91)	37.50	18.46	13.61	2.71
	192 (22.33)	36.09	16.84	12.31	4.37
	244 (28.37)	42.66	23.02	17.18	5.71
	184 (21.39)	44.23	20.09	14.79	5.12
C	364 (33.09)	37.45	21.67	16.76	5.65
	296 (26.91)	41.34	22.36	16.97	5.84
	240 (21.82)	34.68	21.20	16.04	5.27
	200 (18.18)	36.30	20.66	16.03	5.28
D	376 (30.13)	31.44	18.36	14.24	5.04
	344 (27.56)	33.59	19.86	15.44	5.42
	280 (22.44)	36.27	21.34	17.28	5.97
	248 (19.87)	36.69	23.05	19.08	6.27

a : Number and percentages among themselves
b : Percentages in total Ants
c : Percentages in total Insecta
d : Percentages in total Macrofauna
e : Percentages in total Soil fauna

TABLE XXX

The total number of family Ponerinae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

Sites	a	b	c	d	e
A	140 (25.93)	22.15	11.99	8.95	2.35
	120 (22.22)	19.11	9.06	6.93	2.09
	160 (30.37)	23.20	13.02	10.70	3.41
	116 (21.48)	31.87	13.06	10.25	2.87
B	144 (25.71)	22.50	11.08	8.16	2.71
	164 (29.29)	30.83	14.39	10.50	3.73
	172 (30.71)	30.07	16.23	12.11	4.02
	80 (14.29)	19.23	8.73	6.43	2.22
C	228 (31.49)	23.46	13.57	10.50	3.54
	168 (23.21)	23.46	12.69	9.63	3.31
	180 (24.86)	26.01	15.90	12.03	3.95
	148 (20.44)	27.00	15.29	11.86	3.91
D	240 (29.13)	20.07	11.72	9.09	3.22
	244 (29.61)	23.83	14.09	10.95	3.85
	192 (23.30)	24.87	14.63	11.85	4.10
	148 (17.96)	21.89	13.75	11.38	3.74

a : Number and percentages among themselves
b : Percentages in total Ants
c : Percentages in total Insects
d : Percentages in total Macrofauna
e : Percentages in total Soil fauna

TABLE XXXI

The total number of family Pseudomyrmicinae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

Sites	a	b	c	d	e
A	124 (29.52)	19.62	10.62	7.93	2.08
	76 (18.10)	12.10	5.74	4.39	1.32
	164 (39.05)	23.30	13.02	10.70	3.41
	56 (13.33)	15.38	6.31	4.95	1.39
B	148 (29.13)	23.13	11.38	8.39	2.78
	144 (28.35)	27.07	12.63	9.23	3.28
	108 (21.26)	18.08	10.19	7.61	2.53
	108 (21.26)	25.96	11.79	8.68.	3.00
C	204 (29.31)	20.99	12.14	9.39	3.16
	168 (24.14)	23.46	12.69	9.63	3.31
	188 (27.01)	27.17	16.61	12.57	4.13
	136 (19.54)	24.82	14.05	10.90	3.59
D	308 (32.22)	25.75	15.04	11.67	4.13
	252 (26.36)	24.61	14.55	11.31	3.97
	212 (21.34)	27.46	16.16	13.09	4.52
	192 (20.08)	28.40	17.84	14.77	4.84

a : Number and Percentages among themselves
b : Percentages in total Ants
c : Percentages in total Insects
d : Percentages in total Macrofauna
e : Percentages in total Soil fauna

TABLE XXXII

The total number of family Dorylineae and its relative percentages annual mean for the total study period in the four different sites at four different depths.

Sites	a	b	c	d	e
A	76 (29.23)	12.03	2.51	4.86	1.28
	88 (33.85)	14.01	6.65	5.08	1.53
	72 (27.69)	10.23	5.71	4.70	1.50
	24 (9.23)	6.59	2.70	2.12	0.59
B	56 (46.66)	8.75	4.31	3.17	1.05
	16 (13.33)	3.01	1.40	1.03	0.36
	24 (20.00)	4.20	2.26	1.69	0.56
	24 (20.00)	5.77	2.62	1.93	0.67
C	112 (45.16)	11.52	6.67	5.16	1.74
	48 (19.36)	6.70	3.63	2.75	0.95
	48 (19.36)	6.94	4.24	3.21	1.05
	40 (16.13)	7.30	4.13	3.21	1.06
D	160 (43.96)	13.38	7.81	6.06	2.14
	104 (29.67)	10.16	6.00	4.67	1.64
	48 (13.18)	6.22	3.66	2.96	1.02
	48 (13.19)	7.10	4.46	3.69	1.21

a : Number and percentages among themselves
b : Percentage in total Ants
c : Percentage in total Insects
d : Percentage in total Macrofauna
e : Percentage in total Soil Fauna

TABLE XXXIII

The total number of family Dolichoderinae and its relative percentages annual mean for the four different sites of four different depths.

TABLE XXXIV

The total number of Coleoptera end its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	e	Sites	a	b	c	d
64 (28.57)	10.13	5.48	4.09	1.08	A	140 (35.00)	11.99	8.95	2.33
68 (30.36)	10.83	5.14	3.93	1.19		108 (27.00)	8.16	6.24	1.88
68 (30.36)	9.66	5.40	4.44	1.41		76 (19.00)	6.03	4.96	1.58
24 (10.71)	6.59	2.70	2.12	0.59		76 (19.00)	8.56	6.71	1.88
52 (46.43)	8.13	4.00	2.95	0.98	B	140 (29.66)	10.77	7.94	2.64
16 (14.29)	3.01	1.40	1.03	0.36		128 (27.12)	11.23	8.21	2.91
24 (21.43)	4.20	2.26	1.69	0.56		108 (22.88)	10.19	7.61	2.53
20 (17.85)	4.81	2.13	1.61	0.56		96 (20.34)	10.48	7 72	2.67
64 (41.02)	6.58	3.81	2.95	0.99	C	136 (30.09)	8.10	6.26	2.11
36 (23.08)	5.03	2.72	2.06	0.71		124 (27.43)	9.37	7.11	2.45
36 (23.08)	5.20	3.18	2.41	0.79		96 (21.24)	8.48	6.42	2.11
24 (12.82)	4.38	2.48	1.92	0.63		96 (21.24)	9.92	7.69	2.53
112 (42.43)	9.36	5.47	4.24	1.50	D	188 (36.72)	9.18	7.12	2.52
80 (30.30)	7.81	4.62	3.59	1.26		140 (27.34)	8.08	6.28	2.21
40 (15.15)	5.18	3.05	2.47	0.85		140 (27.34)	10.67	8.64	2.99
40 (12.12)	5.92	3.72	3.08	1.01		44 (8.59)	4.09	3.38	1.11

a : Number and percentages among themselves
b : Percentages in total Ants
c : Percentages in total Insects
d : Percentages in total Macrofauna
e : Percentages in total Soil fauna

a : Number and percentages among themselves
b : Percentages in total Insects
c : Percentages in total Macrofauna
d : Percentages in total Soil fauna

TABLE XXXV

The total number of Diptera and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XXXVI

The total number of Hemiptera and its relative percentages annual mean for the total study period in the four different depths.

a	b	c	d	Sites	a	b	c	d
80 (24.69)	6.85	5.12	1.34	A	80 (18.87)	6.85	5.12	1.34
100 (30.86)	7.55	5.77	1.74		132 (31.13)	9.97	7.62	2.30
80 (24.69)	6.35	5.22	1.66		108 (25.47)	8.57	7.05	2.25
64 (19.75)	7.21	5.65	1.58		104 (24.53)	11.71	9.19	2.57
112 (31.11)	8.62	6.35	2.11	B	80 (27.77)	6.15	4.54	1.50
112 (31.11)	9.82	7.18	2.55		80 (27.77)	7.02	5.13	1.82
68 (18.69)	6.42	4.79	1.59		64 (22.23)	6.04	4.50	1.50
68 (18.89)	7.42	5.47	1.89		64 (22.23)	6.99	5.14	1.78
108 (30.00)	6.43	4.97	1.67	C	84 (28.38)	5.00	3.87	1.30
108 (30.00)	8.16	6.19	2.13		84 (28.38)	6.34	4.82	1.66
76 (21.11)	6.71	5.08	1.67		64 (21.62)	5.65	4.28	1.40
68 (18.89)	7.02	5.45	1.81		64 (21.62)	6.61	5.13	1.69
136 (30.09)	6.64	5.15	1.82	D	120 (36.14)	5.86	4.55	1.61
136 (30.09)	7.85	6.10	2. 14		100 (30.12)	5.77	4.49	1.58
92 (20.35)	7.01	5.68	2.14		56 (16.87)	4.27	3.46	0.98
88 (19.47)	8.18	6.77	2.22		56 (16.87)	5.20	4.31	1.42

a : Number and percentages among themselves

b : Percentages in total insects

c : Percentages in macrofauna

d : Percentages in total soil fauna

TABLE XXXVII

The total number of Hymenoptera and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XXXVIII

The total number of Thysanoptera and its relative percentage annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
24 (7.06)	2.05	1.53	0.40	A	64 (32.00)	5.48	4.09	1.08
136 (40.00)	10.27	7.85	2.37		64 (32.00)	4.83	3.70	1.12
92 (27.06)	7.30	6.01	1.91		36 (18.00)	2.86	2.35	0.75
88 (25.88)	9.91	7.77	2.18		36 (18.00)	4.05	3.18	0.89
48 (26.09)	3.69	2.72	0.90	B	64 (26.66)	4.92	3.63	1.20
56 (30.43)	4.91	3.59	1.28		64 (26.66)	5.61	4.10	1.46
40 (21.74)	3.77	2.82	0.94		60 (25.00)	5.66	4.23	1.40
40 (21.74)	4.37	3.22	1.11		52 (21.68)	5.68	4.18	1.45
76 (37.25)	4.52	3.50	1.18	C	64 (34.04)	3.81	2.95	0.99
64 (31.37)	4.83	3.67	1.26		52 (27.66)	3.93	2.98	1.03
32 (15.69)	2.83	2.14	0.70		40 (21.28)	3.53	2.67	0.88
32 (15.69)	3.31	2.56	0.85		32 (17.02)	3.31	2.56	0.84
100 (34.72)	4.88	3.79	1.34	D	64 (32.65)	3.13	2.42	0.86
84 (29.17)	4.85	3.77	1.32		52 (26.53)	3.00	2.33	0.82
64 (22.22)	4.88	3.95	1.37		40 (20.41)	3.05	2.47	0.85
40 (13.89)	3.72	3.08	1.01		40 (20.41)	3.72	3.08	1.01

a : Number and percentages among themselves

b : Percentages in total insects

c : Percentages in macrofauna

d : Percentages in total soil fauna

TABLE XXXIX

The total number of Lepidoptera and iterrelative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XL

The total number of Trichoptera and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
40 (23.81)	3.42	2.56	0.67	A	52 (23.21)	4.45	3.32	0.87
36 (21.43)	2.72	2.08	0.63		60 (26.79)	4.53	3.46	1.05
44 (26.19)	5.41	4.24	1.19		56 (25.00)	4.44	3.66	1.16
48 (28.57)	5.41	4.24	1.19		56 (25.00)	6.31	4.95	1.39
60 (28.30)	4.62	3.40	1.13	B	72 (31.58)	5.54	4.08	1.35
60 (20.30)	5.26	3.85	1.37		48 (21.05)	4.21	3.08	1.09
44 (20.75)	4.15	3.10	1.03		48 (21.05)	4.53	3.38	1.12
48 (22.64)	5.24	3.86	1.33		60 (26.32)	6.55	4.82	1.67
48 (29.27)	2.86	2.21	0.74	C	108 (39.13)	6.43	4.97	1.67
56 (34.15)	4.23	3.21	1.10		56 (20.29)	4.23	3.21	1.10
28 (17.07)	2.47	1.87	0.61		56 (20.29)	4.95	3.74	1.23
32 (19.51)	3.31	2.56	0.84		56 (20.29)	5.79	4.49	1.48
64 (37.21)	3.13	2.42	0.86	D	96 (34.78)	4.69	3.64	1.29
60 (34.88)	3.46	2.69	0.95		68 (24.64)	3.93	3.05	1.07
24 (13.95)	1.83	1.48	0.53		60 (21.74)	4.57	3.70	1.28
24 (13.95)	2.23	1.85	0.63		52 (18.84)	4.83	4.00	1.31

a : Number and percentages among themselves

b : Percentages in total insects

c : Percentages in macrofauna

d : Percentages in total soil fauna

TABLE XLI

The total number of Orthopotor and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XLII

The total number of Dermaptera and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
24 (23.08)	2.05	1.53	0.40	A	32 (25.81)	2.74	2.05	0.54
24 (23.08)	1.81	1.39	0.42		36 (29.03)	2.72	2.08	0.63
28 (26.92)	2.22	1.83	0.58		36 (25.81)	2.86	2.35	0.75
28 (26.92)	3.15	2.47	0.69		24 (19.35)	2.70	2.12	0.59
36 (7.27)	2.77	2.04	0.68	B	48 (34.29)	3.69	2.72	0.90
32 (4.24)	2.81	2.05	0.73		28 (20.00)	2.46	1.79	0.64
32 (24.24)	3.02	2.25	0.75		24 (17.14)	2.26	1.69	0.56
32 (24.24)	3.49	2.57	0.89		40 (28.57)	4.37	3.22	1.11
32 (33.33)	1.90	1.47	0.50	C	52 (37.14)	3.00	2.39	0.81
32 (33.33)	2.42	1.83	0.63		32 (22.86)	2.42	1.83	0.63
16 (16.16)	1.41	1.07	0.35		32 (22.86)	2.83	2.14	0.70
16 (16.16)	1.65	1.28	0.42		24 (17.14)	2.48	1.92	0.63
28 (25.00)	1.37	1.06	0.38	D	56 (35.00)	2.37	2.12	0.75
28 (25.00)	1.62	1.26	0.44		40 (25.00)	2.31	1.80	0.63
28 (25.00)	2.13	1.73	0.60		36 (22.50)	2.74	2.22	0.77
28 (25.00)	2.60	2.15	0.71		28 (17.50)	2.60	2.15	0.71

a : Numbers and percentages among themselves

b : Percentages in total insects

c : Percentages in macrofauna

d : Percentages in total soil fauna

TABLE XLIII

The total number of Myriapoda and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XLIV

The total number of Diplopoda and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c	d
316 (29.92)	20.20	5.31	A	132 (30.00)	41.77	8.44	2.22
344 (32.58)	19.86	6.00		124 (31.00)	36.05	7.16	2.16
212 (20.08)	13.84	4.41		84 (21.00)	39.62	5.48	1.75
184 (17.42)	16.25	4.55		60 (15.00)	32.61	5.30	1.49
388 (30.41)	22.00	7.29	B	152 (29.92)	39.18	8.62	2.86
344 (26.96)	22.05	7.83		128 (25.20)	37.21	8.21	2.91
288 (22.57)	20.28	6.74		116 (22.83)	40.27	8.17	2.71
256 (20.06)	20.58	7.12		112 (22.05)	43.75	9.00	3.11
432 (33.13)	19.89	6.70	C	172 (34.13)	39.81	7.92	2.67
356 (27.30)	20.41	7.02		140 (27.78)	39.33	8.03	2.76
296 (22.70)	19.79	6.50		112 (22.22)	37.84	7.49	2.46
220 (16.87)	17.63	5.81		80 (15.87)	36.36	6.41	2.11
532 (38.66)	20.15	7.13	D	208 (37.14)	39.10	7.88	2.79
436 (31.69)	19.57	6.87		168 (30.00)	38.53	7.54	2.65
240 (17.44)	14.81	5.12		120 (21.43)	50.00	7.41	2.56
168 (12.21)	12.92	4.25		64 (11.43)	38.10	4.92	1.62

Table XLIII:

a : Numbers and percentages among themselves
b : Percentages in macrofauna
c : Percentages in total soil fauna

Table XLIV:

a : Number and percentages among themselves
b : Percentages in total myriapoda
c : Percentages in macrofauna
d : Percentages in total soil fauna

TABLE XLV

The total number of Chilopoda and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XLVI

The total number of Symphyla and its relative percentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	d	Sites	a	b	c	d
84 (20.19)	26.58	5.37	1.41	A	100 (41.67)	31.65	6.39	1.68
168 (40.38)	48.84	9.70	2.93		52 (21.67)	15.11	3.00	0.91
88 (21.15)	41.51	5.74	1.83		40 (16.66)	18.87	2.61	0.83
76 (18.27)	41.30	6.71	1.88		48 (20.00)	26.09	4.24	1.19
112 (27.72)	28.87	6.35	2.11	B	124 (33.70)	31.96	7.03	2.33
108 (26.73)	31.40	6.92	2.46		108 (29.35)	31.40	6.92	2.46
92 (22.77)	31.94	6.48	2.15		80 (21.74)	27.78	5.63	1.87
92 (22.77)	35.94	7.40	2.56		52 (15.21)	20.31	4.18	1.45
144 (31.58)	33.33	6.33	2.33	C	116 (34.12)	26.85	5.34	1.80
116 (25.44)	32.58	6.65	2.29		96 (28.23)	26.96	5.50	1.89
116 (25.44)	39.19	7.75	2.55		68 (20.00)	22.97	4.55	1.49
80 (17.54)	36.36	6.41	2.11		60 (17.65)	27.27	4.81	1.58
152 (42.22)	28.57	5.76	2.04	D	172 (37.72)	32.33	6.52	2.31
108 (30.00)	24.77	4.85	1.70		160 (35.09)	36.70	7.18	2.52
60 (16.66)	25.00	3.70	1.28		60 (13.16)	25.00	3.70	1.28
40 (11.11)	23.81	2.08	1.01		64 (14.04)	38.10	4.92	1.62

a : Number and percentages among themselves

b : Percentages in total myriapoda

c : Percentages in macrofauna

d : Percentages in total soil fauna

TABLE XLVII

The total number of Earthworms and its relative percentages annual mean for the total study period in the four different sites at four different depths.

TABLE XLVIII

The total number of Mollusca and its relative precentages annual mean for the total study period in the four different sites at four different depths.

a	b	c	Sites	a	b	c
56 (40.00)	3.58	0.94	A	24 (19.35)	1.53	0.40
32 (22.86)	1.85	0.56		32 (25.81)	1.85	0.56
28 (20.00)	1.83	0.58		32 (25.81)	2.09	0.67
24 (17.16)	2.12	0.59		36 (29.03)	3.18	0.89
32 (23.53)	1.81	0.60	B	44 (27.50)	2.49	0.83
32 (23.53)	2.05	0.73		44 (27.50)	2.82	1.00
36 (26.07)	2.54	0.84		36 (22.50)	2.54	0.84
36 (26.07)	2.89	1.00		36 (22.50)	2.89	1.00
32 (26.66)	1.47	0.50	C	28 (21.21)	1.29	0.43
32 (26.66)	1.83	0.63		32 (24.24)	1.83	0.63
28 (23.33)	1.87	0.61		40 (30.30)	2.67	0.88
28 (23.33)	2.24	0.74		32 (24.24)	2.56	0.84
32 (24.24)	1.21	0.43	D	28 (25.00)	1.06	0.38
32 (24.24)	1.44	0.50		28 (25.00)	1.26	0.44
40 (30.30)	2.47	0.85		28 (25.00)	1.73	0.60
28 (21.21)	2.15	0.71		28 (25.00)	2.15	0.71

a : Numbers and percentages among themselves

b : Percentages in macrofauna

c : Percentages in total soil fauna

The major group under Myriapoda was Diplopoda which formed nearly 30-50% of the total Myriapoda. The numbers in the different layers steadily decreased from top to the bottom layers for both percentages of total Myriapoda, it was seen that they has a similar vertical distribution only for first annual cycle in site C. In the remaining sites the third layer was much more during both the annual cycles in sites A, B and D and for the second annual cycle in site C, the increase was seen in second layer. However, when the relative percentage abundance of this group Diplopoda among either macrofauna or total soil fauna was considered, they seemed to follow a similar trend as for their vertical distributional numbers, only in sites A and D for both the annual cycles. In case of sites B and C these relative percentages were seen to be on the increase during both the annual cycles for the fourth and the second layers respectively (Table-XLIV).

The next group of importance under Myriapoda was Chilopoda which was 23 to 48% of the total Myriapoda. The steady decrease in numbers from top to the bottom layers was seen in all the sites except in site A, where in the latter case there was a two-fold increase in the second layer which dropped thereafter but the third layer registering more than the first layer. When the relative percentage of this group under Myriapoda was considered it was seen that the fourth layer of sites A and B and the third layer of sties C and D increased when the actual numbers decreased during both the annual cycles. This trend was also true for the relative percentages of this group Chilopoda either among mesofauna or total soil fauna for sites A, and B C. However for site D during second annual cycle the fourth layer registered an increase for these relative percentages of abundance (Table-XLV).

The last group under Myriapoda was Symphyla which was 20 to 42% of the total Myriapoda. There was a steady decrease in numbers for both the annual cycles in sites B and C. Site D registered a fall and rise in alternate layers for both annual cycles, while in site A there was a slight increase in the four layer during the first annual cycle, rise in the second layer during the second annual cycle. The steady decrease from top to the bottom layers was also seen for the relative percentage of abundance of this group either among total myriapods, macrofauna or total soil fauna only in site B for both the annual cycles, while in site C, there was an increase in the second and fourth layer. This latter phenomenon was also seen in site D for both the annual cycles. In site A it followed a trend similar to their vertical distributional numbers, except for the third layer where the relative percentage abundance in total myriapods showed an increase (Table-XLVI).

Annelida formed a very minor portion of the macrofauna, and comprised of 1 to 5% of the total macrofauna. Either the steady decrease in numbers from top to the bottom layers or the similar numbers with a decrease till the bottom layer was seen for the second annual cycle in site D and both the annual cycles in sites A and C. Site B registered an increase after the third layer which maintained so till the fourth, while site D in the first annual cycle showed an increase in the third layer. The trend for the relative percentage of abundance of this group either among the macrofauna or total soil fauna was seen to be only in site B, while they were in the reverse trend for site D for both the annual cycles. In site A this latter trend was seen from the second layer till fourth layer for both the annual cycles (Table-XLVII).

The group Mollusca came last in terms of abundance under macrofauna, comprising of 0.5 to 4 % of the total macrofauna. Here again as the annelida vertical distributional numbers either remained constant or decreased from top to bottom layers for both the annual cycles in sites B and D. In site A, the trend was in reverse while in site C there was a fall and rise in alternate layers during both the annual cycles. A trend similar to their vertical distributional numbers was seen only in sites A and C. When their relative percentage among macrofauna or total soil fauna was considered, site B showed an increase in the second layer for their relative percentages as well as the fourth layer, while in site D, a trend in the reverse was seen in these relative percentages of abundance which increased from top to the bottom soil layers (Table-XLVIII).

SEASONAL FLUCTUATIONS

When a seasonal analysis of total soil fauna was done, it was observed that they ranged from 90 to nearly 2,900 × $10^2/m^2$, when all the sites were considered. The minimum was seen for th month of June in sites A and B, while the maximum was recorded in the month of December in si D. The range in the different soil layers when considered was between 200 to 950 × $10^2/m^2$. Th interesting observation moreover was that when each site was considered, the maximum an minimum for the years of study was in June and December respectively for all the sites except site ; where the minimum occurred in the month of January during both the years of study. Thi phenomenon was also true when the individual layers in different sites (A, B, C, D) was als considered (Fig. 2).

A similar seasonal study when done for microfauna, it was seen to follow the same patterns as the total soil fauna not only in different sites but also in different soil layers during the entire study period. It ranged from 20 to 170 × $10^2/m^2$, the minimum in site B in the month of June and the maximum in sites C and D in the month of December. While the individual soil layers were considered the microfauna ranged from a minima of 4 to a maxima of 60 × $10^2/m^2$ (Fig. 3).

Under the major sub-groups of microfauna, it was seen that the prostigmatid mites followed exactly the same trend as it was seen either for total soil fauna or for total microfauna. In any case they ranged from a minima of 24 × $10^2/m^2$ to a maxima of 168 × $10^2/m^2$. When all the sites were considered the minima occurred in January in site A while the maxima occurred in December in site C. In the different layers the Prostigmatid mites ranged from a minimum of 4 × $10^2/m^2$ to a maximum of nearly 60 × $10^2/m^2$, the minimum occurring in summer months and maxima in winter months (Fig. 4). The next was Protozoa which ranged from a minimum of total absence to a maximum of nearly 50 × $10^2/m^2$. A similar phenomenon as for total microfauna in that minimum occurred in summer months (April, May, June) and the maximum in the winter season (November, December) (Fig. 4).

When the group Protozoa was broken up in lower levels like flagellata, ciliata and amoebae a similar trend of fluctuation was observed and maximum of more than 4 × $10^2/m^2$ was never recorded in any of these groups in any soil layer in different sites during both the years of study (Fig. 5).

After microfauna the next major group comprised of mesofauna which was seen to follow a nearly similar pattern in their seasonal fluctuations as for the microfauna or total soil fauna during the entire study period. However, the total mesofauna ranged from a minimum of 524 × $10^2/m^2$ to maximum of

1,788 × $10^2/m^2$, the former in the month of June in site B and the latter in the month of December in site D. All the sites did show the minima and maxima in June and December respectively during both the years of study except in site A, where the minima was recorded in July. The range in the individual layers at different sites of mesofauna was between 108 and 576 × $10^2/m^2$ during the entire study period in different sites (A, B, C, D) (Fig. 6).

Among the major subdivisions under soil-mesofauna, Collembola revealed a pattern of seasonal abundance and fluctuations, quite in contrast to all the others described so far, in that the minimum was always recorded in all the sites and in all the soil layers in the month of January for both the years of study, though the maximum continued to be in December. Collembola ranged from a minimum of nearly 240 × $10^2/m^2$ to a maximum of 628 × $10^2/m^2$ at the different sites during the entire study period. The range in the individual soil layers were between 40 and 200 × $10^2/m^2$ (Fig. 7).

When the different families of Collembola were considered for their seasonal fluctuations, all of them more or less followed the similar pattern as for Collembola, especially the families Entomobryidae and Hypogastruridae with a slight deviation in families Sminthuridae and Isotomidae where the minimum though not very significant, was recorded in the month of March (Fig. 8). The number in families Entomobryidae, Hypogastruridae, Sminthuridae and Isotomidae ranged from 88 to 304 × $10^2/m^2$ in the months of March and December; 72 to 200 × $10^2/m^2$ in the months of January and December; 44 to 120 × $10^2/m^2$ in the months of April, June and December and 20 to 84 × $10^2/m^2$ in the months of March and December respectively. The range in the individual layers ranged from 4 to 84 × $10^2/m^2$, in all the families (Fig. 8).

The next major group after Collembola in total mesofauna was Acarina, which seemed to follow the same pattern as for Collembola in all the sites except site D which recorded a summer minima as was seen for total soil fauna or microfauna. This phenomenon was also true when Acarina was looked at its sub-order levels as mesostigmata, cryptostigmata and astigmata. They ranged as whole from 108 to 624 × $10^2/m^2$ in different sites. In mesostigmata, cryptostigmata and astigmata the ranges were as 52 to 280 × $10^2/m^2$ in the months of January and December; 40 to 212 × $10^2/m^2$ and 16 to 132 × $10^2/m^2$ respectively. The Acarina population in the individual soil layers ranged from 4 to 80 × $10^2/m^2$ (Fig. 7 & 9).

Araneida, which comes next in importance after Acarina in terms of abundance under mesofauna seemed to follow a similar pattern of seasonal fluctuation as has been observed for Collembola. The population ranged from 92 to 408 × $10^2/m^2$ in the months of January and December respectively. In individual soil layers they ranged from 20 to 128 × $10^2/m^2$. This pattern of seasonal fluctuation was also true when Araneida was seen at its family level and especially in family Clubionidae and Lycosidae, while in Linyphiidae in site D, the first cycle showed a summer minima, though it was true for second annual cycle. The population ranged from 28 to 184 × $10^2/m^2$ in the months of January, February and December respectively. When the individual layers were considered the ranges were from 4 to 56 × $10^2/m^2$ in the same months in all the families of Araneida (Fig. 10).

The remaining groups under mesofauna being Protura, Diplura, Isopoda and Chelonethi which had a common seasonal fluctuation pattern in the first three groups, in that they revealed a summer minima and winter maxima while in the last group namely Chelonethi the minimum was always in January and maximum in December. The population in all the groups ranged from 16 to 108 × $10^2/m^2$ in the months of January and December respectively. When the individual soil layers were considered the range was 4 to 36 × $10^2/m^2$ (Fig. 11).

The third major group in the total soil fauna was macrofauna which revealed a seasonal fluctuation with a maximum peak of occurrence in February and minimum in June, July. This was true not only in different sites under consideration but also when the individual soil layers were looked at. The range of population was from 300 to 908 × $10^2/m^2$ in the months of June and February, December for both the annual cycles of study. The range was from 44 to 300 × $10^2/m^2$ at the individual soil layers (Fig. 12).

The most abundant group in macrofauna was total insects, which showed a more or less similar pattern in their seasonal fluctuation as macrofauna which is quite understandable because the fluctuation pattern depended upon insects. They ranged from 224 to 732 × $10^2/m^2$ in the months of June and December respectively. The range for individual soil layers was from 36 to 280 × $10^2/m^2$ in both the annual cycles of study (Fig. 13).

When total insects was sub-divided into its major categories, it was seen that ants were the most dominant group and recorded a maxima in February in site A, but in October for the other sites, while the minimum was recorded during May-June. It was true when all the sites as well as all the layers were also considered. The range of population were from 128 to 496 × $10^2/m^2$. The range in individual soil layers were from 20 to 148 × $10^2/m^2$ (Fig. 13).

The ants when looked at its family levels in the present investigation where 5 families were present, all the families revealed a more or less similar picture as was seen for the total ants, in that the maximum occurred in February in all the sites and October in site A, while the minimum was observed in May-June in all the sites at all the depths. The range of population in different families of ants like (Myrmicinae, Ponerinae, Dorylinae, Pseudomyrimioinae and Dolichoderinae) ranged from 44 to 148 × $10^2/m^2$ in the months of April and October; 24 to 96 × $10^2/m^2$ in the months of May and October; 12 to 68 × $10^2/m^2$ in the months of April and October; 20 to 124 × $10^2/m^2$ in the months of April and October; and 12 to 56 × $10^2/m^2$ in the months of August and October respectively. While the individual layers were considered, the ranges were from 4 to 44 × $10^2/m^2$ in all the sites for both the annual cycles (Fig. 14).

Among the other sub-divisions of total insects, which included orders like Coleoptera, Diptera, Hemiptera, Hymenoptera, Thysanoptera, Lepidoptera, Trichoptera, Orthoptera and Dermaptera, all of them revealed a winter maxima and a summer minima (Fig. 15). The range in the insect orders were 16 to 72 × $10^2/m^2$ in the months of July and December; 8 to 80 × $10^2/m^2$ in the months of June and December; 16 to 52 × $10^2/m^2$ in the same months; 0 to 60 × $10^2/m^2$ in the same months; 0 to 48 × $10^2/m^2$ in the months of January, February and December; 0 to 54 × $10^2/m^2$ in the months of March, April and December; 16 to 40 × $10^2/m^2$ in the months of April, May, June and December; 0 to 32 × $10^2/m^2$ in the months of March, April and August; and 0 to 40 × $10^2/m^2$ in the months of April, May, June and December. The range of population in individual layers were 0 to 24 × $10^2/m^2$ in the months of April and November-December respectively (Fig. 15 & 16).

Macrofauna which predominantly contained insects had as the second major group Myriapoda. This group was divided into Symphyla, Chilopoda and Diplopoda. However, when either Myriapoda or different sub-groups were observed for the seasonal fluctuations during the entire period of investigation it was observed that a winter maxima particularly in December existed, and a summer minima between April to June was observed. The total Myriapoda ranged from 48 to 196 × $10^2/m^2$ in the months of July and December respectively. The range in individual layers was 4 to 60 × $10^2/m^2$. The different three sub-groups ranged from 4 to 64 × $10^2/m^2$ in the months of June, July, August and December; 16 to 64 × $10^2/m^2$ in the months of June and December and 20 to 76 × $10^2/m^2$ in the months of July and December respectively in terms of dominance. The population when seen in each soil layers ranged from 4 to 36 × $10^2/m^2$ (Fig. 13 & 17).

Mollusca and Earthworms formed the least abundant among the macrofauna, their seasonal pattern of fluctuation showed a maxima in autumn (August and September) and a minima during both summer and winter in Mollusca, while in Earthworms it was only in summer. The population ranged from nil to 28 × $10^2/m^2$ and nil to 40 × $10^2/m^2$ respectively. These ranged again nil to 12 × $10^2/m^2$ when the individual soil layers was considered (Fig. 18).

Physico-Chemical factors

The various physico-chemical factors undertaken in the present study were broadly placed under three major categories (1) physical (environmental), (2) physical and (3) chemical. Under physical (environmental), soil Temperature, Air Temperature, Moisture content and Rainfall was included, while the second physical incorporated pH, Conductivity, Bulk-density and Porosity of the soil, while the chemical factors were Organic Carbon, Nitrogen, Phosphorus and Potassium.

The soil and air temperature at the different layers and different sites were seen to reach a peak in September while the minimum was in March in soil and in November in air for both the annual cycles. The range of soil and air temperature were from 30 to 35°C and 24 to 38° respectively (Fig. 19).

Rainfall had a summer maxima and winter minima true for all the sites. It ranged from nil to 308.18 cm during the first annual cycle, while in second annual cycle it was from 1.3 to 355.3 cm. The moisture content of the soil, however, unlike rainfall showed a bimodal peak of maxima, one in summer and one in winter in all the sites, while the minimum observed was between the months of February and April (Fig. 20). The range of moisture content was 10 and 89% approximately in all the sites for both the years of study (Fig. 20).

The pH of soil had a general trend of summer minima and winter maxima in both years for most of the sites and most of the layers, in that, though July figured in all the sites as maximum, the minimum was in November for site A and September and December for the remaining sites. pH ranged from 5.0 to 7.4 during the entire study period (Fig. 21). The specific conductance of soil was seen to follow a reverse trend as that of pH in general for the different sites. However the upper soil layers showed a maxima in the winter months and in summer in the bottom two layers. The specific conductance of soil ranged from 5.25 to 60.06 μm hos/cm in upper soil layers while in lower layers it was from 9.45 to 58.20 μm hos/cm (Fig. 21).

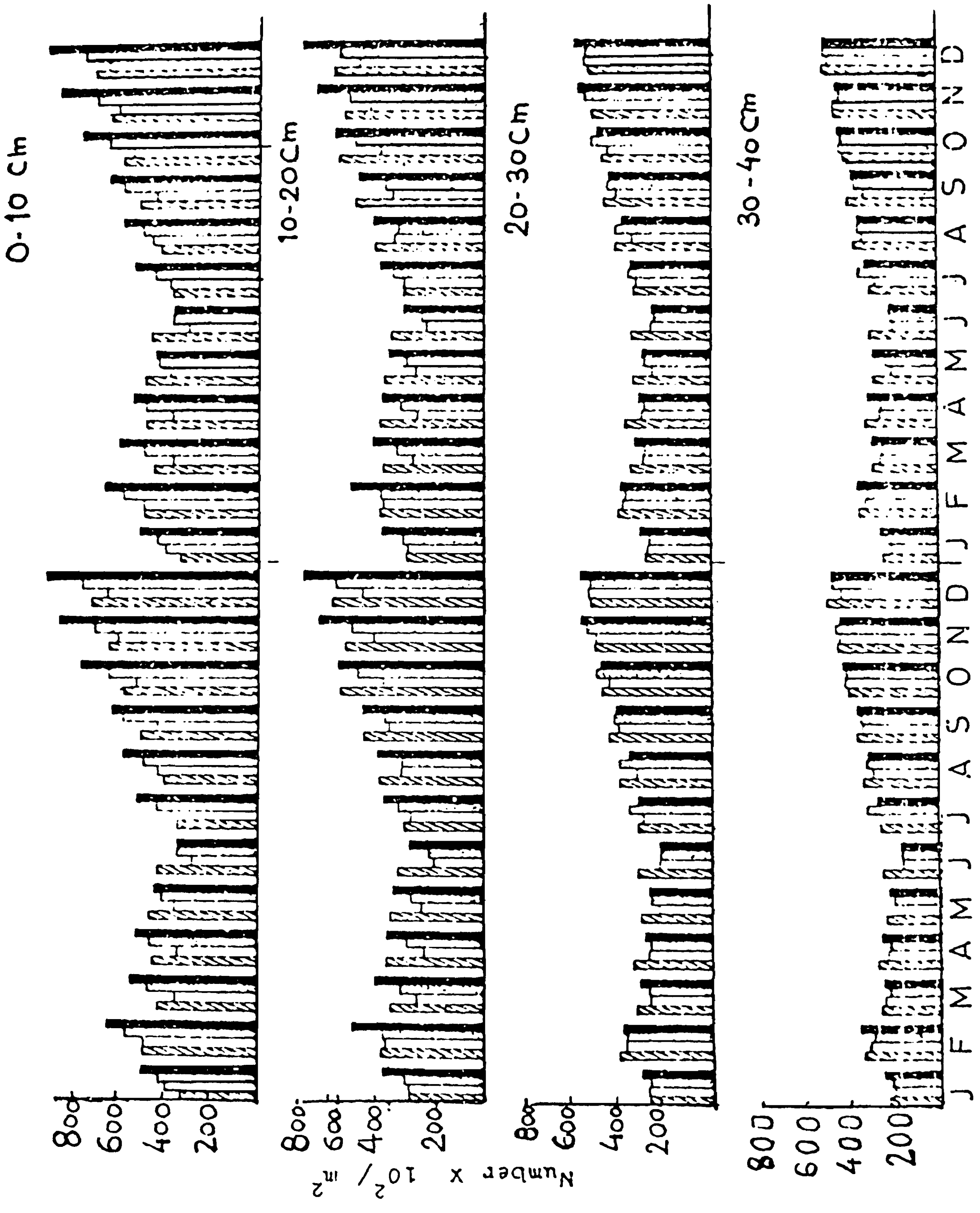

Fig. 2. The seasonal fluctuation of soil fauna.

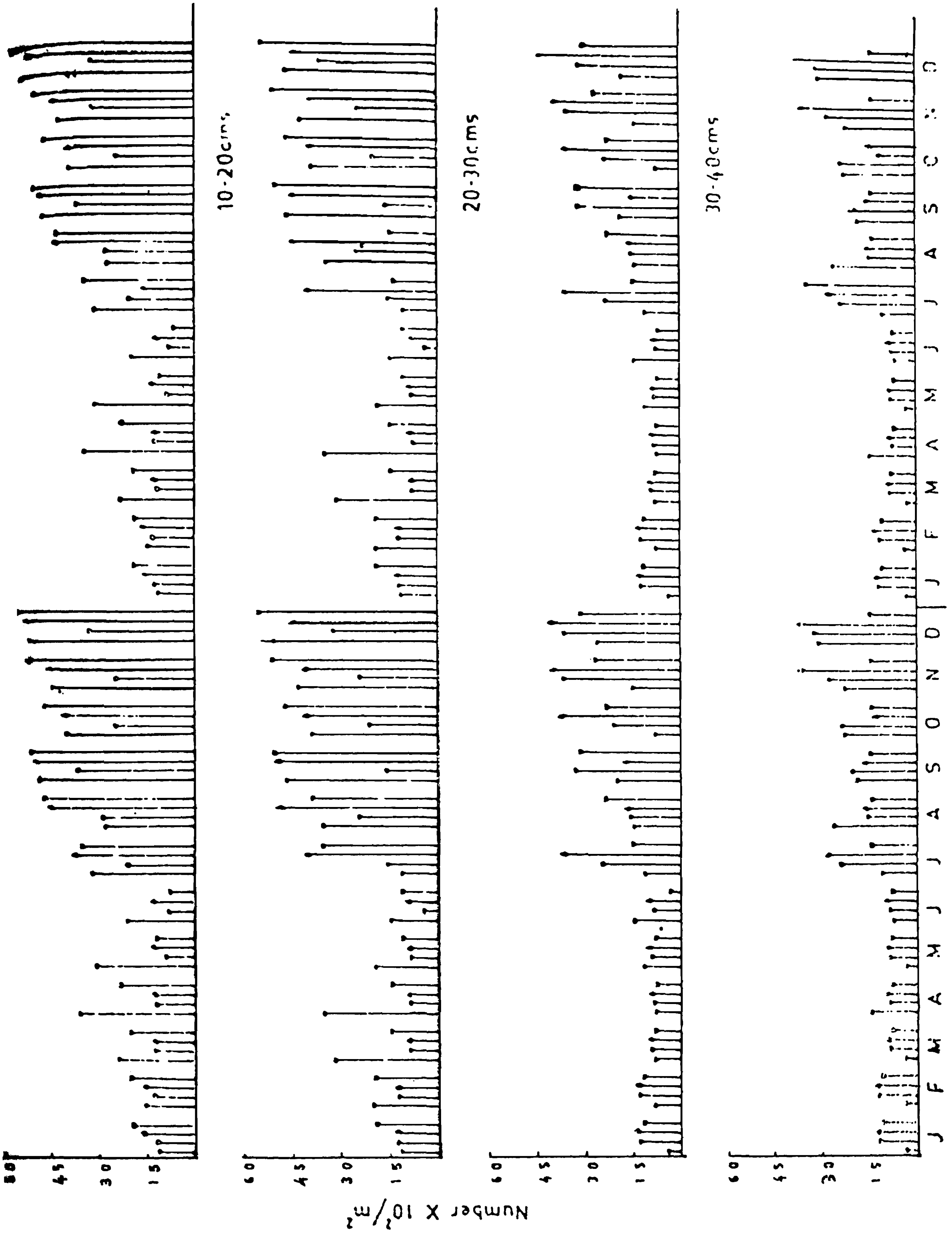

Fig. 3. The seasonal fluctuation of microfauna.

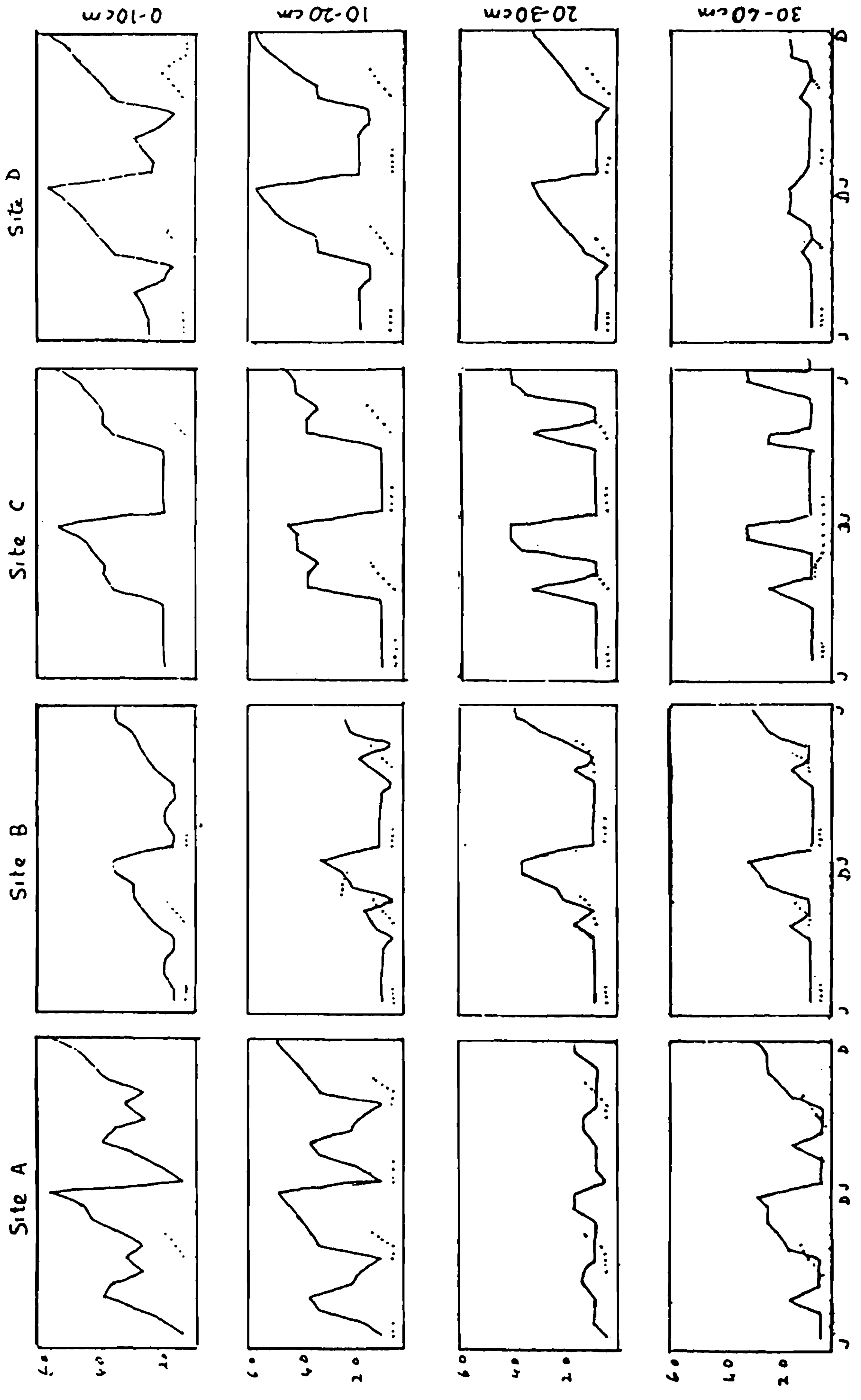

Fig. 4. The seasonal fluctuation of Prostigmata and total Protozoa.

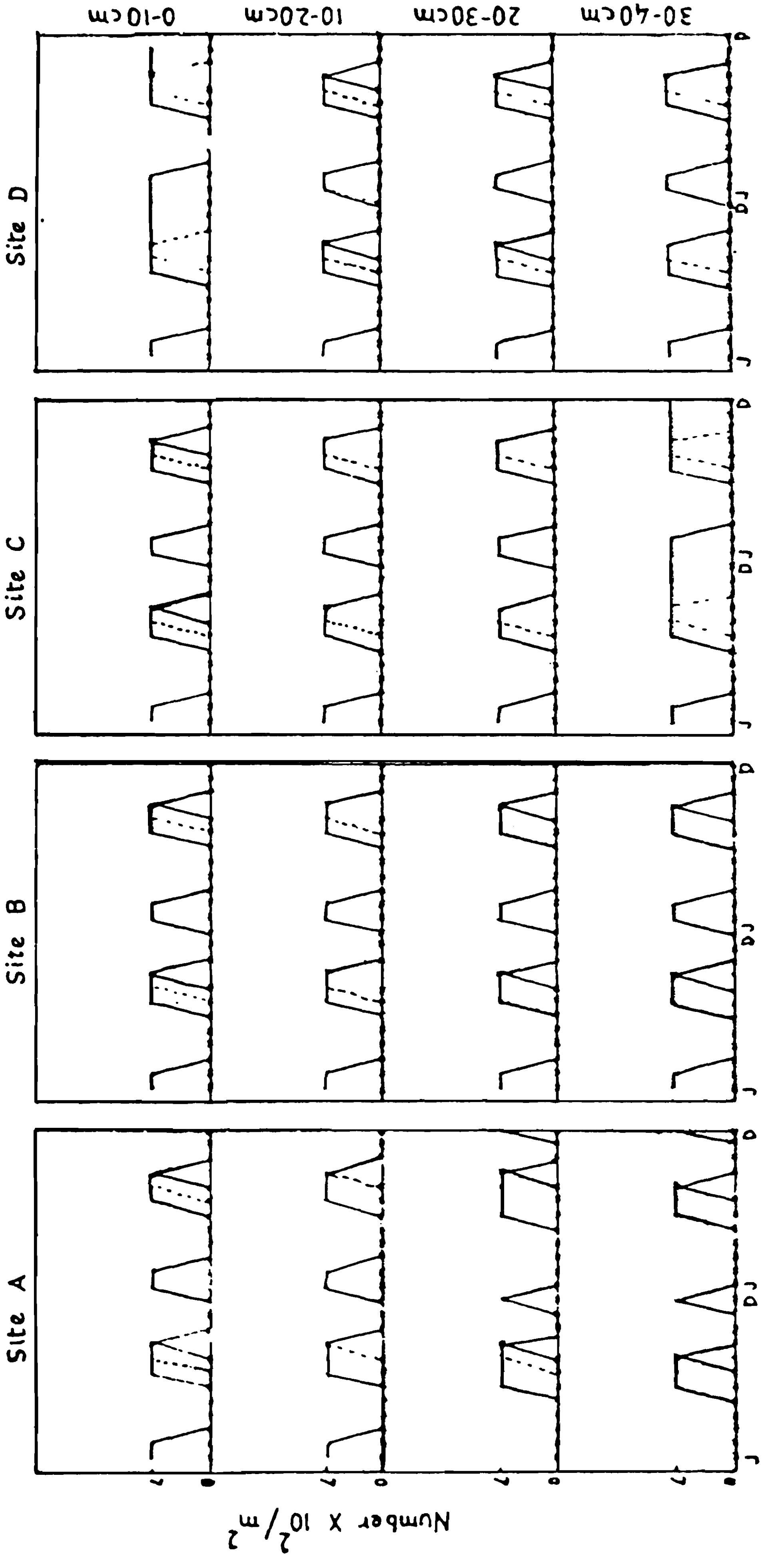

Fig. 5. The seasonal fluctuation of Flagelata, Ciliate and Amoebae.

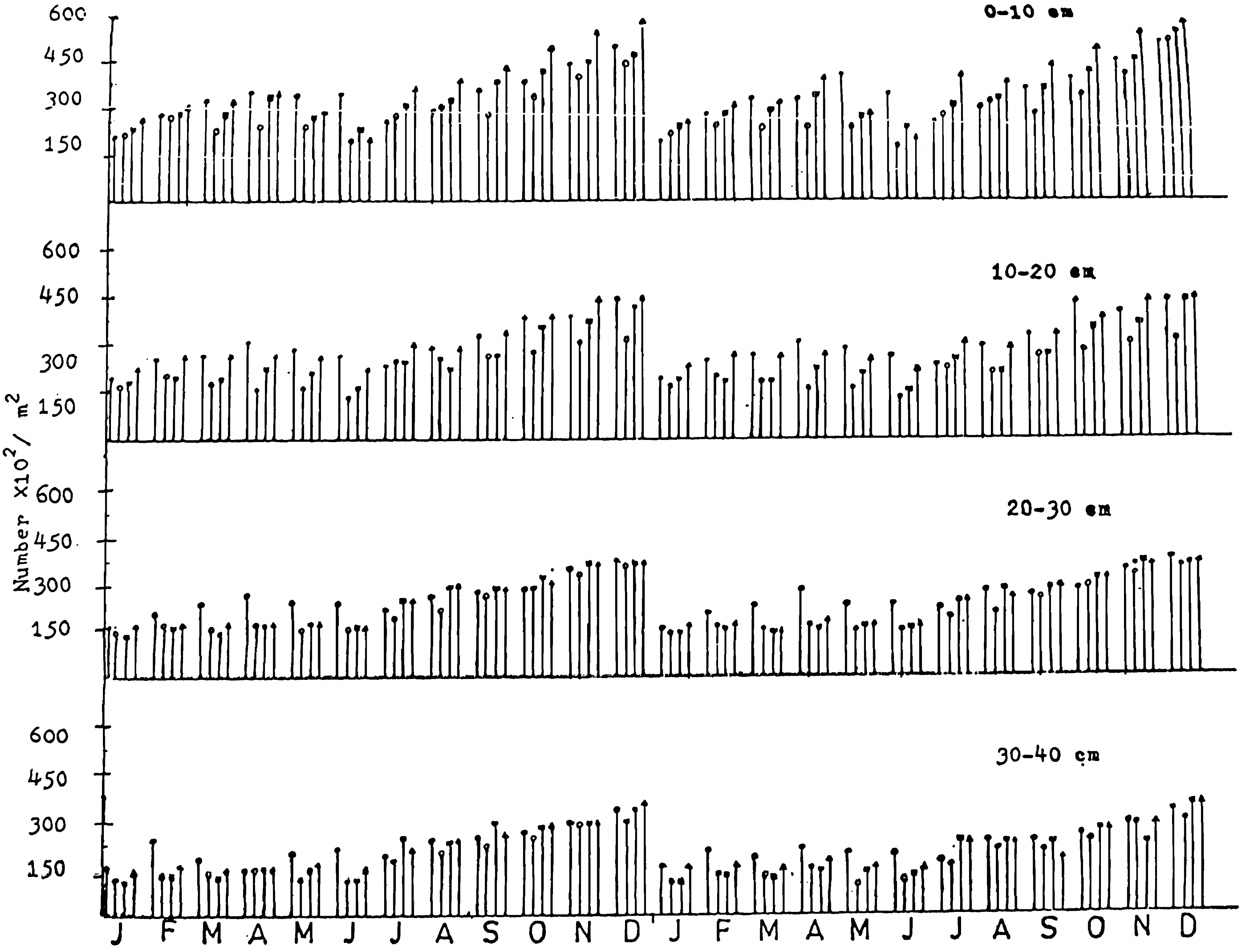

Fig. 6. The seasonal fluctuation of total Mesofauna.

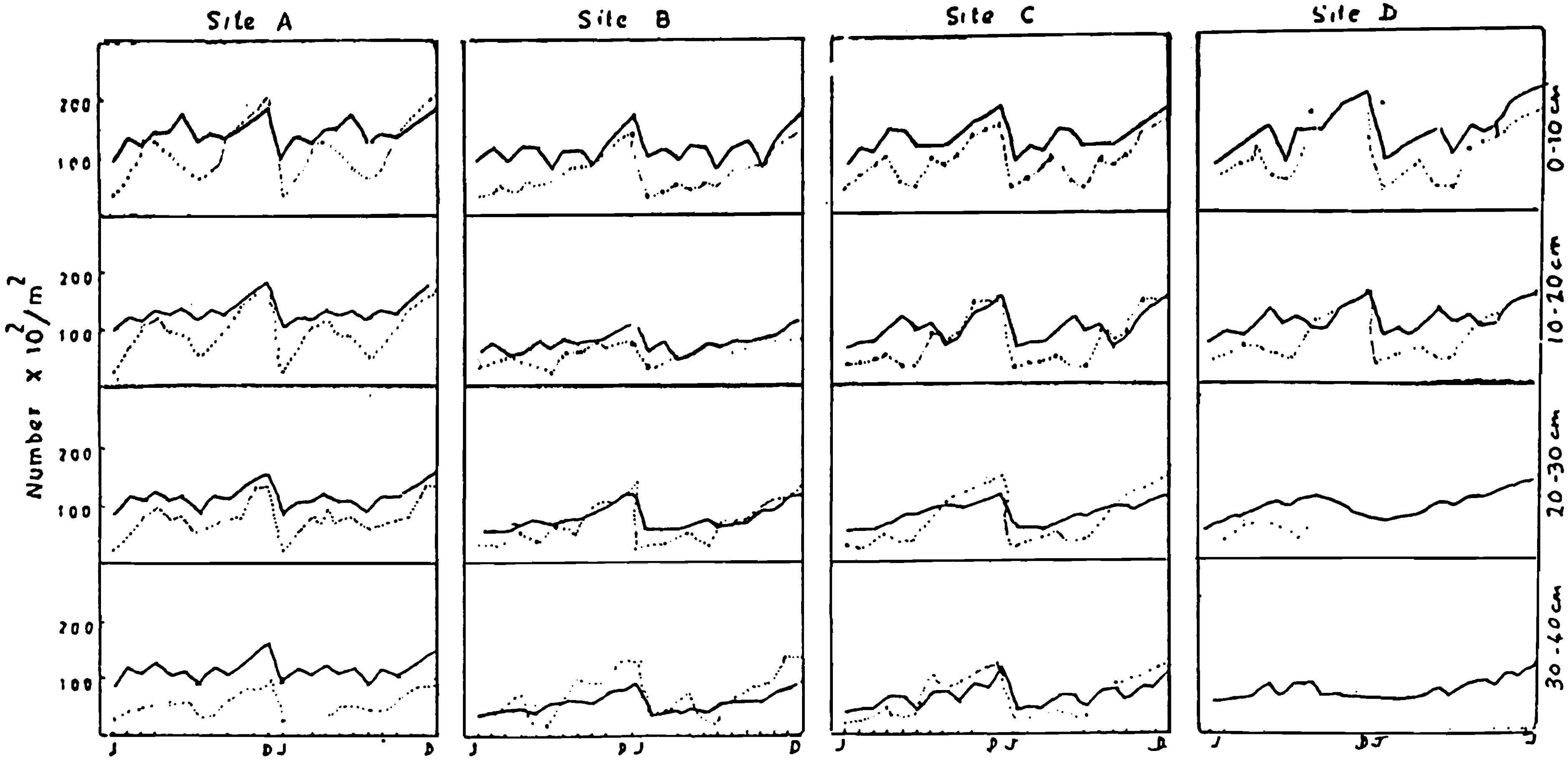

Fig. 7. The seasonal fluctuation of total Collembola and total Acarina.

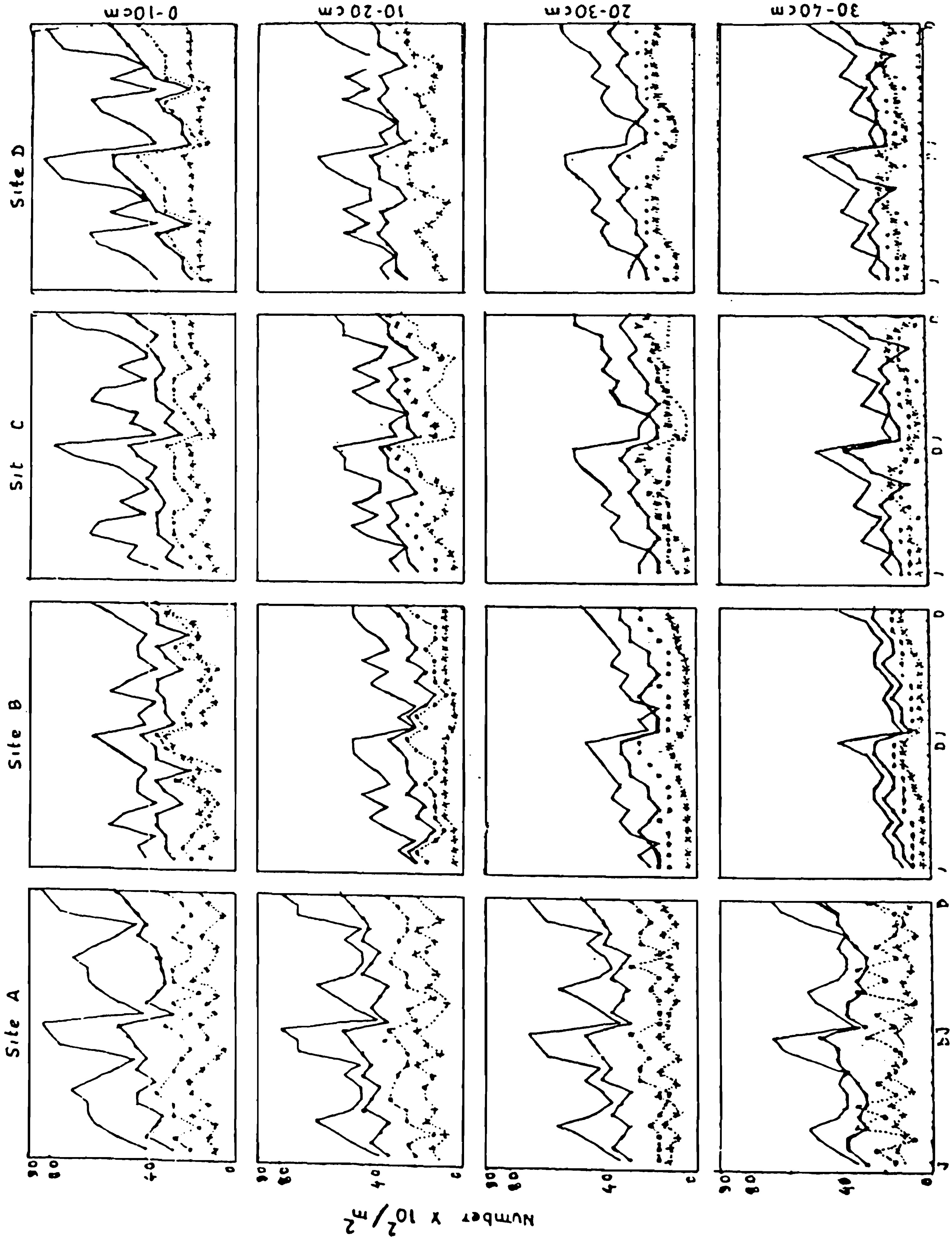

Fig. 8. The seasonal fluctuation of families of Collembola.

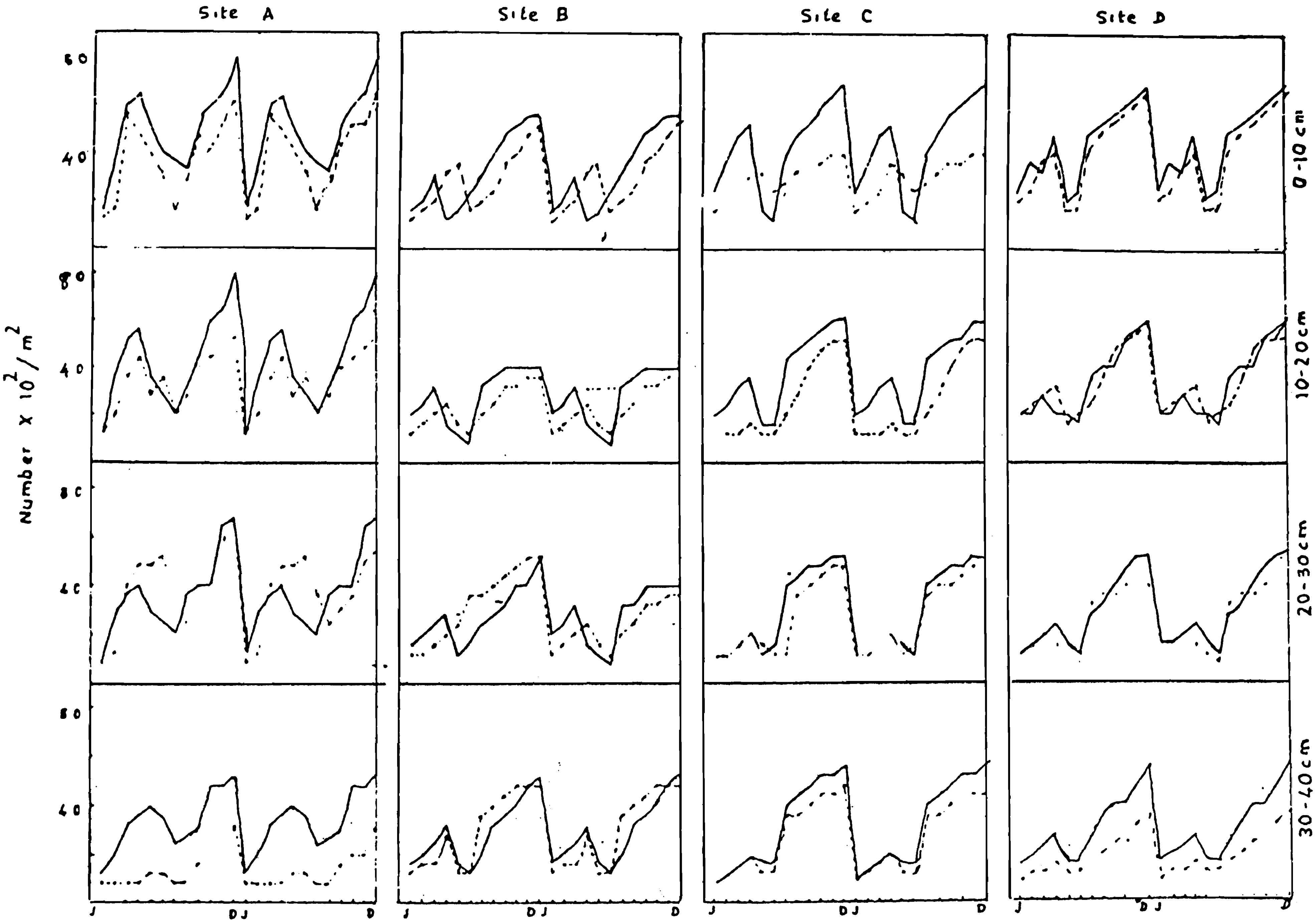

Fig. 9. The seasonal fluctuation of sub-orders of Acarina.

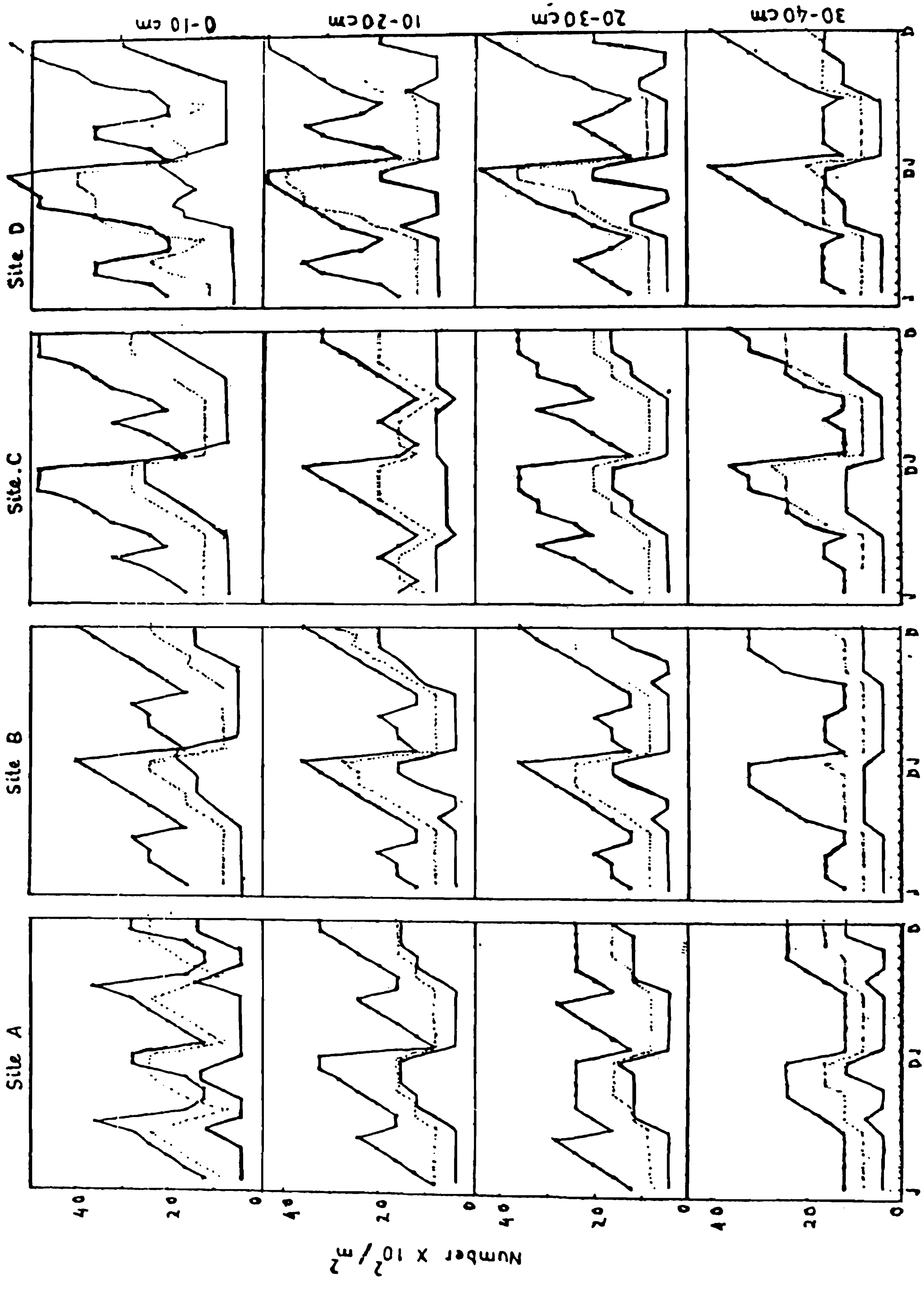

Fig. 10. The seasonal fluctuation of families of Araneida.

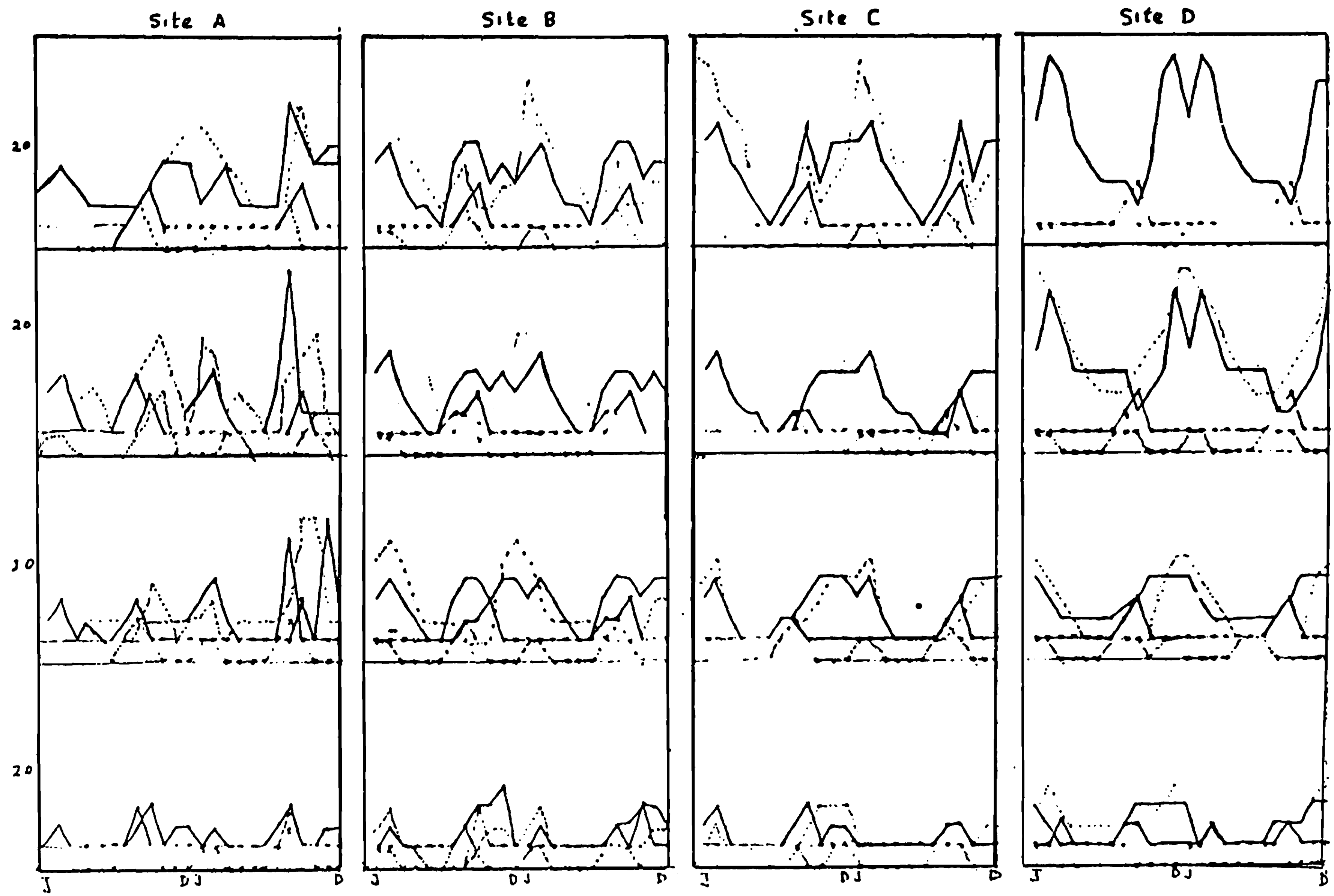

Fig. 11. The seasonal fluctuation of Chelonethii, Diplura, Protura and Isopoda.

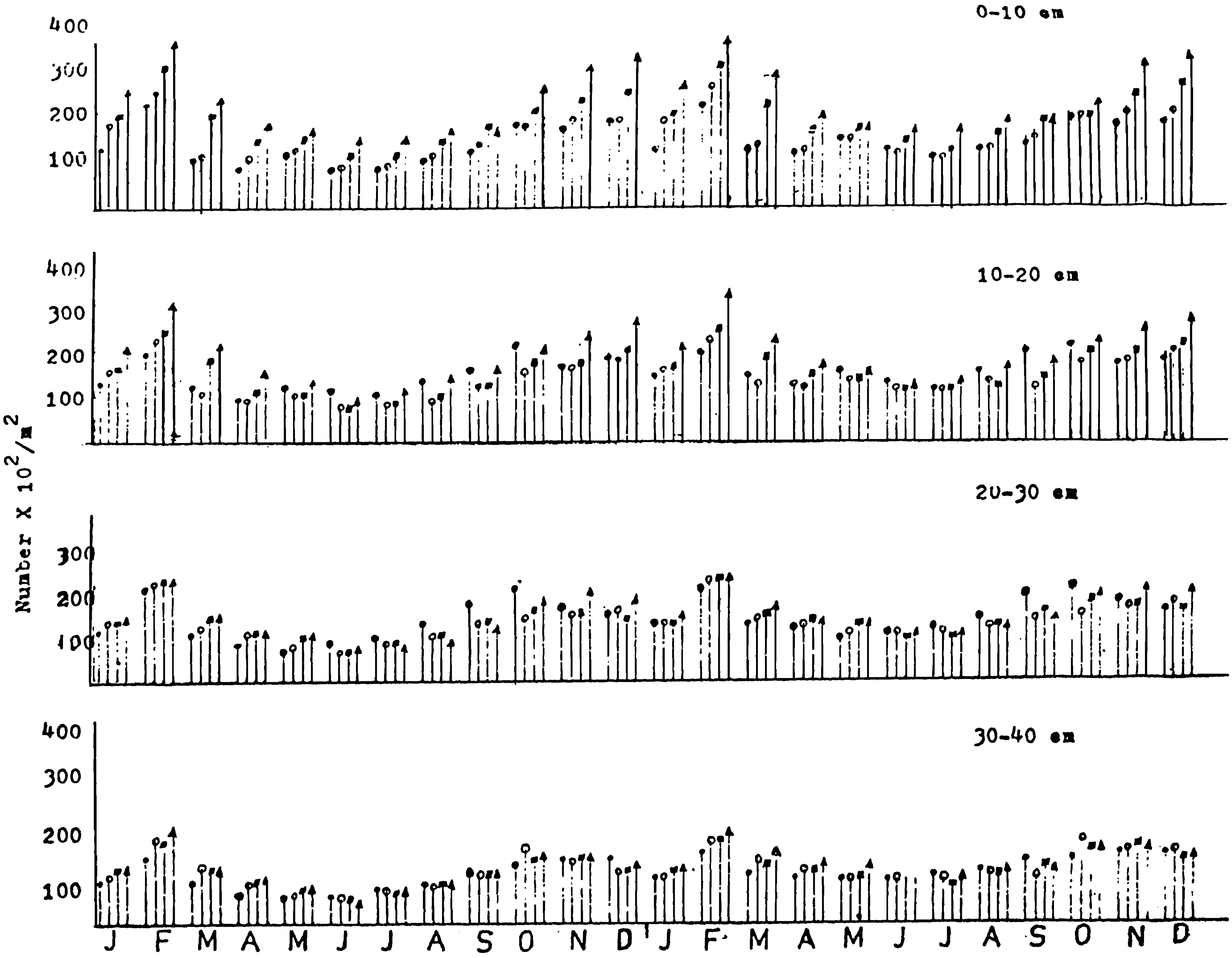

Fig. 12. The seasonal fluctuation of macrofauna.

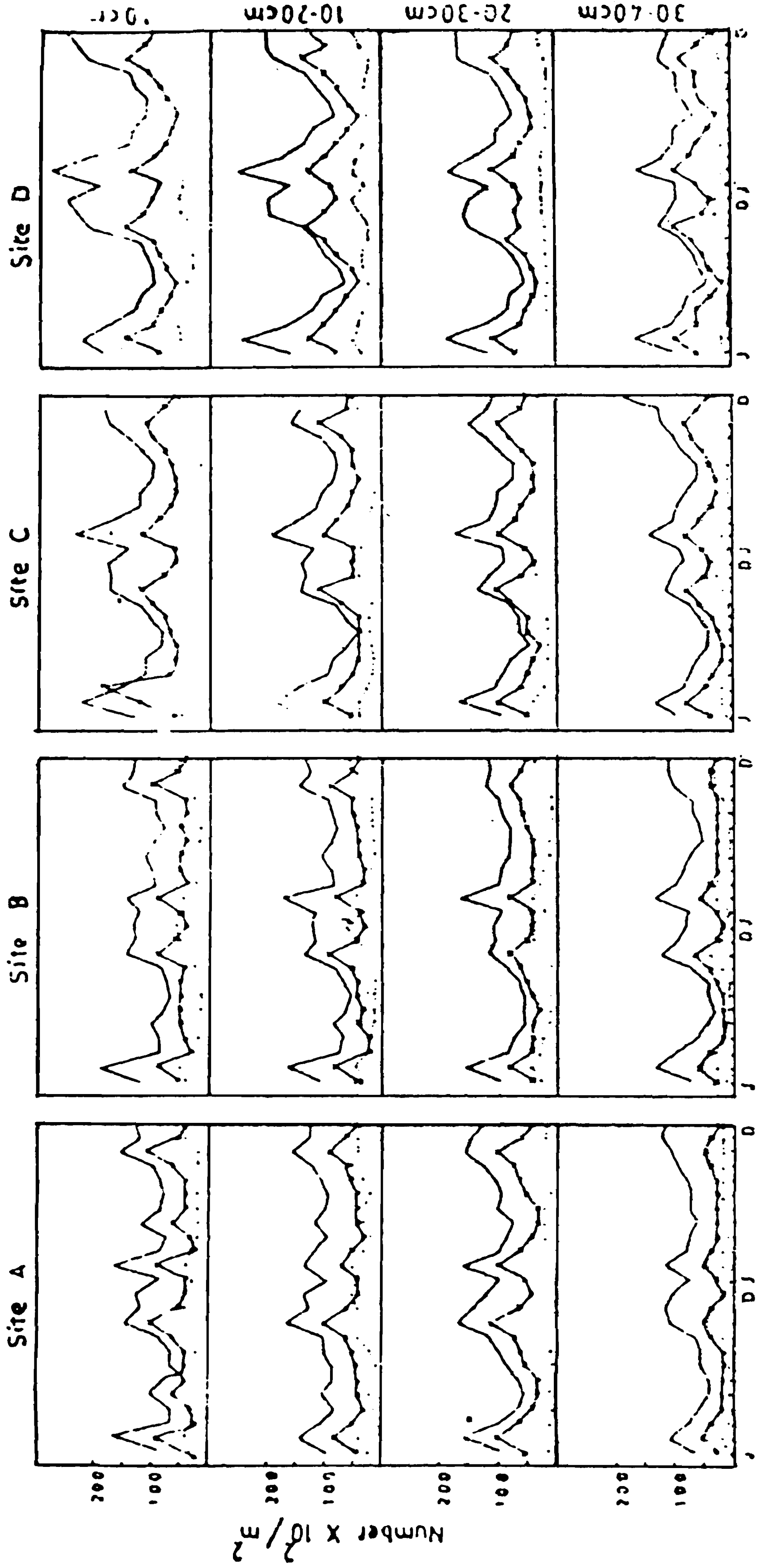

Fig. 13. The seasonal fluctuation of total insecta, total Myriapoda and total Ants.

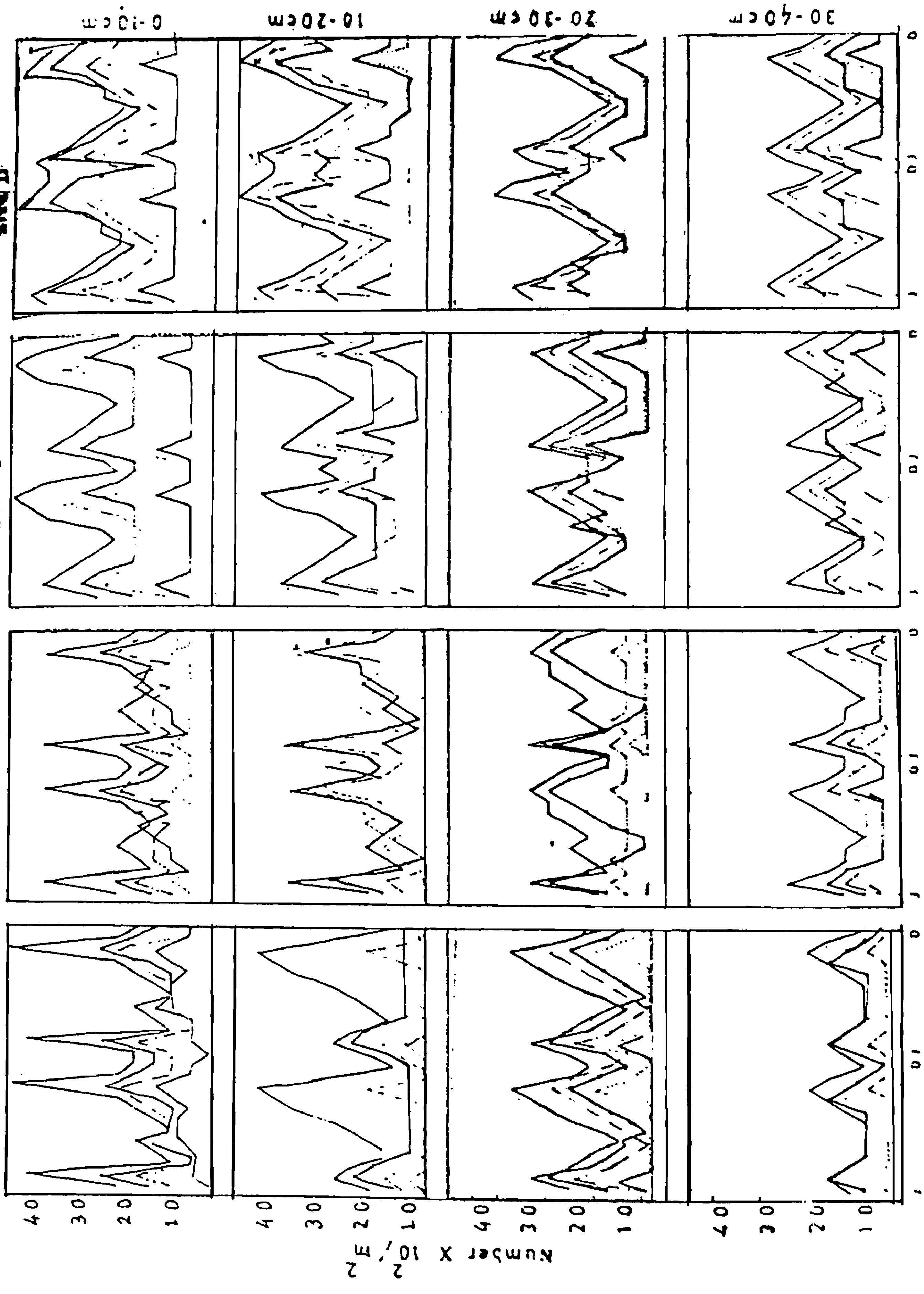

Fig. 14. The seasonal fluctuation of families of Ants.

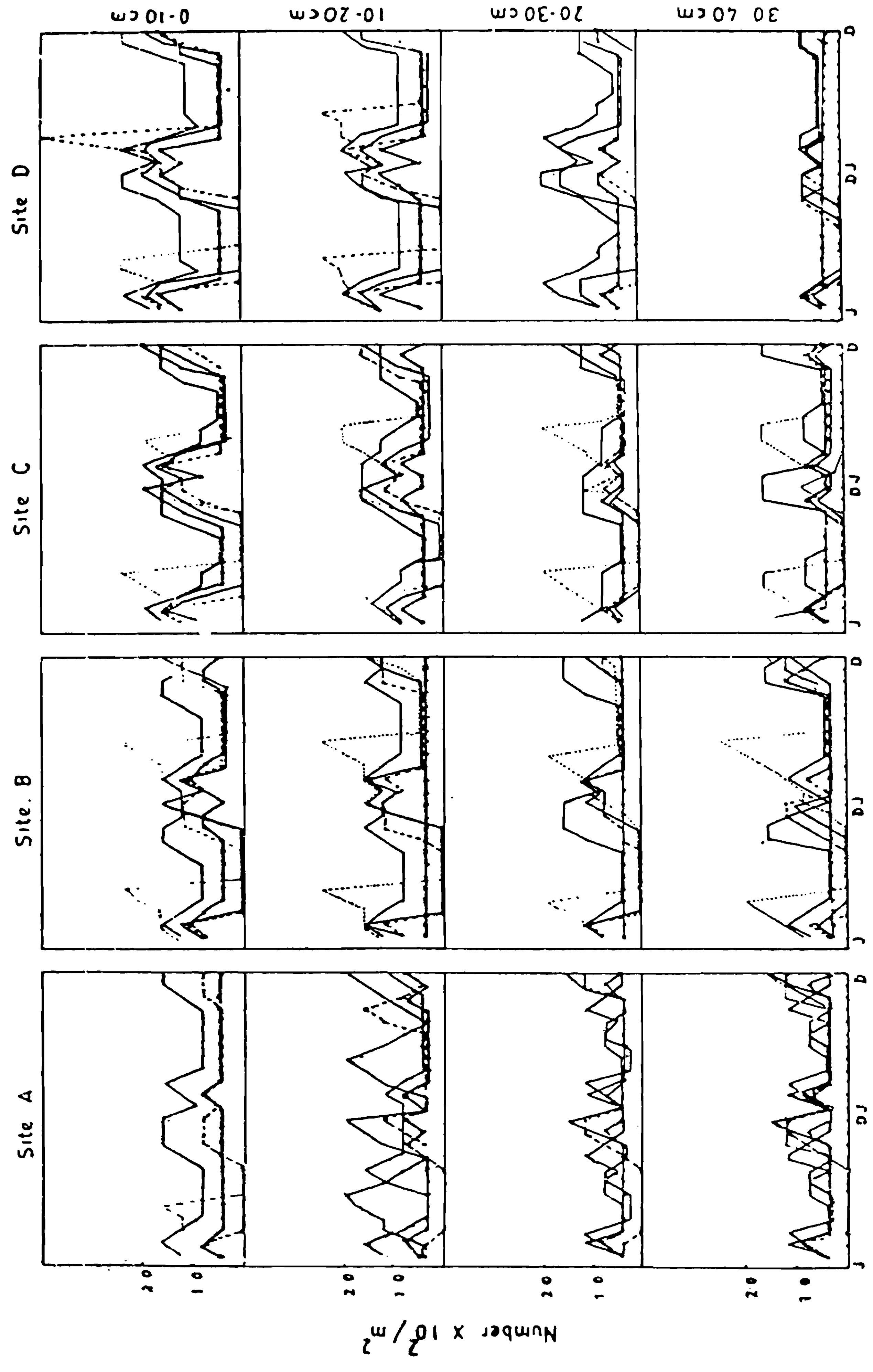

Fig. 15. The seasonal fluctuation of Endopterygote insects.

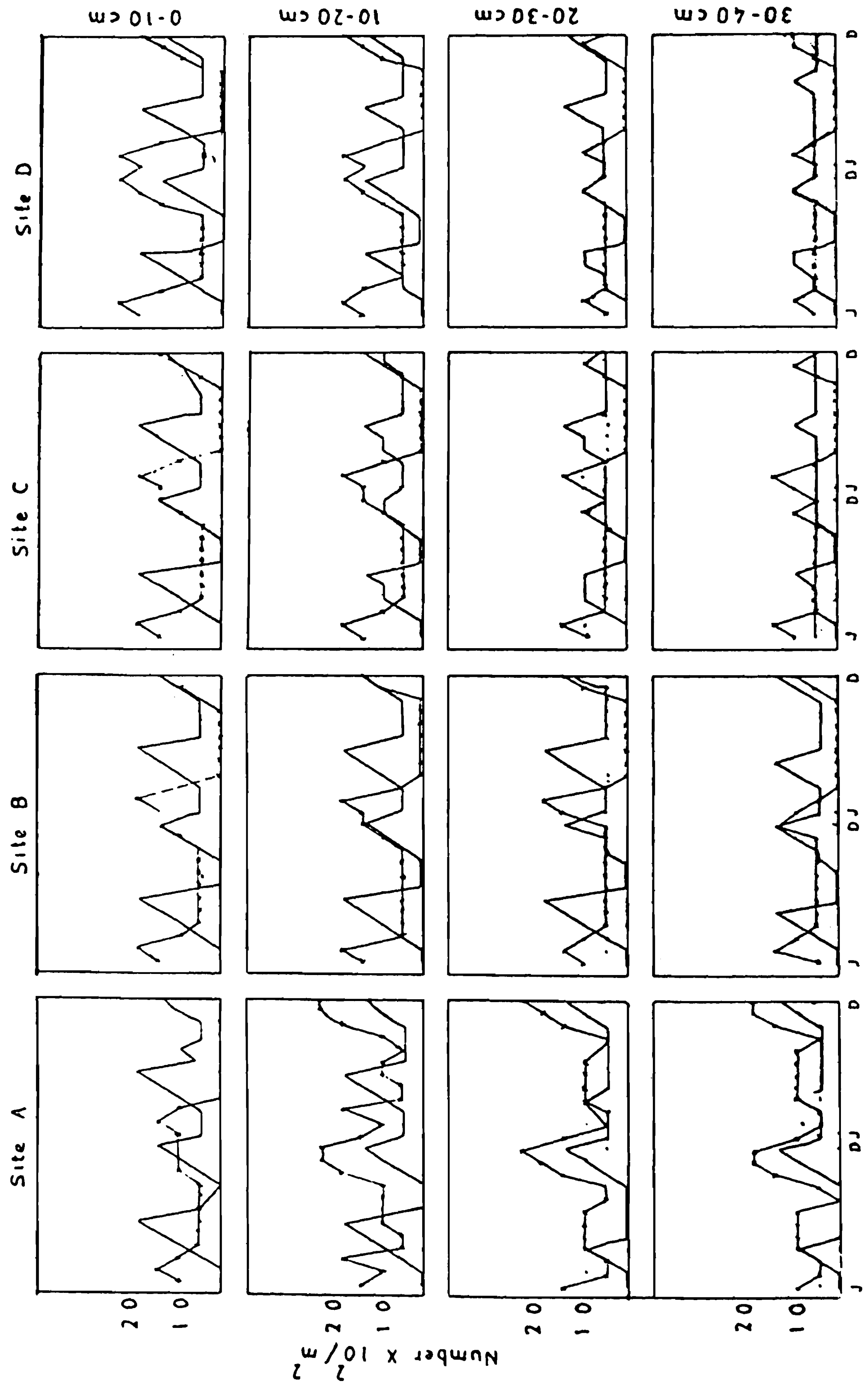

Fig. 16. The seasonal fluctuation of Exopterygote insects.

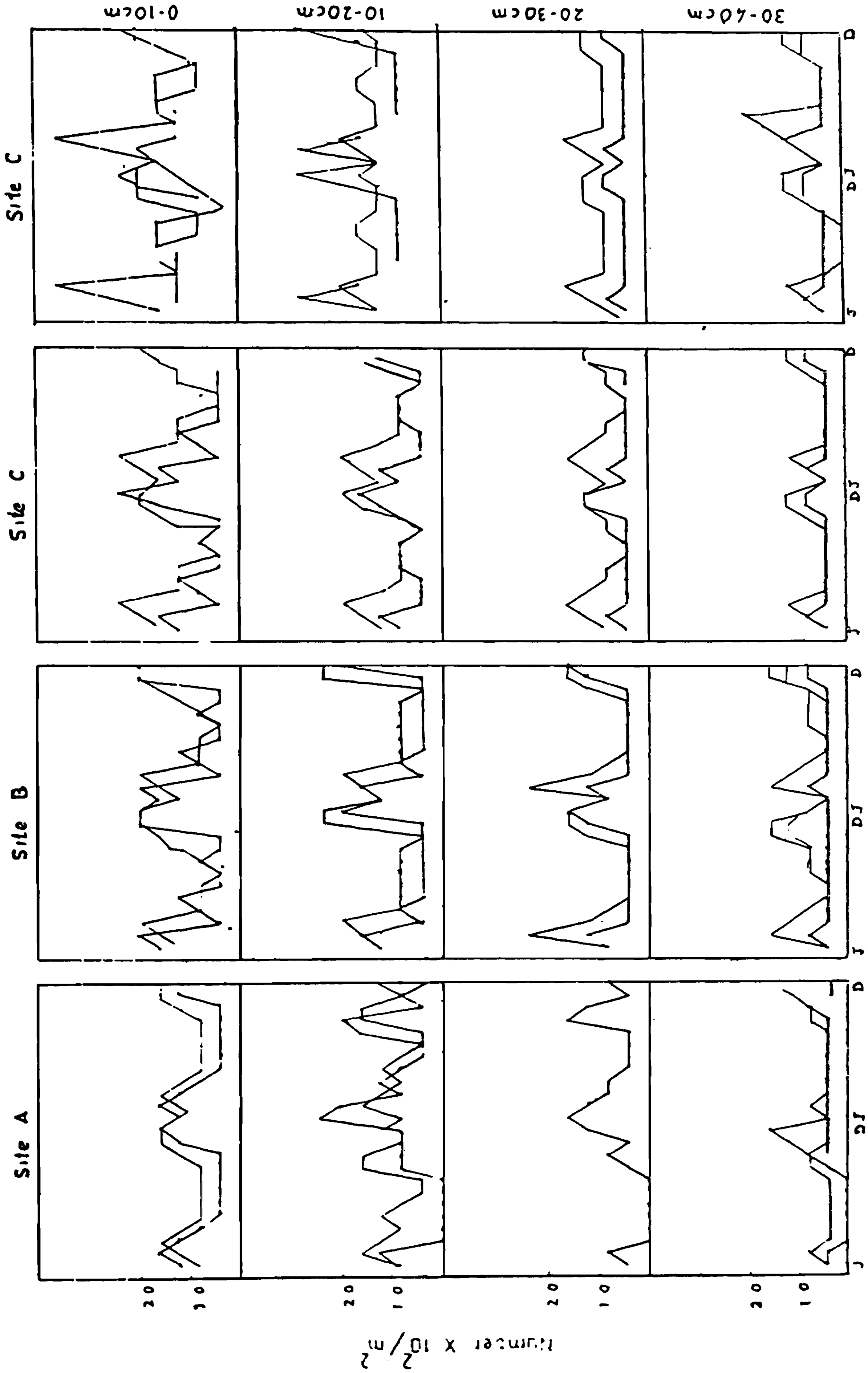

Fig. 17. The seasonal fluctuation of sub-orders of Myriapoda.

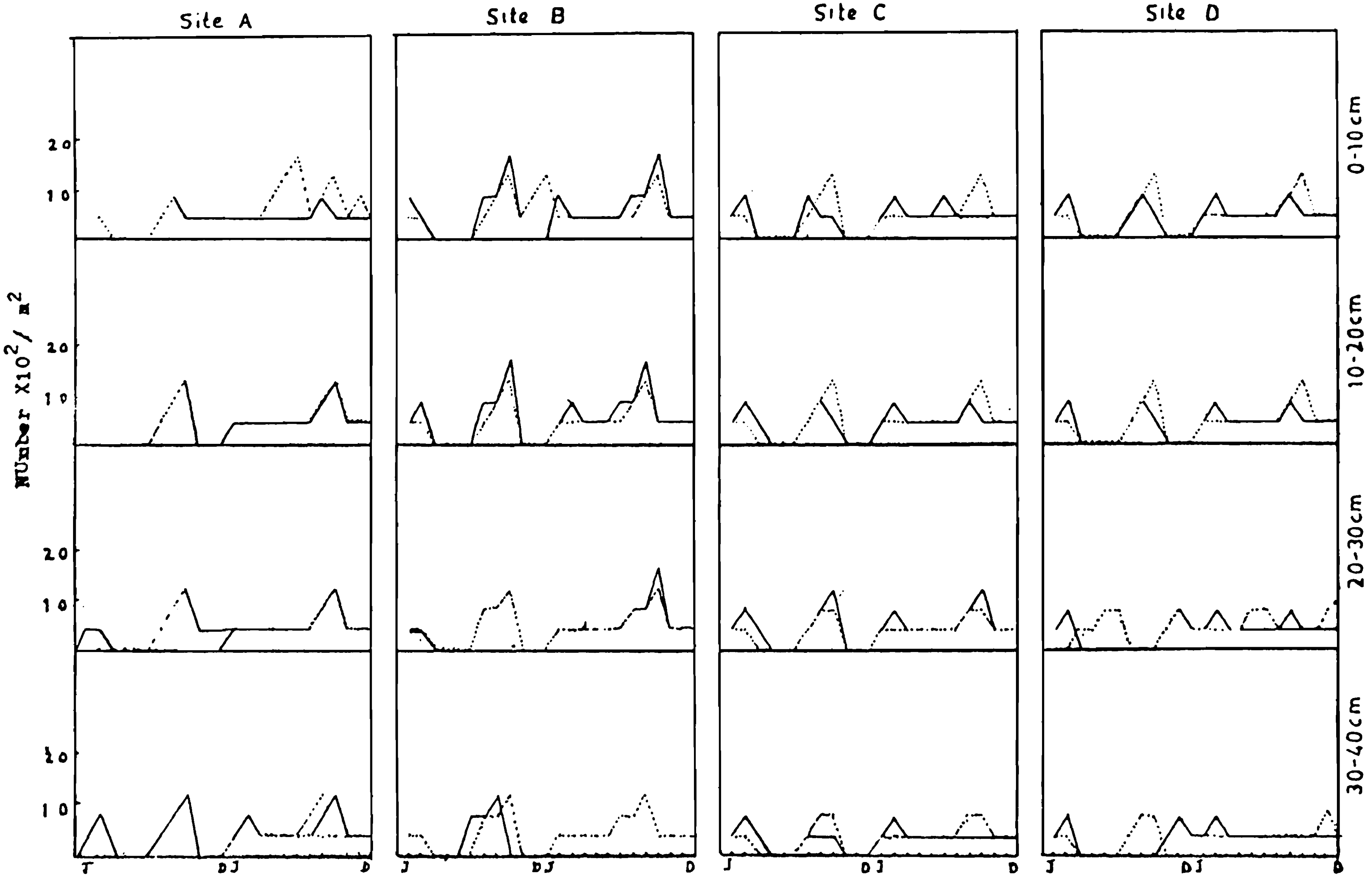

Fig. 18. The seasonal fluctuation of Mollusca and Earthworm.

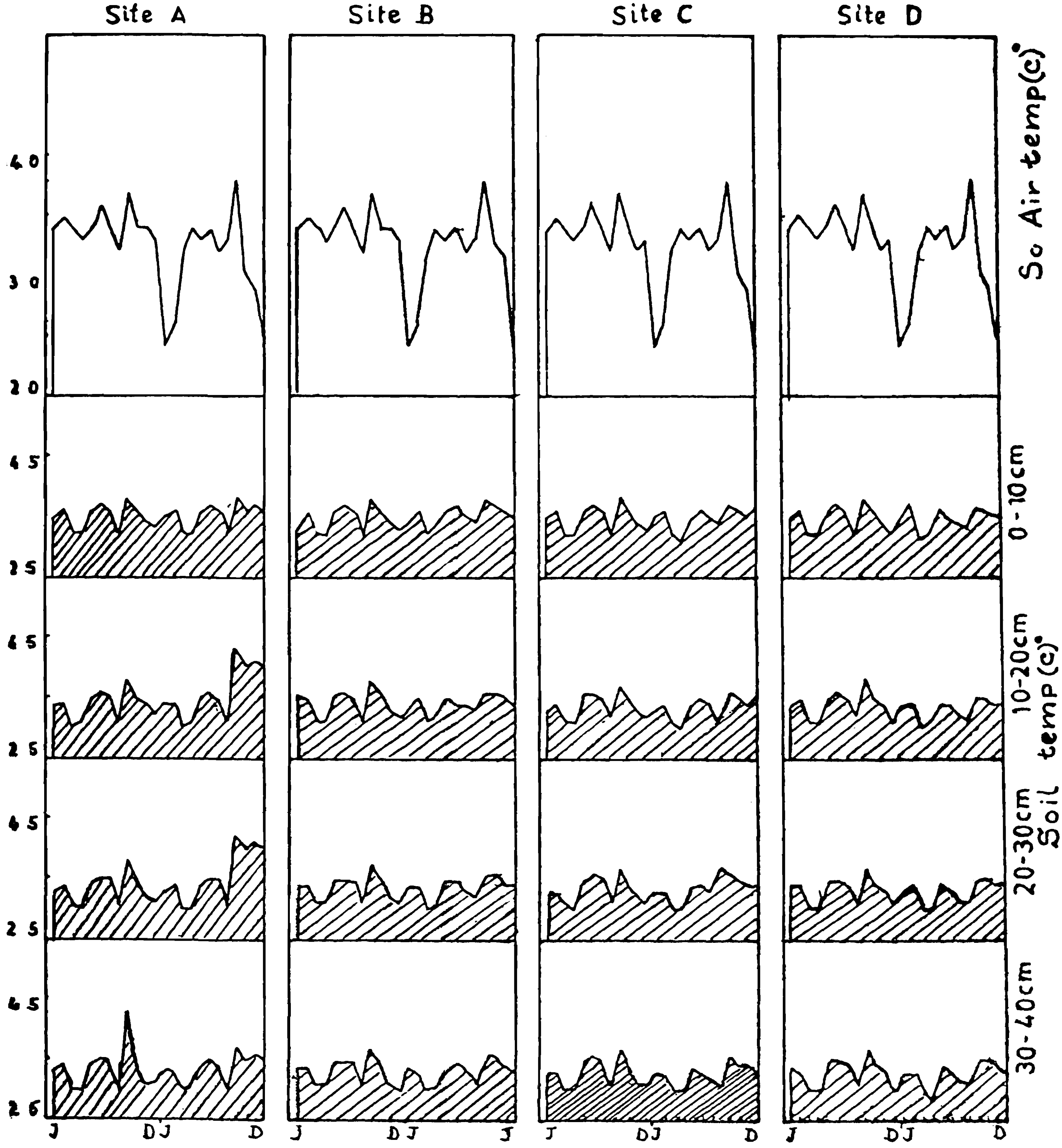

Fig. 19. The seasonal fluctuation of Air temperature and Soil temperature.

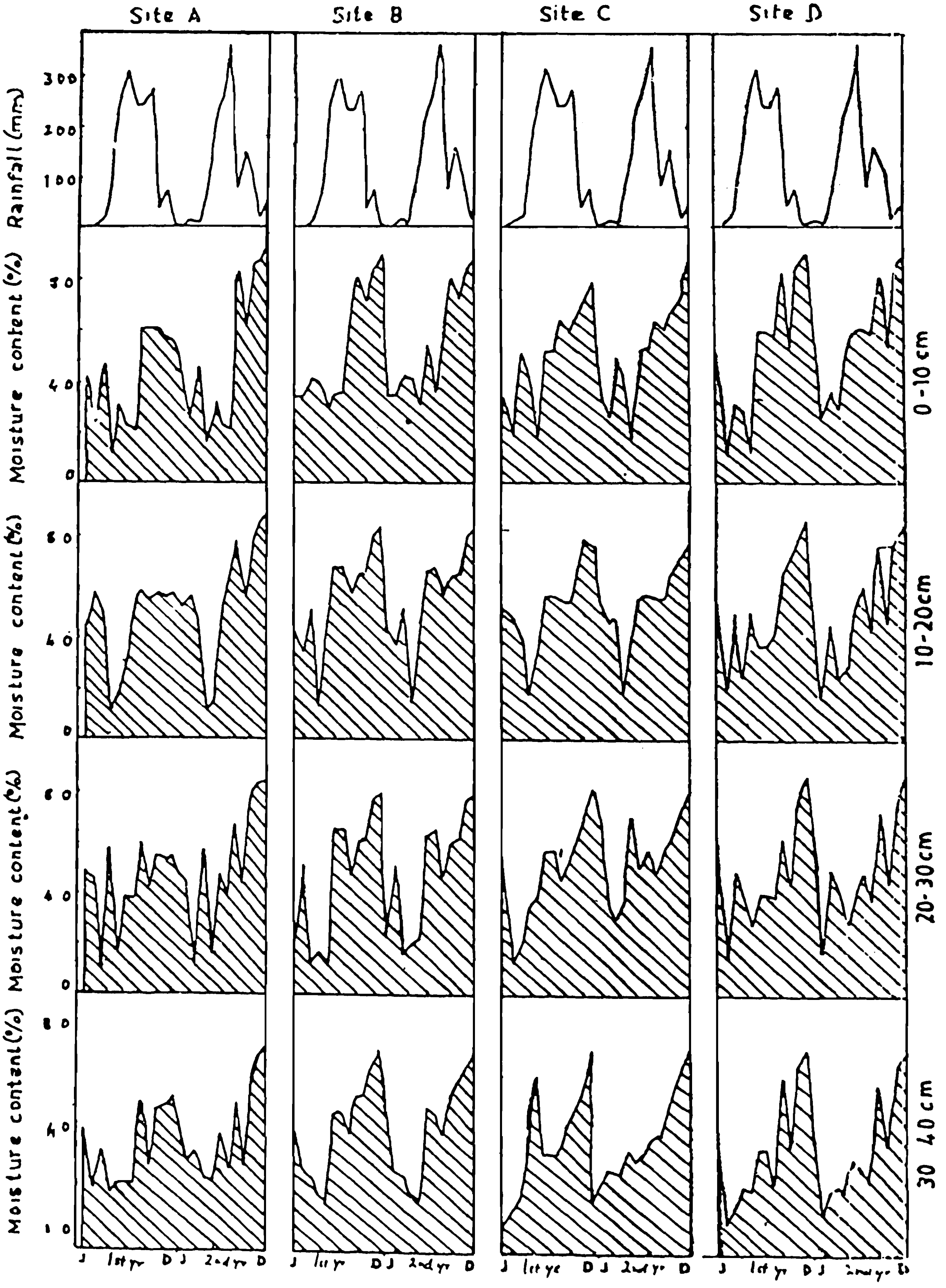

Fig. 20. The seasonal fluctuation of Rainfall and Moisture content.

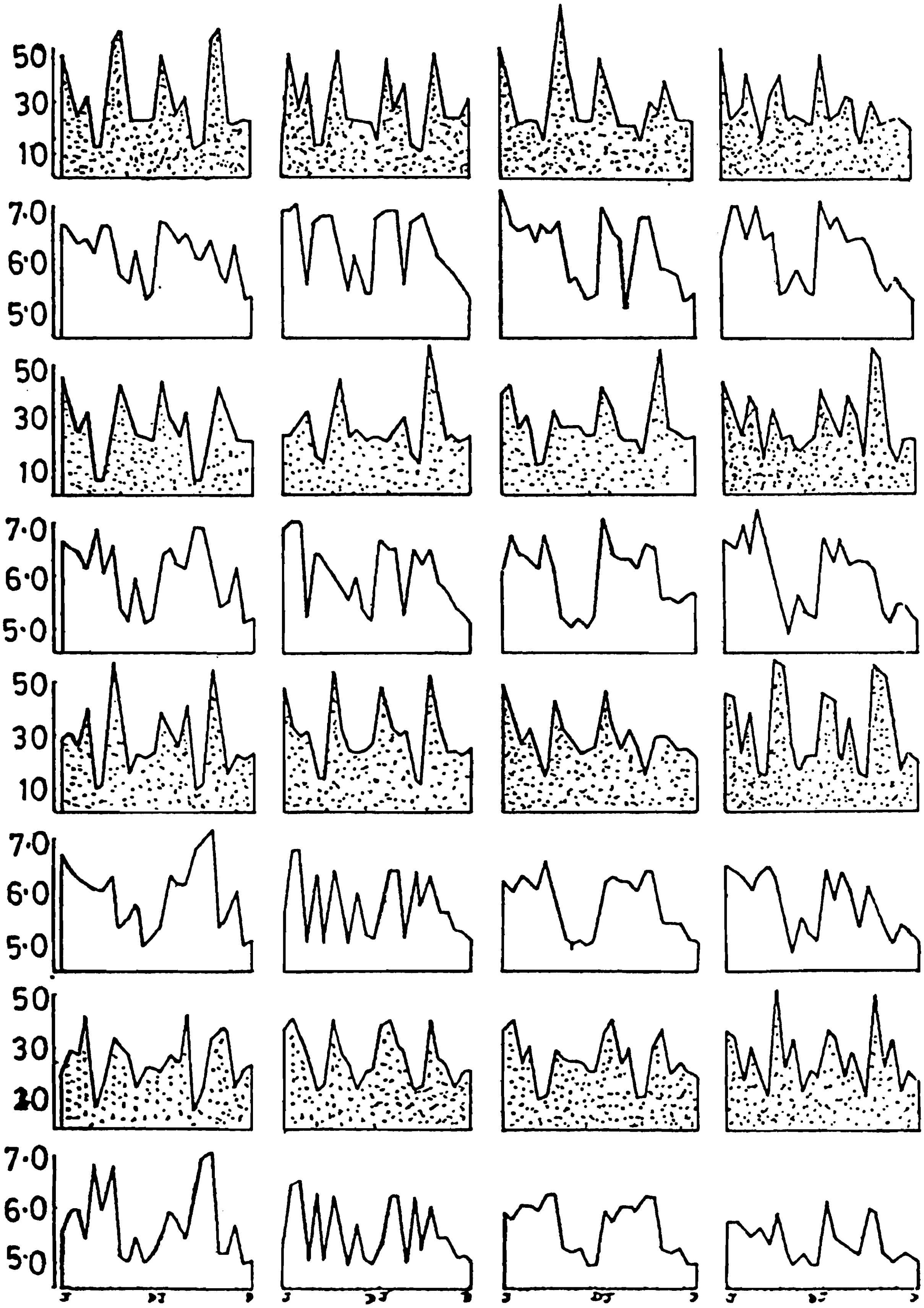

Fig. 21. The seasonal fluctuation of pH and Conductivity.

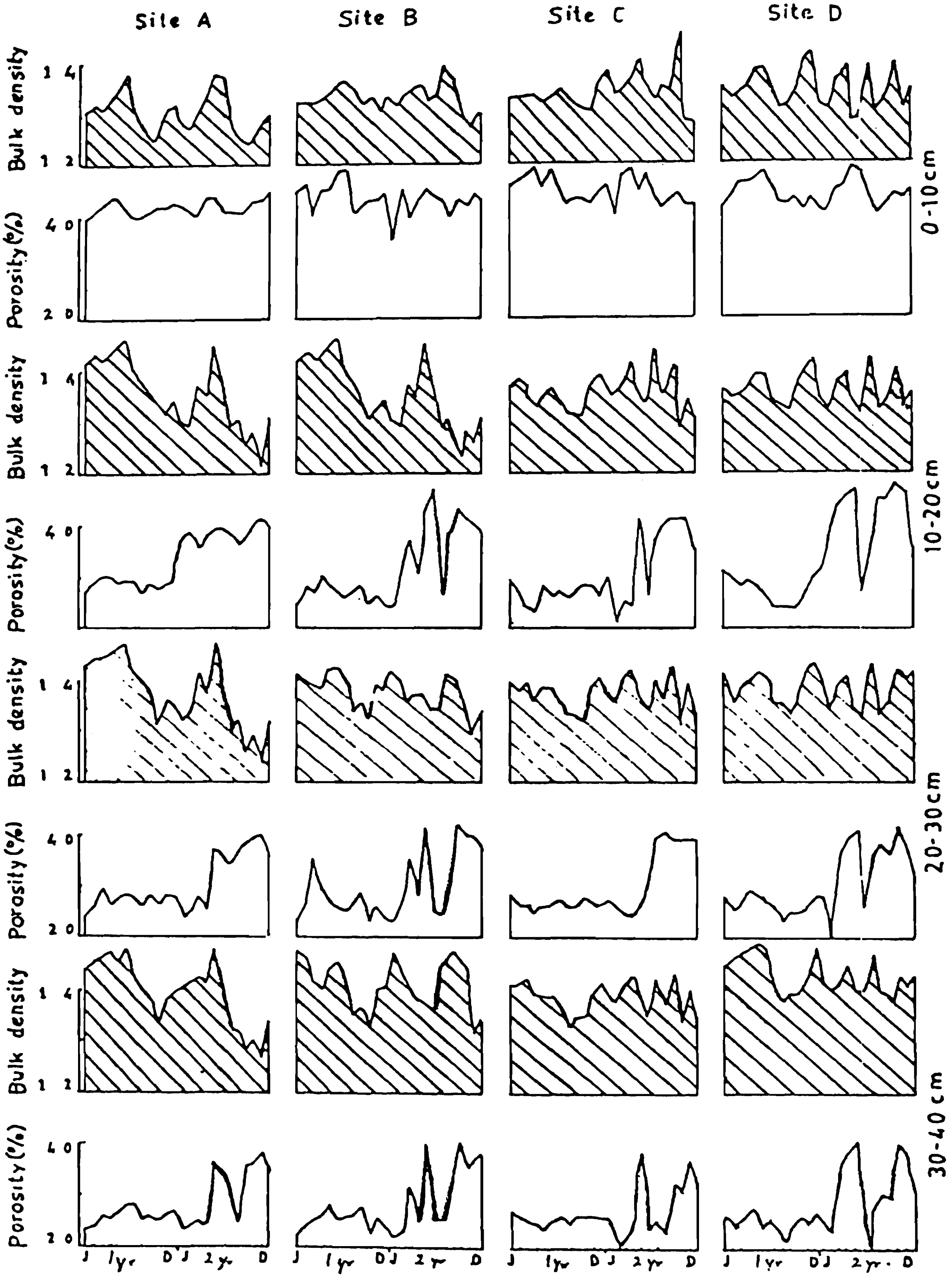

Fig. 22. The seasonal fluctuation of bulk-density & porosity.

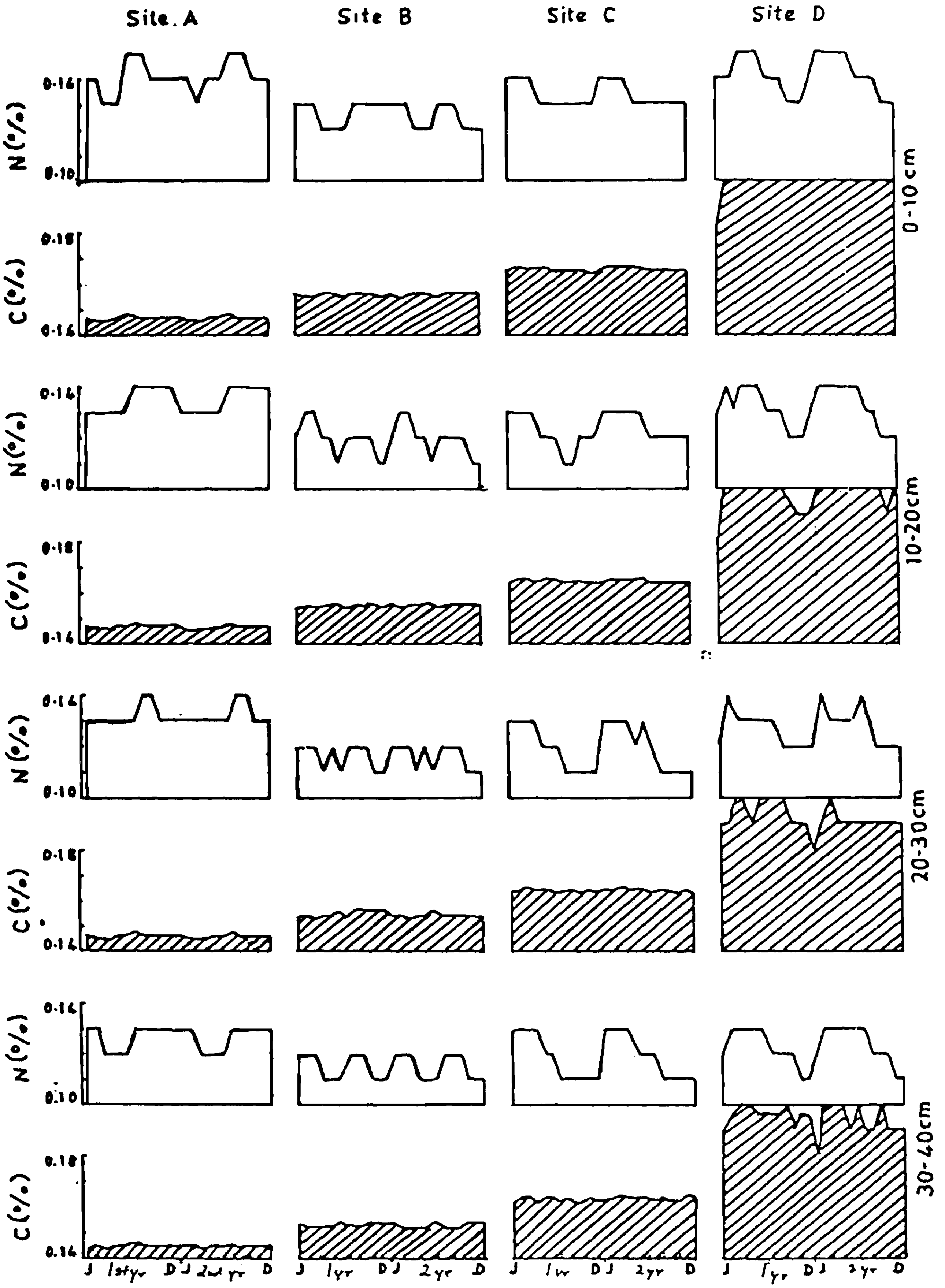

Fig. 23. The seasonal fluctuation of carbon and Nitrogen.

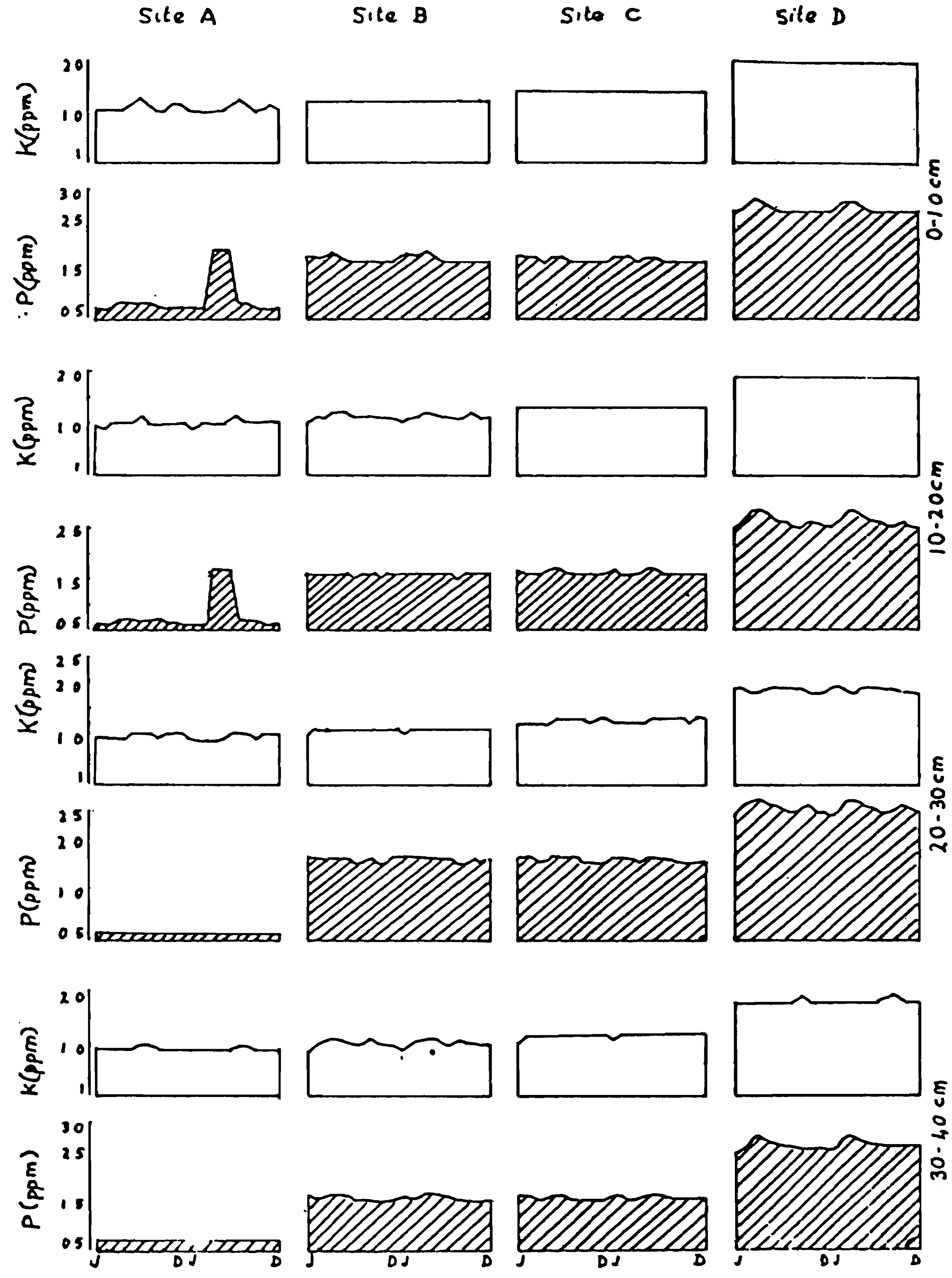

Fig. 24. The seasonal fluctuation of Potassium & Phosphorus.

The bulk density of the soil in both the annual cycles in sites A and B was maximum in the summer months and minimum in October, while it was maximum in December in sites C and D, though the minimum was the same. The bulk density ranged from 1.30 to 1.48 units in the first annual cycle and 1.24 to 1.43 units in the second annual cycle. The porosity of the soil followed the same pattern more or less as that of pH in all the sites, and ranged from 22.03 to 48.9% in all the sites during the entire study period (Fig. 22).

All the chemical factors (C, N, P, and K) also revealed the summer maxima and winter minima in all the sites in all the soil layers. The ranges of C, N, P and K were 1.45 to 2.1%; 0.12 to 0.18%; 0.06 to 0.28 ppm and 0.9 to 2.0 ppm respectively (Figs. 23 and 24).

DISCUSSION

The present work is unique, in that though the immediate effects on soil fauna after either burning or other stress factors considerable literature exists, very little is available on land abandoned after cultivation. Moreover, the work incorporated not only the study of cultivated land abandoned from 1 to 20 years, but also that this land was cultivated after the logging and burning processes had taken place and then left fallow. It is known that the length of a fallow period depends to a large extent on the vigour of several secondary succession, which is a complex ecological mechanism, we therefore confined ourselves only to the restoration of fertility of soil in such abandoned fallows by a comparative study of only the soil fauna in the different age groups of the fallows enabling identification of the actual period of recolonization to the original level of soil fauna.

It was seen that in general, the oldest fallow (20 years) had the maximum number of either total soil fauna or when broken up into micro, meso and macrofauna levels. This clearly indicated that a build up of soil fauna in older fallows exists. However, it was also observed from the results that the least abundance of the groups was seen in site B (5 years old), when one should have expected the lowest numbers in site A (1 year old), being the youngest fallow and the most recently abandoned after cultivation. This could be explained by the fact that immediately after cultivation any soil left untouched would attract a heavy density of soil fauna which would start colonizing, but unfavourable mineral conditions and other non suitable edaphic factors, results in decrease in numbers as can be observed in site B. These results agree with those of Karpinen (1958), Huhta *et. al.* (1967; 1969) and Moritz (1965) where they have clearly indicated a temporary increase in the numbers of soil fauna in particular Oribatids, immediately after clear cutting. However, reports also exist of the populations falling to half the original values (Kuhnelt, 1950) for Collembola. This immediate increase and later stabilizing effects primarily depends on succession of soil developments, which depends on the development of soil types (Rosek, 1978). Further, soil animal groups which occur in the later successional stages cannot live in less developed earlier stages probably for eco-physiological reasons, as they are not passive components of succession, hence they change the soil micro structure and are capable of pushing succession actively forward.

This is very true as seen from the results that micro, meso, macro and total soil fauna which dropped from the youngest fallow to the five year old fallow thereafter increased steadily till all of them recorded maximum in the oldest, which presumably could be the last stage of succession and total recolonization. This last aspect was very true in particular for mesofauna which recorded an abundance in the oldest fallow (site D) at a level equivalent to that in the youngest fallow (site A), which proves that stabilization had taken place and the density being reached to threshold levels, in addition to the species diversity. This was supported by the fact that in the present study a clear phenomena of succession and stabilization is seen. The numbers of either meso, micro or macrofauna when considered as a percentage of the total soil fauna in different sites, there was a drop in mesofauna, more or less equal levels in microfauna and increased percentage abundance of the total macrofauna as one goes from the youngest (site A) to the oldest fallow (site D).

One clear observation from the present study was that in the vertical distribution of the total soil fauna, there was a steady decrease from the top to the bottom soil layers regardless of the age of the fallow. This was true also when seen from either micro, meso or macrofaunal divisions, with minor variations at certain groups. Though the present study has been done on abandoned fallows after cultivation, yet the common phenomenon of soil inhabiting fauna abundant near the soil surface was observed, characteristic of any soil condition due to adequate living space, favourable moisture aeration rates and accumulation of organic debris, Weis-fogh, 1948; Murphy, 1953; Haarlov, 1960; Hale, 1967 and Wallwork, 1970. Similarly, there are exceptions to this general rule, for certain taxa which are deep soil inhabitants like Symphyla, Protura, Pauropoda, some mites and collembola as can also be seen from the present study when there were slight fluctuations in the study, decrease phenomenon from the top to bottom soil layers, revealing at certain times increase in the second layer, a rise and fall in alternate layers or an increase in the bottom-most layer, as has also been shown by early workers for general soil studies like Glasgow (1939), Salt *et. al.* (1948), Sheals (1957), Edwards (1959a,b), Poole (1961), Evans *et. al.* (1961) and Price (1975). This was also very true when the percentage of the total of either individual major groups or the larger broader divisions of micro, meso and macrofauna levels as in the present study, was observed. The study area no doubt though modified considerably by the effects of cultivation, fallowing and other habital disturbances associated with agricultural practices, the actual numbers or the percentages of the totals in the deeper soils for certain groups could be attributed to the result of surface impoverishment, favouring in the development of sub-surface fauna (Price, 1973; Price and Benham, 1977). This depth distribution is known to be governed by a complexity of factors, of which feeding habits, size of the individuals and microclimate conditions are some of the important ones. The reaction of these soil communities to such factors is different for groups or species and hence it would be difficult to generalize and assess the most important factor or factors determining their depth distribution (Pande and Berthet, 1975). However, the nearest correlation for depth distribution could be attributed to the larger climatic conditions of the area in operation at that given period of time.

To be more certain, one has to see that seasonal variations in the different groups as shown in the graphs (Fig. 2 to 18) for the present study. If so observed it was seen that there was a clear regularity in the seasonal fluctuations of not only the soil fauna but also in all its major sub-divisions and groups during both the annual cycles in all the sites. Invariably there was a clear rising of population from the maximal peaks in most cases during the winter months and especially in the months of November and December which is the onset of a cold period if at all in these humid tropics. This phenomenon was seen for all the major groups including total soil fauna like microfauna, mesofauna and macrofauna, except that in the latter the maximum though still in cold winter months occurred in the month of February and not in the months of November and December as in the other cases.

Further, the minimum recorded for these major groups was observed to be confined to the summer months and in most cases just before the onset of the monsoons, in the months of June and July. Such a regularity of a seasonal trend of fluctuation, where the maximum is in the winter and minimum in summer months was also seen in all the sub-divisions in the present study except in the case of Protozoa and its sub-groups, Chelonethi, Diplura, Isopoda, Mollusca ad Earthworms. Here the maximum was seen to occur in the autumn months of August, September, while the minimum was still in the summer months as in the other cases. One exception was seen in the order Diptera where the summer months of May recorded maximum and minimum in September, where one cannot draw conclusions to the possibilities of such an occurrence for only this group, though later some light is thrown when they are correlated with different abiotic and edaphic factors. Groups like Collembola, Cryptostigmata, Astigmata, Araneida and its two families, Clubionidae and Lycosidae were maximum in the winter month of December, minimum in the succeeding month of January. This seasonal trend of fluctuations has been seen to be observed in all the sites undertaken in the present study with very minor variations if at all among themselves.

Though the above have been general observations in regard to maximum and minimum population in the various groups of soil fauna studied, it was seen that in most cases there is a bimodal peak of abundance, where the magnitude of one is much less than the other. These peaks of abundance whether occurring during the winter months or autumn months always alternated with the summer or post-monsoon moths of very low abundances. This phenomenon was true for the minor subdivisions of the soil fauna also as shown in the present study (Fig. 3 to 18). Various authors have reported different peaks of abundance, as Bellinger (1954) recorded spring peak, while Poole (1961) a summer maxima with small winter peak, while Joosse (1969) spring and autumn for some species and summer for others. The work in tropical soils which is confined to southeast Asia and Japan, where Ogino *et. al.*, (1965) showed a collembola increase from August to March while Takeda (1973) recorded two peaks one in winter and other in summer. Niijima (1975) showed three peaks for the dominant species of Collembola studied. All these reveal that our own study also show affinities with one or more of the above reports, yet no definite trend of fluctuations can be seen to be similar in any two studies. Different climatic conditions prevailing in different regions always has an effect on the pattern of fluctuation disallowing any true comparison between any two regions. In the present study, it was also seen in particular for Collembola though December was the maximum, the immediate succeeding months recorded the minimum in both the annual cycles which further builds up slowly, indicative of an over-wintering population (Wallwork, 1959; Evans *et. al.*, 1961, Madge, 1969). The next major group being Acarina also revealed the trend similar to Collembola in the first year of study in sites A,B and C and for the second year in all the sites and for the first year in site D where it recorded a minimum in June. Such peaks of abundance in winter is not unusual (Curry, 1971). All the other groups followed one of these.

The pattern of seasonal fluctuations as mentioned above, was seen not to differ much between the different sites. However while the vertical distribution of the different groups were undertaken and their there does seem to be variations between the sites. The total soil fauna, microfauna and mesofauna revealed an increase in abundance from August to October-November in the second layer during both the years of study only in site A. Further in site D in the first two layers, microfauna is more or less constant, while in the remaining sites as in the case of macrofauna for all sites, the trend of a top to bottom layers decrease in numbers was seen throughout the study period irrespective of abundance or fall. This phenomenon of the second layer recording more in some months or were the same as related to the top surface layers was seen usually in site A even at minor sub-division levels like Prostigmata, Collembola, Hypogastruridae, Sminthuridae, Astigmata and family Clubionidae. The only groups which showed a constant decrease from top to the bottom soil layers without the effect of any season was Protozoa, Isotomidae, Acarina, Lycosidae, Chelonethi, Diplura, Protura, Isopoda and most of the macrofaunal groups. The groups Prostigmata, Sminthuridae, Cryptostigmata, Linyphidae revealed in site D for certain months and specially during the autumn months of August to October-November an increase in the second layer or more or less equal to the surface layer. The vertical distribution phenomenon as seen in site A where there was definitely migration to the second layer on the onset of winter could have been due to the non-stabilizing effect of the soil in the youngest fallow (site A) in contrast to the remaining fallows, where a clear separation of species in relation to primarily the pore space could have taken place. Further, in site A the surface layer has very little of litter cover in relation to other sites and this being exposed to cold temperature (winter) and desiccation (summer) of the soil surface would probably be responsible for such migration for the top to the second layer. Moreover, it was only observed in certain groups which were the most dominant groups in the present study (Van der Drift, 1951 and Usher, 1964). In site D a similar phenomenon as seen in site A for certain groups could be attributed to the fact that as reported earlier by many soil workers even in untouched forest soils, presence of a definite vertical migration in some species was in relation to their feeding behaviour. As only major subdivisions were taken into consideration in the study, it was not possible therefore to pinpoint the actual mechanism responsible for vertical migration in the oldest abandoned fallow (site D) though the effect of some abiotic factors and edaphic factors on these groups cannot be ruled out. Further as has been reported earlier, Acarina had a much evener vertical distribution than Collembola when one considered the major dominant groups in the present study. Such high populations in one strata and low populations in the other without any evidence of seasonal changes in vertical distribution have also been noted by many workers such as Glasgow (1939), Strickland (1945, 1947) and Stockli (1957).

The concept of vertical distribution of Collembola was outlined by Usher (1970a) and Hale (1966), who feel that seasonal changes in vertical distribution are not necessarily caused by differential mortality in Collembola. In groups where the maximum density irrespective of the season was seen in the top layer could be attributed to the attraction to the top humus layer where exists very small amplitudes of humidity and temperature and the presence of rich contents of organic substances (Imdate, 1974) and the annual pattern of seasonal incidence of any group in relation to their specific life history and ecoclimate of their habitat (Nosek, 1977). Therefore, unless the actual recruitment pattern of species are examined, the interpretation of seasonal density and its fluctuations in the vertical distribution can give very little concrete information. Populations are known with short generation times (r - strategists) to feed on labile organic substrates and exhibit marked fluctuations generation times (r - strategists) to feed on labile organic substrates and exhibit marked fluctuations while those with long generation times (K - strategists) are expected to consume nonliable substrates and hence show lower density fluctuations. Hence it is primarily dependent upon the opportunity for the individual species in any community for developing apt life history strategies adapt to the mosaic of the physical, environmental and food resources of the soil (Mitchel, 1977). The above phenomenon though not possible to be identified clearly indicates at least that the stability of the tropical fauna in the present study as one goes from the youngest abandoned fallow (site A) to the oldest abandoned fallow (site D) might be a consequence of their birth rate in conjunction with iteoparity (Cole, 1954). All these suggest that the vertical distribution is closely related with the habitat character and is determined and dependent by the response of the individuals to these characters (Takeda, 1973).

It is for this reason that the seasonal vertical distribution of soil fauna and its various groups in the different sites have been correlated with the various physico-chemical factors both of the atmosphere and the soil. When so considered it was seen the pH was usually maximum in the summer and minimum in winter in all the soil layers in different sites undertaken for both the annual cycles. However, in most of the cases, pH was negatively correlated to the various groups and highly significant. Moreover it was seen that for total soil fauna, mesofauna, Collembola and Acarina it was not significant while positively significant at $p < 0.01$ in the first layer at site A and negatively significant for the microfauna and prostigmata. This factor may also have some bearing for the vertical distribution of these groups showing maxima in the second layer during certain months. A similar phenomenon was also observed for Prostigmata in site D. pH was totally non-significant in the groups like Protozoa and total Insecta. There was no clear cut correlation variation in the soil layers at different sites except in A where most of these major groups revealed a highly significant negative correlation in the second and third layer for most sites. In the present study, pH was mostly on the acidic side therefore most of the groups were related to acidity (Hale, 1966; Nosek, 1957). Still further reports do exist of pH having no effect (Agrell, 1941; Bellinger, 1954; Paclt, 1956; Cassagnau, 1961, 1964; and Christiansen, 1964) (Tables XLIX to LXIV).

Conductivity revealed two peaks of increase in most of the sites one during the monsoon ad the other during winter. However, this factor was seen to be mostly nonsignificant and does not seem to play any major role except in Protozoa and Araneida. In these groups there was a negative correlation for the vertical distribution in various sites.

After pH, the next important factor which seem to affect the soil faunal levels was observed to be the soil moisture content. Here the correlation for most of the groups in the various levels at the different sites for both the annual cycles revealed a highly significant positive correlation, in particular for major subgroups and for those groups mentioned earlier where a vertical distribution pattern seasonally occurs the correlationship was at $P < 0.01$ level. However, many investigations have shown no relationship between soil moisture and various groups of soilfauna (Macfadyen, 1952, 1954; Huther, 1961; Marcuzzi, 1967, 1968, 1973), while others reported definite negative correlation (Hammer, 1934, 1937, 1953 and Stebaeua, 1962), yet it is known.

Acari and Collembola require high humidity (Kuhnelt, 1950; Christiansen, 1964), and that the period of prolonged drought seem to have serious effects on the survival of the individual (Nielsen, 1955a, 1955b) and that Collembola has been reported to be relatively resistant to short duration flooding and capable of not only living in the submerged conditions but also laying and hatching of eggs has been carried out. This therefore confirms from the present study that primarily it is the moisture gradient in the soil which was responsible for not only the vertical distribution but also for seasonal fluctuations in particular to total soil fauna, microfauna, mesofauna, prostigmata, acarina, collembola, aranedida, total insecta, ants total myriapoda which was directly correlated to the moisture content of the soil whereas, in the other groups it seemed to have they little effect (Tables-XLIX to LXIV).

Soil temperature and air temperature in the present study seemed to play a very negligible role in the abundance and vertical distribution, seasonally in all the sites for all the major groups. However air temperature, wherever observed significantly like Acarina, Total Insecta and Myriapoda were seen to affect primarily the surface layer and was significant negatively correlated at $P < 0.01$. In case of soil temperature a similar phenomenon was seen except that they were mostly positively significant at $P < 0.05$ level particularly in groups like total ants, acarina and myriapoda. Such a finding where the temperature either soil or atmosphere having very little effect on groups of soil fauna find very little support from the existing literature. Kevan (1965), Butcher *et. al.* (1971), Gupta and Dhooria (1974) showed a marked effect of soil and air temperature while Niijima (1971) attributed temperature effecting Collembola densities in winter.

However it is recorded that though temperature influences the metabolic rate, yet it is not considered ecologically important when soil fauna are capable of migrating to the deeper layers during high or low temperatures (Kuhnelt, 1950 and Christiansen, 1964), Reports exist for either winter or summer movements of many soil invertebrates moving down especially when temperature either rises or falls below a critical level (Dowdy, 1944; Pierrard *et. al.* 1963; Bocock and Heath, 1967 and Mitchell, 1978) (Tables-XLIX to LXIV).

Importance of rainfall as an abiotic factor affecting soil faunal groups in the present study seemed to be very negligible. There was no definite positive or negative correlation wherever they were significantly correlated either between layers of the same site or even between sites. These effects seem only as a negative correlation when the total soil fauna was considered and acarina for only the fourth layers and total insecta and myriapoda in particular, where in the latter the first layer in all the sites and the third layer in sites B and C were highly significant (negatively correlated at $P < 0.01$ level), while for the second layer in the same groups for all the sites it was positively correlated at $P < 0.05$ level. Such statistically non-significant seasonal differences of precipitation affecting the soil moisture is reported earlier (Burns, 1952; Terranut, 1956). However it is known that rainfall is the most important climate element in these areas. Therefore with the increase in rainfall and the topography of the region and steepness of the slope, affects the soil fauna (Muir, 1955), which probably helps these animals to be adapted to such situations.

The bulk density of the soil in the present study which seem to be a factor affecting soil fauna was observed to be a highly significant though negative in most of the groups at $P < 0.01$ level and in particular for the third and fourth layers. Further it was observed that in no case the animals in the first layer of any site was effected by the bulk density. The important groups affected by this factor in the third and fourth layer were Collembola, total mesofauna, Prostigmata, Acarina, Araneida, Insecta, Ants and Myriapoda. In addition, the total soil fauna showed a significant correlation in the second layer as was also true for total microfauna and ants. It seems to be that the third and the fourth layer of any site is the deciding fact for bulk density to operate as the factor on soil animals. From literature it seems that there are no reports of bulk density and soil faunal relationships either in forest soils, grassland or otherwise. The nearest was that of physical characteristics of compacted soil (Gooderham, 1973; El-Karouri, 1974; Aritajat, 1975 and Aritajat *et. al.* 1977).

The porosity of the soil and its effects on the various groups in the different soil layers seem to play a very negligible role even in major groups like Collembola and Acarina and total insects. This factor seems to play a role if at all in the fourth layer in site C for which no definite reason can be attributed. The first layer showing significantly positive correlation with the soil fauna and porosity was seen in groups like Protozoa and Araneida, while a negative correlation in the same layer was seen in Prostigmata at $P < 0.05$. Porosity as a factor is known to be directly related to the drainage and therefore probably affects the reproductive capacity of the animals (Margalef, 1963; Pianka, 1970). Further it is known that with a soil moisture content of 30%, the relative humidity of soil pore-spaces may not fall below 90% (Thandrup, 1939). This excess water therefore creates competition for living space (Murphy, 1955). This phenomenon can also be seen in the present study when during the rainy months groups like Protozoa and Apaneida while showing either more or less equal abundance in the top two layers, and Prostigmata shows a negative correlation proving its migration due to its predatorial habits to deeper layers.

In regard to the chemical factors undertaken in the present study it seems that only Nitrogen and Potassium seem to play a significant role if at all, while Carbon and Phosphorus showed no definite trends of correlations either between layers or between sites. It seems that the third layer especially in sites A and D was affected by the chemical factors such as Nitrogen and Potassium, the former negatively and latter positively significant at $P < 0.05$ levels. Phosphorus and Carbon wherever present and significantly correlated was only in the fourth layer mostly in site C. The earlier phenomenon was seen to be in groups like Collembola, total mesofauna, Prostigmata, Araneida and Acarina, while the latter was seen among the same groups and in addition in Protozoa. The negatively significant correlation of Potassium particularly in the second layer in most sites were observed to be in the groups of insects, Ants and Myriapods. The latter negative correlation was also seen for Phosphorus in the second layer in all the sites at $P < 0.05$. Such negative correlation particularly between the levels of Nitrogen and Phosphorus in the soil have been well documented and the positive correlations of Phosphorus to larger groups is similarly known (Edwards and Lofty, 1974). Similar negative correlations with Carbon has also been shown by these workers. It is however difficult to see how the amount of Phosphorus would play any role as those of Carbon, Nitrogen and Potassium. Work also exist on the levels of Phosphorus, positively correlated at least at specific levels of spiders and Collembola while at latter total numbers was much less affected by Potassium as was seen in the present study (Edwards *et. al.* 1975). Soil animals are known to return the elements to soil in the chemical forms quite different from plants and their moults and faeces contribute chemicals like Phosphorus, while Earthworms and Ants are known to excavate chemicals from deeper layers and bring it to the surface (Byzova, 1970; Koklovskaja, 1965; Dimo, 1958; Lee and Wood, 1971).

TABLE XLIX

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study site A and at the soil depth 0–10 cm

	TF	MiF	Pro	Pros	MeF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	0.348	0.764**	0.149	0.691**	0.268	0.153	– 0.045	– 0.566**	– 0.268	– 0.153	– 0.045	– 0.348
Con	–0.094	0.330	– 0.470*	0.451*	0.243	0.280	0.169	– 0.697**	– 0.243	– 0.280	– 0.169	0.094
Moi.	–0.433*	– 0.499*	– 0.295	– 0.395	– 0.328	– 0.243	– 0.216	0.066	0.328	0.243	0.216	0.433*
ST.	0.311	– 0.110	– 0.219	– 0.437*	– 0.263	– 0.338	– 0.516*	– 0.094	0.263	0.338	0.516*	– 0.311
AT.	0.472*	– 0.071	– 0.246	0.161	0.386	0.325	0.190	– 0.011	– 0.386	– 0.325	– 0.190	– 0.472*
RF.	0.626**	– 0.032	– 0.246	0.040	0.533*	0.415	0.047	0.070	– 0.533*	– 0.415	– 0.047	– 0.626**
BD.	–0.132	0.304	0.486*	0.153	0.286	0.234	0.184	0.316	– 0.286	– 0.234	– 0.184	0.132
Por.	–0.053	– 0.440*	0.543**	– 0.578**	0.197	– 0.215	0.180	0.597**	0.198	0.215	0.180	0.053
C	0.369	– 0.159	– 0.147	– 0.110	0.287	0.224	0.182	0.115	– 0.287	– 0.224	0.182	– 0.369
N	0.090	– 0.038	– 0.529*	0.115	0.292	0.297	0.032	– 0.223	– 0.292	– 0.297	0.032	– 0.090
P	0.390	0.108	0.257	0.031	0.192	0.190	0.219	0.261	– 0.192	– 0.190	– 0.219	– 0.390
K	0.038	– 0.183	0.000	– 0.176	0.229	0.259	0.184	0.224	– 0.229	– 0.259	– 0.184	– 0.038

* = P < 0.05
** = P < 0.01

Cond. : Conductivity; Moi. : Moisture content; S.T. : Soil temperature; A.T. : Air temperature; R.F. : Rainfall; B.D. : Bulk–density; Por. : Porosity.

Tsf : Total soil fauna; MiF : Microfauna; Pros : Prostigmata; Pro : Protozoa; MeF : Mesofauna; Col : Collembola; Aca : Acarina; Ara : Araneida; MaF : Macrofauna; Ins : Insects; Ant : Ants; Myr : Myriapoda.

TABLE L

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study site A and at the soil depth 10–20 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.688**	- 0.321	- 0.070	- 0.753**	- 0.677**	- 0.670**	- 0.581*	- 0.749**	- 0.335	- 0.075	- 0.121	- 0.360
Con	- 0.125	0.065	0.454*	- 0.035	- 0.296	- 0.257	- 0.387	- 0.160	0.006	- 0.103	- 0.040	- 0.019
Moi	0.340	0.166	0.304	0.084	0.206	0.153	0.009	0.346	0.546**	0.409	0.454*	0.432*
ST	0.135	- 0.228	0.090	- 0.150	0.108	0.071	0.007	0.234	0.313	0.307	0.149	0.373
AT	- 0.137	- 0.223	0.160	- 0.040	- 0.142	- 0.195	-0.081	- 0.065	- 0.203	- 0.230	0.186	0.255
RF	- 0.339	- 0.290	0.091	- 0.346	- 0.224	- 0.149	- 0.232	- 0.054	- 0.443*	- 0.394	- 0.185	0.476*
BD	- 0.536*	- 0.412	- 0.085	- 0.393	- 0.406	- 0.318	0.062	- 0.147	- 0.254	- 0.060	- 0.519*	- 0.256
Por	0.056	- 0.076	0.123	- 0.088	0.137	0.172	- 0.008	0.170	0.252	0.340	0.460*	0.240
C	- 0.065	0.157	- 0.099	0.403	0.351	0.337	0.322	0.240	0.382	0.252	0.521*	0.176
N	0.620**	0.585*	- 0.097	0.503*	0.627**	0.038	- 0.014	0.131	0.097	0.060	0.433*	0.055
P	- 0.316	- 0.321	- 0.087	- 0.284	- 0.243	- 0.132	- 0.141	- 0.235	- 0.329	- 0.207	- 0.588*	- 0.315
K	0.063	0.133	0.073	0.153	0.211	0.227	0.262	0.364	- 0.327	- 0.890**	- 0.519*	- 0.457*

* = $P < 0.05$
** = $P < 0.01$

Cond : Conductivity; Moi : Moisture content; S.T. : Soil temperature; A.T. : Air temperature; R.F. : Rainfall; B.D. : Bulk-density; Por : Porosity.

TF : Total soil fauna; MiF : Microfauna; Pros : Prostigmata; Pro : Protozoa; McF : Mesofauna; Col : Collembola; Aca : Acarina; Ara : Aranaida; MaF : Macrofauna; Ins : Insecta; Ant : Ants; Myr : Myriapoda.

TABLE LI

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study site A at the soil depth 20–30 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	– 0.694**	– 0.549**	– 0.271	– 0.504*	– 0.720**	– 0.646**	– 0.533*	– 0.600**	– 0.271	– 0.252	– 0.109	– 0.194
Con	– 0.309	– 0.425*	– 0.112	– 0.497	– 0.310	– 0.345	– 0.334	– 0.103	– 0.140	– 0.062	0.495	– 0.397
Moi	0.471*	0.192	0.221	0.038	0.338	0.467*	0.141	0.371	0.412	0.389	0.274	0.068
ST	0.212	0.361	0.362	0.130	0.021	– 0.005	– 0.042	0.234	0.348	0.221	0.190	0.447*
AT	– 0.153	0.222	0.392	– 0.106	0.113	– 0.198	– 0.056	0.008	– 0.179	– 0.251	– 0.061	– 0.059
RF	– 0.271	0.300	0.471*	0.053	– 0.139	– 0.240	– 0.079	0.041	– 0.398	– 0.501*	– 0.378	– 0.256
BD	– 0.650**	– 0.256	– 0.256	– 0.094	– 0.429*	– 0.423*	– 0.204	– 0.429	– 0.672**	– 0.687**	– 0.459*	– 0.570*
Pro	0.440*	0.479*	0.238	0.436*	0.379	0.268	0.353	0.283	0.889	– 0.042	– 0.155	– 0.041
C	0.049	0.380	0.373	0.007	0.226	0.865	0.143	0.475*	– 0.041	– 0.012	– 0.030	– 0.134
N	0.203	0.505*	0.860**	– 0.175	0.110	0.124	0.051	0.355	0.428*	0.464*	0.432*	0.258
P	0.000	0.000	0.000	– 0.383	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K	0.462*	0.465*	0.117	0.483*	0.527*	0.482*	0.445*	0.558**	0.143	0.216	0.007	– 0.058

* = $P < 0.05$
** = $P < 0.01$

Con : Conductivity; Moi : Moisture content; S.T. : Soil temperature; A.T : Air temperature; R.F. : Rainfall; B.D. : Bulk–density; Por : Porosity.

T.F : Total soil fauna; MiF : Microfauna; Pros : Prostigmata; Pro : Protozoa; McF : Mesofauna; Col : Collembola; Aca : Acarina; Ara : Araneida; McF : Macrofauna; Ins : Insects; Ant : Ants; Myr : Myriapoda.

TABLE LII

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study – period at study site A at the soil depth 30–40 cms

	TF	MiF	Pro	Pros	MeF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.581**	- 0.633**	0.125	- 0.735**	- 0.582**	- 0.505*	- 0.415	- 0.216	0.008	- 0.389	- 0.430*	- 0.426*
Con	0.232	0.182	0.241	- 0.023	- 0.095	0.013	- 0.052	- 0.120	0.256	- 0.203	0.004	- 0.073
Moi	0.584**	0.655**	0.258	0.602**	0.555**	0.654	0.510*	0.186	0.272	0.485*	0.404	0.391
ST	0.073	- 0.012	- 0.200	0.090	0.114	0.240	0.130	0.183	0.030	0.266	0.203	0.396
AT	- 0.196	- 0.080	0.014	- 0.103	- 0.156	- 0.176	- 0.378	- 0.028	- 0.357	- 0.079	- 0.342	- 0.107
RF	- 0.332	- 0.078	0.414	- 0.257	- 0.211	- 0.094	- 0.578**	- 0.442*	0.210	- 0.048	- 0.465*	- 0.249
BD	- 0.664**	- 0.649**	- 0.162	- 0.663**	- 0.643**	- 0.448*	- 0.123	- 0.302	- 0.216	- 0.472*	- 0.081	- 0.415
Por	- 0.081	0.221	- 0.039	0.255	0.358	0.416	0.342	0.031	0.037	0.434*	0.345	0.243
C	0.052	- 0.058	0.136	- 0.078	- 0.076	0.242	0.055	- 0.067	0.210	- 0.024	0.080	0.313
N	0.567**	0.497*	0.049	- 0.082	- 0.028	0.101	0.364	0.063	0.101	- 0.099	0.256	0.299
P	- 0.668**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K	- 0.668**	0.225	0.899**	- 0.129	- 0.160	0.097	- 0.295	- 0.304	0.402	- 0.211	- 0.151	- 0.208

* = $P < 0.05$
** = $P < 0.01$

Con : Conductivity; Moi : Moisture content; S.T. : Soil temperature; A.T. : Air temperature; R.F. : Rainfall; B.D. : Bulk-density; Por : Porosity.

TF : Total soil fauna; MiF : Microfauna; Pros : Prostigmata; Pro : Protozoa; MeF : Mesofauna; Col : Collembola; Aca : Acarina; Ara : Araneida; MaF : Macrofauna; Ins : Insects; Ant : Ants; Myr : Myriapoda.

TABLE LIII

The correlation coefficient between the different ahictic factors and the major groups of soil fauna for the total study period at study site B at the soil depth 0-10 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.597**	- 0.645**	- 0.221	- 0.598**	0.178	0.141	- 0.091	- 0.571**	- 0.271	- 0.183	0.098	- 0.353
Con	0.074	0.124	0.236	0.248	0.039	0.081	0.168	- 0.691**	- 0.253	- 0.291	- 0.163	0.096
Moi	0.771**	0.801**	0.548**	0.641**	0.623**	0.481*	0.211	0.112	0.318	0.348	0.281	0.438*
ST	0.045	0.049	0.128	0.321	0.114	0.234	0.638**	- 0.084	0.274	- 0.391	0.581**	- 0.319
AT	- 0.325	0.291	0.284	0.184	0.392	0.374	0.182	- 0.018	- 0.392	- 0.312	- 0.196	- 0.481*
RF	- 0.489*	- 0.121	- 0.214	- 0.013	0.423	0.384	0.087	0.071	- 0.541**	- 0.423*	- 0.097	- 0.631**
BD	- 0.334	0.297	0.212	0.148	0.281	0.272	0.192	0.321	- 0.291	- 0.335	- 0.188	0.152
Por	- 0.202	- 0.069	0.418	- 0.435*	0.114	0.295	0.183	0.581**	0.197	0.291	0.189	0.081
C	0.004	- 0.296	- 0.212	- 0.189	0.256	0.241	0.191	0.123	- 0.293	- 0.312	0.183	- 0.381
N	0.176	0.399	0.414	0.119	0.281	0.298	0.071	- 0.281	- 0.281	- 0.119	0.041	- 0.098
P	- 0.412	0.285	0.313	0.113	0.212	0.181	0.292	0.251	- 0.181	- 0.181	- 0.220	- 0.391
K	0.000	0.297	0.000	0.181	0.238	0.274	0.174	0.242	- 0.234	- 0.291	- 0.183	- 0.081

* = $P < 0.05$
** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LIV

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study site B at the soil depth 10–22 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.475*	- 0.547**	- 0.082	- 0.641**	- 0.612**	0.612**	- 0.571**	- 0.723**	- 0.312	- 0.041	- 0.112	- 0.312
Con	- 0.049	0.235	- 0.462*	- 0.081	- 0.316	- 0.281	- 0.313	- 0.112	0.007	- 0.109	- 0.081	- 0.016
Moi	0.548**	0.680**	0.308	0.091	0.282	0.183	0.008	0.348	0.587**	0.419	0.481*	0.442*
ST	0.190	- 0.021	0.081	- 0.154	0.118	0.082	0.009	0.332	0.318	0.309	0.153	0.381
AT	- 0.399	- 0.333	0.186	- 0.081	- 0.192	- 0.181	- 0.092	- 0.081	- 0.281	- 0.241	0.191	0.259
RF	- 0.449*	- 0.258	0.041	- 0.414	- 0.284	- 0.181	- 0.258	- 0.069	- 0.479*	- 0.381	- 0.191	0.482*
BD	0.496*	- 0.254	- 0.091	- 0.312	- 0.491*	- 0.398	0.092	- 0.187	- 0.212	- 0.091	- 0.512*	- 0.281
Por	0.094	- 0.029	0.191	- 0.091	0.181	0.182	- 0.009	0.117	0.281	0.346	0.412	0.281
C	- 0.240	- 0.156	0.081	0.402	0.350	0.363	0.328	0.261	0.391	0.257	0.581**	0.196
N	- 0.264	- 0.403	0.091	0.508*	0.612**	0.051	- 0.081	0.182	0.091	0.081	0.481*	0.057
P	0.023	- 0.126	- 0.091	- 0.281	- 0.256	- 0.181	- 0.143	- 0.241	- 0.331	- 0.281	- 0.591**	- 0.323
K	- 0.279	- 0.277	- 0.173	0.158	0.281	0.231	0.281	0.381	- 0.338	- 0.818**	- 0.512*	- 0.461*

$* = P < 0.05$

$** = P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insecta; Ant = Ants; Myr = Myriapoda.

TABLE LV

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study period at study site B at the soil depth 20–30 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	– 0.457*	– 0.418	0.068	– 0.456*	– 0.502**	– 0.505*	– 0.553**	– 0.482*	0.130	0.083	0.136	– 0.031
Con	– 0.162	– 0.020	0.438*	– 0.191	– 0.240	– 0.333	– 0.328	– 0.216	0.056	– 0.019	– 0.015	– 0.055
Moi	0.580**	0.789**	0.173**	0.743**	0.757**	0.701**	0.790**	0.714**	0.234	0.269	0.376	0.202
ST	0.021	0.202	0.285	0.097	0.059	0.131	0.111	0.016	– 0.033	0.028	0.294	– 0.305
AT	0.010	– 0.128	0.275	– 0.238	– 0. 185	– 0.140	– 0.093	– 0.232	– 0.306	– 0.436*	– 0.178	– 0.467*
RF	– 0.194	– 0.031	0.360	– 0.173	– 0.189	– 0.071	– 0.047	– 0.250	– 0.628**	– 0.652**	– 0.309	– 0.721**
BD	– 0.488*	– 0.432*	0.159	– 0.337	– 0.428*	– 0.417	– 0.453*	– 0.438*	0.428*	0.419	0.276	0.306
Por	0.319	0.265	– 0.016	0.272	0.284	0.349	0.291	0.281	0.071	0.160	0.179	0.000
C	0.005	0.004	– 0.560*	0.153	0.140	0.185	0.162	0.151	0.017	0.020	– 0.205	0.204
N	– 0.474*	– 0.277	0.627**	– 0.528*	– 0.544**	– 0.483*	– 0.557**	– 0.505*	0.016	– 0.077	– 0.067	– 0.223
P	– 0.349	– 0.433*	– 0.340	– 0.313	– 0.407	– 0.389	– 0.407	– 0.338	0.009	0.047	– 0.240	0.114
K	0.160	0.183	– 0.075	0.217	0.301	0.347	0.365	0.279	0.001	0.021	0.199	0.004

* = $P < 0.05$

** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T = Soil temperature; A.T = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro : Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insecta; Ant = Ants; Myr = Myriapoda.

TABLE LVI

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study period at study site B at the soil depth 30–40 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	– 0.316	– 0.319	0.010	– 0.616**	– 0.582**	– 0.583**	– 0.413	– 0.219	0.001	– 0.381	– 0.440**	– 0.448*
Con	– 0.198	0.109	0.245	– 0.083	– 0.094	0.023	– 0.081	– 0.131	0.284	– 0.281	0.008	– 0.081
Moi	0.707**	0.867**	0.453*	0.643**	0.554**	0.681**	0.581**	0.192	0.281	0.494*	0.481*	0.394
ST	– 0.474	– 0.058	0.242	0.094	0.124	0.341	0.138	0.194	0.041	0.284	0.208	0.382
AT	– 0.310	– 0.245	0.141	– 0.113	– 0.181	– 0.192	– 0.384	– 0.112	– 0.367	– 0.083	– 0.352	– 0.187
RF	– 0.393	– 0.093	0.412	– 0.253	– 0.210	– 0.084	– 0.572**	– 0.414	0.208	– 0.084	– 0.336	– 0.242
BD	– 0.023	0.453*	– 0.460*	– 0.632**	– 0.613**	– 0.448*	– 0.101	– 0.301	– 0.214	– 0.471*	– 0.071	– 0.423*
Por	0.317	0.224	0.084	0.312	0.348	0.420	0.341	0.081	0.307	0.414	0.342	0.241
C	0.354	0.236	– 0.483*	– 0.071	– 0.073	0.341	0.081	0.216	– 0.034	0.091	0.313	0.341
N	– 0.326	0.249	0.094	– 0.091	– 0.018	0.201	0.361	0.083	0.108	– 0.091	0.354	0.281
P	– 0.797**	– 0.550**	0.183	0.193	0.485*	0.231	0.414	0.423*	0.493*	0.118	0.119	0.121
K	– 0.136	– 0.337	0.642**	– 0.112	– 0.140	0.023	– 0.192	– 0.301	0.201	– 0.209	– 0.151	– 0.118

* = $P < 0.05$

** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insecta; Ant = Ants; Myr = Myriapoda.

TABLE LVII

The correlation coefficient between the different abiotic factors and the major groups of soil fauna for the total study period at study period at study site C at the soil depth 0–10 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	– 0.601**	– 0.402	– 0.123	– 0.581**	0.117	0.123	– 0.080	– 0.542**	– 0.281	– 0.181	0.081	– 0.343
Con	0.018	0.196	0.248	0.298	0.084	0.091	0.193	– 0.698**	– 0.268	– 0.299	– 0.181	0.101
Moi	0.489*	0.674**	0.313	0.418	0.408	0.210	0.103	0.308	0.342	0.281	0.281	0.432*
ST	0.225	0.205	0.132	0.221	0.101	0.212	0.632**	– 0.081	0.217	– 0.381	0.580**	– 0.309
AT	0.220	– 0.033	0.212	0.438*	0.423*	0.371	0.114	– 0.001	– 0.382	– 0.212	– 0.116	– 0.423*
RF	– 0.240	0.220	– 0.212	– 0.023	0.428*	0.381	0.081	0.061	0.541**	– 0.429*	– 0.097	– 0.648**
BD	– 0.237	– 0.292	0.418	0.142	0.292	0.273	0.191	0.328	– 0.091	– 0.241	– 0.198	0.162
Por	– 0.594**	– 0.626**	0.448*	– 0.440*	0.134	0.291	0.191	0.591**	0.196	0.282	0.191	0.093
C	– 0.562**	– 0.513*	– 0.281	– 0.191	0.212	0.241	0.191	0.128	– 0.281	– 0.212	0.183	– 0.282
N	– 0.366	– 0.670**	0.720**	0.129	0.312	0.323	0.118	– 0.313	– 0.318	– 0.214	0.121	– 0.101
P	– 0.680**	– 0.693**	0.414	0.123	0.284	0.182	0.281	0.241	– 0.181	– 0.173	– 0.232	– 0.384
K	– 0.672**	– 0.095	0.113	0.191	0.332	0.281	0.182	0.243	– 0.334	– 0.280	– 0.191	– 0.071

* = $P < 0.05$
** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por – Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro : Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insecta; Ant = Ants; Myr = Myriapoda.

TABLE LVIII

The correlation coefficient between the different abiotic factors and the major groups of the soil fauna for total study period, at study site C at the soil depth 10–20 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.511*	- 0.534*	- 0.191	- 0.713**	- 0.703**	0.613**	- 0.818**	- 0.423*	- 0.151	- 0.223	- 0.123	- 0.433*
Con	0.091	0.241	0.558**	- 0.153	- 0.421	- 0.371	- 0.423*	- 0.223	0.117	- 0.208	- 0.191	- 0.123
Moi	0.492*	0.371**	0.302	0.191	0.372	0.194	0.118	0.342	0.512*	0.423*	0.581**	0.413
ST	0.167	- 0.081	0.091	- 0.584**	0.123	0.112	0.119	0.342	0.391	0.373	0.184	0.391
AT	- 0.603**	- 0.581**	0.191	- 0.091	- 0.182	- 0.191	- 0.113	- 0.112	- 0.373	- 0.253	- 0.181	0.253
RF	- 0.059	0.448*	- 0.123	- 0.414	0.391	0.188	- 0.212	-0.081	- 0.471*	- 0.381	- 0.192	0.523*
BD	- 0.547**	0.254	- 0.113	- 0.332	- 0.481*	- 0.339	0.091	- 0.181	- 0.281	0.381	- 0.442*	0.291
Por	0.590**	- 0.212	0.182	- 0.118	0.191	0.198	- 0.008	0.118	0.298	0.391	0.513*	0.372
C	0.487*	0.181	0.123	0.414	0.381	0.373	0.381	0.281	0.383	0.357	0.581**	0.210
N	- 0.822**	- 0.616**	0.098	0.616**	0.681**	0.068	- 0.019	0.192	0.098	0.088	0.582**	0.158
P	- 0.554**	- 0.118	- 0.098	- 0.381	- 0.266	- 0.183	- 0.188	- 0.258	- 0.388	- 0.291	- 0.588**	- 0.584**
K	- 0.544**	- 0.288	- 0.181	0.168	0.384	0.241	0.288	0.388	- 0.393	- 0.761**	- 0.551**	- 0.468*

* = $p < 0.05$

** = $p < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Ace = Acarina ; Ara = Araneide; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LIX

The correlation coefficient between the different abiotic factors and the major groups of the soil fauna for total study period at study site C at the soil depth 20–30 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.504*	- 0.483*	0.032	- 0.492*	- 0.544**	- 0.599**	- 0.489*	- 0.424*	0.142	0.092	0.135	- 0.044
Con	- 0.196	- 0.081	0.449*	- 0.214	- 0.341	- 0.383	- 0.323	- 0.255	0.081	- 0.290	- 0.025	- 0.025
Moi	0.375	0.577**	0.123	0.562**	0.574**	0.604**	0.678**	0.634**	0.241	0.248	0.365	0.198
ST	- 0.117	0.284	0.314	0.113	0.108	0.235	0.247	0.082	- 0.710	0.020	0.345	-0.434*
AT	- 0.313	- 0.334	0.281	- 0.313	- 0.191	- 0.141	- 0.091	- 0.238	- 0.391	- 0.448	- 0.183	- 0.488*
RF	- 0.674**	- 0.505*	0.274	- 0.310	- 0.181	- 0.074	- 0.078	- 0.241	- 0.341	- 0.431*	- 0.172	- 0.473*
BD	- 0.605**	- 0.612**	0.184	- 0.383	- 0.448*	- 0.434*	- 0.461*	- 0.442*	0.437*	0.408	0.273	0.304
Por	0.469*	0.385	- 0.181	0.291	0.273	0.348	0.282	0.274	0.081	0.118	0.181	0.117
C	0.596**	0.014	- 0.432*	0.123	0.114	0.174	0.143	0.145	0.023	0.014	- 0.241	0.208
N	- 0.779**	- 0.544**	0.817**	- 0.732**	- 0.561**	- 0.441**	- 0.581**	- 0.501**	0.081	- 0.018	- 0.083	- 0.313
P	- 0.609**	- 0.642**	- 0.314	- 0.343	- 0.412	- 0.383	- 0.409	- 0.333	- 0.007	- 0.043	- 0.243	0.118
K	- 0.606**	- 0.183	0.174	0.313	0.408	0.434*	0.361	0.278	0.058	0.084	0.123	0.099

* = $P < 0.05$

** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; MeF = Mesofauna; Col = Collembola; Acc = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LX

The correlation coefficient between the different abiotic factors and the major groups of the soil fauna for total study period at site C at the soil depth 30–40 cms

	TF	MiF	Pro	Pros	MeF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.130	- 0.181	0.081	- 0.514*	- 0.572**	- 0.414	- 0.403	- 0.292	0.008	- 0.317	- 0.423*	- 0.434*
Con	0.059	0.043	0.212	- 0.071	- 0.081	0.033	- 0.070	- 0.121	0.273	- 0.273	- 0.007	- 0.071
Moi	- 0.043	- 0.134	0.414	0.523*	0.551**	0.613**	0.571**	0.119	0.273	0.481*	0.471*	0.333
ST	0.139	0.114	0.212	0.081	0.131	0.339	0.157	0.181	0.071	0.271	0.207	0.379
AT	- 0.513*	- 0.431*	0.318	- 0.303	- 0.343	- 0.113	- 0.481*	- 0.182	- 0.313	- 0.091	- 0.342	- 0.158
RF	- 0.291	- 0.084	0.431*	- 0.241	- 0.223	- 0.073	- 0.581**	- 0.492*	0.248	- 0.086	- 0.341	- 0.281
BD	- 0.624**	0.515*	- 0.414	- 0.682**	- 0.653**	- 0.471*	- 0.118	- 0.371	- 0.216	- 0.462*	- 0.013	- 0.464*
Por	0.830**	0.616**	0.221	0.431*	0.412	0.515*	0.347	0.118	0.372	0.423*	0.351	0.272
C	- 0.338	0.247	- 0.431*	- 0.113	- 0.084	0.381	0.112	0.438*	- 0.081	0.081	0.323	0.439*
N	- 0.472*	0.340	0.081	- 0.084	- 0.023	0.243	0.354	0.072	0.107	- 0.073	0.343	0.273
P	- 0.637**	- 0.447*	0.172	0.182	0.472*	0.234	0.404	0.427*	0.482*	0.127	0.123	0.137
K	- 0.634**	- 0.527*	- 0.342	- 0.172	- 0.170	0.053	- 0.118	- 0.352	0.242	- 0.281	- 0.141	- 0.124

* = $P < 0.05$

** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; MeF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LXI

The correlation coefficient between the different abiotic factors and the major groups of the soil fauna for total study period at study site D at the soil depth 0-10 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	0.871**	0.313	0.140	0.541**	0.261	0.121	0.081	0.551**	0.112	0.253	0.184	0.114
Con	0.226	0.414	0.464*	0.414	0.253	0.281	0.172	0.543**	0.281	- 0.275	0.112	0.121
Moi	0.530*	0.539**	0.313	0.212	0.851**	0.213	0.218	0.066	0.313	0.241	- 0.212	- 0.428*
ST	0.116	0.121	0.281	- 0.414	0.261	0.332	0.501*	0.801**	0.011	0.269	0.414	0.213
AT	- 0.249	0.171	- 0.243	0.191	0.382	0.339	0.190	0.121	0.384	0.313	0.119	- 0.481*
RF	- 0.257	0.081	0.241	0.091	0.515*	0.412	0.113	0.036	0.534*	- 0.413	- 0.043	0.616**
BD	- 0.294	0.541**	0.396	0.112	0.313	0.241	0.196	0.312	- 0.283	- 0.241	- 0.191	0.145
Por	0.452*	0.112	0.414	0.131	- 0.113	0.313	0.118	- 0.515*	- 0.192	- 0.212	- 0.113	- 0.093
C	- 0.601**	0.142	- 0.113	- 0.181	0.296	0.234	0.172	0.134	0.251	- 0.251	0.172	- 0.313
N	- 0.802**	0.541**	0.526*	- 0.192	0.281	0.279	- 0.081	0.212	- 0.182	- 0.184	- 0.212	- 0.381
P	- 0.588**	- 0.318	- 0.243	0.031	0.181	0.179	0.215	0.243	0.114	- 0.173	- 0.215	- 0.319
K	0.409	- 0.173	0.000	- 0.118	0.232	0.212	0.184	0.231	0.218	- 0.214	- 0.313	- 0.089

* = $P < 0.05$

** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LXII

The correlation coefficient between the different abiotic factors and the major groups of the soil fauna for total study periord at study site D at the soil depth 10-20 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.032	- 0.348	- 0.131	- 0.643**	- 0.680**	- 0.681**	- 0.570**	- 0.637**	- 0.374	- 0.073	- 0.131	- 0.370
Con	- 0.318	0.142	0.494*	- 0.081	- 0.284	- 0.246	- 0.356	- 0.119	0.008	- 0.119	- 0.040	- 0.116
Moi	- 0.076	- 0.116	0.302	0.094	0.305	0.243	0.008	0.045	0.580**	0.402	0.476*	0.431*
ST	0.204	- 0.341	0.081	- 0.144	0.209	0.061	0.008	0.235	0.316	0.317	0.152	0.383
AT	- 0.220	- 0.331	0.186	- 0.083	- 0.173	- 0.198	- 0.112	- 0.072	- 0.303	- 0.418*	0.424*	0.112
RF	- 0.439*	- 0.294	0.098	- 0.351	- 0.231	- 0.152	- 0.233	- 0.080	- 0.481*	- 0.391	- 0.183	0.474*
BD	- 0.530*	- 0.444*	- 0.088	- 0.380	- 0.440*	- 0.310	0.061	- 0.141	- 0.267	0.347	0.461*	0.243
Por	0.502*	- 0.072	0.112	- 0.113	0.351	0.182	- 0.009	0.117	0.256	0.341	0.462	0.081
C	0.523*	- 0.056	0.424*	0.387	0.381	0.333	0.245	0.389	0.281	0.597**	0.193	- 0.061
N	0.576**	0.481	- 0.097	0.504*	0.616**	0.038	- 0.015	0.132	0.093	0.081	- 0.318	0.317
P	0.797**	0.313	- 0.097	- 0.225	- 0.247	- 0.142	- 0.181	- 0.241	- 0.336	- 0.271	- 0.581**	- 0.324
K	0.771**	- 0.135	0.072	0.143	0.223	0.228	0.217	0.394	- 0.317	0.760**	- 0.460*	- 0.444

* = $P < 0.05$
** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LXIII

The correlation coefficient between the different abiotic factors and the major groups of the major groups of the soil fauna for total study period at study site D at the soil depth 20–30 cms

	TF	MiF	Pro	Pros	MeF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.607**	- 0.580**	- 0.284	- 0.481*	- 0.690**	- 0.641**	- 0.530*	- 0.537**	- 0.580**	- 0.212	- 0.107	- 0.191
Con	- 0.319	- 0.415	- 0.102	- 0.487*	- 0.300	- 0.335	- 0.324	- 0.097	- 0.130	- 0.052	0.185	- 0.387
Moi	0.492*	0.172	0.201	0.018	0.318	0.447*	0.121	0.350	0.400	0.370	0.273	0.058
ST	0.089	0.350	0.352	0.100	0.011	- 0.004	- 0.041	0.314	0.341	0.211	0.180	0.440*
AT	- 0.269	0.281	0.412	- 0.136	0.153	- 0.202	- 0.156	0.008	- 0.162	- 0.241	- 0.041	- 0.051
RF	- 0.593**	- 0.117	0.412	0.481*	0.083	- 0.141	- 0.250	- 0.083	0.051	- 0.372	- 0.508*	0.246
BD	- 0.595**	- 0.550**	- 0.213	- 0.093	- 0.419	- 0.413	- 0.219	- 0.419	- 0.616**	- 0.636**	- 0.452*	- 0.561**
Por	0.536*	0.436*	0.231	0.426*	0.373	0.258	0.251	0.293	0.112	- 0.080	- 0.181	- 0.081
C	0.541**	0.081	0.391	0.351	0.008	0.285	0.081	0.152	0.498*	- 0.083	- 0.024	- 0.035
N	- 0.682**	0.671*	0.861**	- 0.181	0.230	0.134	0.067	0.385	0.518*	0.536*	0.481*	0.368
P	- 0.601**	0.000	0.000	- 0.443*	0.000	0.000	0.000	0.113	0.442*	0.818**	0.123	0.143
K	- 0.596**	0.515*	0.178	0.196	0.669**	0.518*	0.442*	0.608**	0.153	0.219	0.000	- 0.098

* = $P < 0.05$

** = $P < 0.01$

Con = Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; MeF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneide; MaF = Macrofauna; Ins = Insects; Ant = Ants; Myr = Myriapoda.

TABLE LXIV

The correlation coefficient between the different abiotic factors and the major groups of the soil fauna for total study period at study site D at the soil depth 30–40 cms

	TF	MiF	Pro	Pros	McF	Col	Aca	Ara	MaF	Ins	Ant	Myr
pH	- 0.618**	0.727**	0.136	- 0.616**	- 0.481*	- 0.504*	- 0.413	- 0.213	- 0.009	- 0.414	- 0.431*	0.516*
Con	- 0.172	- 0.113	0.281	- 0.081	- 0.112	0.118	- 0.063	- 0.186	0.286	- 0.304	- 0.007	- 0.421
Moi	0.586**	0.658**	0.268	0.616**	0.565**	0.636**	0.523*	0.196	0.272	0.473*	0.414	0.381
ST	0.252	- 0.018	- 0.200	0.098	0.124	0.241	0.136	0.173	0.081	0.281	0.303	0.393
AT	- 0.344	- 0.090	0.018	- 0.113	- 0.186	- 0.181	- 0.373	- 0.038	- 0.342	- 0.081	- 0.341	- 0.108
RF	- 0.439*	- 0.091	0.424*	- 0.353	- 0.224	- 0.088	- 0.588**	- 0.452*	0.216	- 0.053	- 0.481	- 0.251
BD	- 0.130	- 0.639**	- 0.181	- 0.652**	- 0.640**	- 0.441*	- 0.228	- 0.313	- 0.316	- 0.461	- 0.091	- 0.419
Por	0.255	0.281	- 0.041	0.254	0.388	0.406	0.341	0.081	0.309	0.414*	0.348	0.258
C	- 0.047	- 0.068	0.186	- 0.173	- 0.081	0.240	0.053	- 0.081	0.281	- 0.031	0.083	0.391
N	- 0.754**	0.688**	0.053	- 0.181	- 0.038	0.111	0.361	0.083	0.109	- 0.091	0.281	0.277
P	- 0.247	0.000	0.113	0.118	0.141	0.138	0.113	0.124	0.218	0.418	0.110	0.139
K	- 0.021	0.238	0.713**	- 0.186	- 0.166	0.088	- 0.286	- 0.306	0.504*	- 0.218	- 0.161	- 0.281

$^{*} = P < 0.05$

$^{**} = P < 0.01$

Con : Conductivity; Moi = Moisture content; S.T. = Soil temperature; A.T. = Air temperature; R.F. = Rainfall; B.D. = Bulk density; Por = Porosity.

TF = Total soil fauna; MiF = Microfauna; Pros = Prostigmata; Pro = Protozoa; McF = Mesofauna; Col = Collembola; Aca = Acarina; Ara = Araneida; MaF = Macrofauna; Ins = Insecta; Ant = Ants; Myr = Myriapoda.

In conclusion some of the major aspects which has been observed from the present study has shown that the immediate abandonment of land after agriculture shows an increase in the soil animal population level and in particular mesofaunal levels as seen in site A. There was a drop however in the subsequent aged sites (B and C) while again in the oldest abandoned fallow (site D) it reached to the level of site A. Moreover, a definite successional pattern was seen in the case of macrofaunal levels where the maximum, recorded in site D, indicating thereby that the colonization of macrofauna is the deciding factor for relating to soil fertility in such abandoned fallows after agricultural practices. Literature revels that macrofauna is dependent on the litter layer for an increase in population density (Nakamura and Yamauchi, 1970 and Nakamura, 1971). Further, it is recorded that though some animals get destroyed after shifting cultivation, the species density decreases within 4 to 5 years and stabilizes after 25 years (McColl, 1974). Moreover from the present study it appears that the environment for vertical migration is the moisture gradient of the soil, while temperature is only secondary, thereby permitting the annual cycle to be partitioned by different faunal groups. It is also known that the physical property of the climate within the soil was less variable than that of the air above, showing thereby that animals are committed to survive than the manipulation of ecosystems for benefit of human ends. The result of the present study revealed that mobility of the population seem to be a regulating factor of ecological production and that particular topic groups of soil invertebrates reflects better than their population density in successional trend of the ecosystem studied (Kaczmarek, 1978).

The clearing of forest and cultivation of land in tropics results in harsher environment with extremes of temperature, moisture and direct impact of rain. These changes would have a greater effect on smaller organisms than on larger ones as seen in the present study. In particular Collembola and Acarina can be seen to increase in numbers and then stabilize being the dominant groups,. while Prostigmata was seen to be directly related to porosity and hence more in the youngest site (Wallwork, 1976). Such reports exist also in Nigeria and some humid tropics (Lasebiken, 1975). Next in importance, acidity, salinity and differences of Nitrogen being common limiting factors for animal colonization takes nearly 50 years for breaking down the elements to allow any colonization (Molyneux, 1963). Further, acidity is always known to increase with weathering (Luxton, 1976b). With all these criteria, the density increases of mesofaunal groups which affects the total soil fauna could be attributed to three main reasons, (1) apart from active migration, wind aids disposal (Freeman, 1952; Buahin and Edwards, 1963), (2) the life cycle being relatively short, therefore adapted for colonization, the production being more than one generation per year (Sheals, 1956) and lastly (3) low initial population of predatory pressure (Dunger, 1968a). All this can be very clearly observed from the present study and is in confirmation with earlier workers like Bruning *et. al.* 1965 who find density to be increasing after 8 years of reclaimed site and in particular humidity being one factor and soil moisture content affecting the densities (Hale, 1963; Ashraf; Ashraf, 1971 and Hutson, 1974). Similarly, Neumann (1973) has shown surface fauna colonizes especially Coleoptera after a 3 year period. All this revealed that land within a year of reclamation does support a larger and varied soil fauna while it may take several years for larger groups like macrofauna to become established. This is confirmed from the present study that the youngest site has still increasing density number, more or less stabilizing in the oldest fallow (Hutson, 1980). The study therefore could probably support the view of Hutchinson (1953) who defined co-active patterns as resulting from competitive interaction, where the stochaistic influences of the soil acting on its microenvironments is balanced.

All the above conclusions could be effectively significant as the density of the soil fauna in the present study seem to be in concordance with earlier workers from tropical situations. Moreover the present estimates can be seen to approach even much more than those recorded for temperate densities (Greenslade and Greenslade, 1968), and it would be premature therefore to make any definite statements, as tropical work is still in a relatively early stage and more so in India.

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