SOIL FAUNAL DIVERSITY OF FOREST PLANTATIONS WITH SPECIAL REFERENCE TO EUCALYPTUS

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DEPARTMENT OF AGRICULTURAL ENTOMOLOGY
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SOIL FAUNAL DIVERSITY OF FOREST PLANTATIONS WITH SPECIAL REFERENCE TO EUCALYPTUS

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Affectionately Dedicated to

My Beloved Parents

and Brothers

DEPARTMENT OF AGRICULTURAL ENTOMOLOGY
UNIVERSITY OF AGRICULTURAL SCIENCES
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CERTIFICATE

This is to certify that the thesis entitled **"SOIL FAUNAL DIVERSITY OF FOREST PLANTATIONS WITH SPECIAL REFERENCE TO EUCALYPTUS"** submitted by **Mr.B.K.KRISHNAPPA** for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ENTOMOLOGY** of the University of Agricultural Sciences, Bangalore, is a record of research work done by him during the period of his study in the university, under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bangalore
November 24 , 1994

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INTRODUCTION

I INTRODUCTION

Soil is both a resource and a habitat for the plants and animals. The soil fauna in general occupy an important position in the soil ecosystem and play a significant role in the complex process of decomposition of organic matter, nutrient cycling and improve the fertility status. As early as 1878, Muller recognised the important links between the role of soil fauna in the genesis of different humus forms and forest productivity. The abundance and diversity of the fauna are influenced by the types of vegetation cover, climate, physical and chemical properties of soil, nature and depth of the litter and humus and availability of food. The forest ecosystem is rich in soil fauna compared to other agro-ecosystems.

Among the several forest tree types, the popularity of eucalyptus as a plantation species is attributable to its being generally very adaptable, fast growing with a wide range of utility from sawn and processed wood products to high calorific value of fuel wood as well as it could be put to a variety of environmental and ornamental uses. Afforestation with eucalyptus in reserve forests of Karnataka and several states of India

is being carried out under several schemes such as (i) Soil conservation, (ii) Fast growing species, (iii) Drought prone area programme, (iv) Rehabilitation of degraded forests. However Eucalyptus has been subjected to much vilification and obliquy.

Some of the arguments of the environmentalists against growing eucalyptus plantations are that, i) it is a heavy consumer of water with the result the water table is lowered and the whole hydrological balance gets upset, ii) it takes away considerable amounts of nutrients and thus depletes the soil fertility, iii) it does not allow any fauna and flora to grow beneath it due to allelopathic effect in the soil, iv) it changes the composition of the soil due to the oil content in the fallen leaves which do not normally decompose faster compared to other forest plantations.

According to Annaduari (1988) eucalyptus litter had a more complex fauna than that of tea or coffee, with the soil acari always dominant. Fifty seven species of Collembola were observed in a tall eucalyptus forest in south eastern New South Wales of Australia. The fauna was dominated by entomobryiids of the genera Paronellides, Lepidocyra and Willowsia (Greenslade et al., 1991). However the studies on soil faunal status

in forest plantations like eucalyptus in India is scanty.

Although many studies have been conducted describing the seasonal and vertical distribution patterns of soil faunal population in tropical and subtropical forests, there is no information available on the effects of eucalyptus plantation on the community ecology of soil fauna in Indian sub-continent. Therefore, with this in view, the present investigation was undertaken to fill this lacunae with the following objectives:

1. To study the distribution and diversity of soil micro arthropods in the eucalyptus plantation.
2. To study the comparative litter and soil faunal diversity of eucalyptus and other forest plantations.
3. To study the seasonal variation of soil fauna as influenced by different habitats.
4. To study the effects of eucalyptus plant parts on the development of soil fauna.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

The review on the soil faunal diversity in different forest ecosystem is presented below for a better understanding of the function and their ecological role as these animals have a direct role in litter decomposition, nutrient cycling and maintaining soil structure. These reviews are based on the information available mostly from other countries and a few research reports from India.

II.A Distribution, abundance and diversity of soil fauna

Detailed information on the distribution and diversity of soil fauna in forest ecosystem is very scarce. The vertical distribution of oribatid mites and Collembola in litter, humus and mineral layers of a hemlock yellow birch 'mor' was studied, the greater part of the fauna was found in the top 7-10 cm of the soil profile which was made up of two distinct layers, litter and humus. The number of mites was approximately four times more than Collembola in all three layers (Wallwork, 1959). Peterson (1980) recorded the vertical distribution of nine selected spieces in beach wood forest ecosystem in Denmark. All the species were confined to the litter and upper most 6 cm mineral

layer. Species like Lepidocyrtus lignorum and Tomocerus flavescens dominated in the litter layer whereas Folsomia nana and Isotoma notabilis were more dominant below the litter. Similarly the distribution of soil fauna in an ever green broad leaved forest in Japan showed that three species of Isopods viz., Armadillo dorsalis, Porcellio sp. and Trichoniscus sp. were recorded. The number of biomass were estimated at 1123 and 6655mg for A. dorsalis, at 104 and 904mg for Porcellio sp. and 250 and 740mg for Trichoniscus sp. per square meter respectively. The size class distribution did not change throughout the year in case of A. dorsalis. However in Porcellio sp. changes with each season. Spatial distribution patterns of three species of isopods was almost random (Watanabe, 1980).

Vertical distribution of Collembola in Norwegian coniferous forest revealed that all species were distributed on an average in the upper 6 cm soils. In podzols only four species viz., Tullbergia callipygos, T. quadriospina, Karlstejnia norvegica and Wankeliella mediochaeta were consistently present below 6cm mineral layer. Except for the larger species which were restricted to the surface layers, many other species showed considerable variation in depth distribution between both soils and seasons. The relative vertical

distribution of the different species was rather flexible (Hagvar, 1983). Similarly, Adis et al. (1987) noticed about 50,000 arthropods per square metre soil in a secondary dryland forest in Brazil during the dry season. Vertical distribution showed 77 per cent of all arthropods in the upper most layer (3.5cm depth), 15 per cent below the humus layer (3.5-7cm depth) and only 8 per cent in 7-14cm depth. Of the total fauna extracted, more than 75 per cent was represented by Acari and Collembola. Vegter et al. (1988) made observations on distributional ecology of Collembola (Entomobryidae) in the forest floor of Netherlands. Fifteen species of Entomobryidae belonging to five genera were recorded. Species with a high frequency of occurrence were dominant species in most wood lands, species like Orchesella villosa and Heteromurus nitidus in particular were relatively abundant in a restricted number of wood lands.

Vats and Handa (1983) studied seasonal density of soil-litter arthropods in a forest dominated by Dalbergia sissoo in Haryana, Collembola were the most dominant group in all seasons, constituting 73.50 per cent of the total arthropod population followed by Acari. However the populations were highest in summer

and lowest in the rainy season. Densities of Collembola and Acarina in the soil and litter of three indigenous South Australian forests related to soil layer, site and seasonal differences were recorded. Most variation was associated with layer differences, being greatest in the Prostigmata and Onychiuridae. Seasonal variation was more compared to site variation in all collembolan groups except the Entomobryidae. Densities of all the groups had marked seasonal variation which was similar to that of rainfall, minimum density and activity occurred in the last week of January, a period of maximum temperature and low soil moisture content (Hutson and Veitch, 1987).

Similarly seasonal population abundance of soil microarthropods in the grassland and tree planted (mostly with Eucalyptus spp.) areas of semi arid tropical savanna in Telengana region of Andhra Pradesh was reported by Reddy and Venkataiah (1990). Among the microarthropods, Collembola (mostly, Lepidocyrtus sp.) was dominant followed by Acarina, dominated by Lancetoppia willmanni. These arthropods were minimum in abundance during summer (April to mid June) and maximum during the rainy season (mid June to September). The microarthropods were more common in the surface layer compared to the sub layer of grassland whereas Acarina

was present in both layers particularly during rainy season. Differences in species richness and diversity of microarthropod populations were most significant in the 0-10cm layer.

Theodore et al. (1942) observed the humus layer fauna under 'mull' and 'mor' conditions at a forest near New York. 'Mor' soils had more fauna than 'mull' soils and mites were found to inhabit in large numbers followed by Collembola. Similarly studies on the comparison of oribatid mite communities in 'mor' and 'mull' soils in a temperate forest in Japan revealed that the mean total oribatid population densities during the study period were 52,000/sq.m and 27,200/sq.m in the 'mor' and 'mull' soils respectively. Total species collected during the study period were 95 spp. and 92 spp. in the 'mor' and 'mull' soils respectively. Mean species per sample core (S) were higher in the 'mor' soil whereas diversity (H') and evenness (j) were higher in the 'mull' soils (Kaneko, 1985).

In comparison to 'moder' conditions, the 'mull' forest had higher number of species, more equable rank-abundance relations, dominance of macrofauna and microfauna, and greater trophic diversity. However, the 'moder' forest had lower species with few species

acarines were more abundant in the conifers than in the broad leaf litter (Sharma et al., 1984).

Altogether 4288 individuals belonging to 10 orders were extracted from soil of a dry deciduous sal forest of Midnapur district, West Bengal. The population density varied from 2419-31910/sq. m. with an average density of 13722/sq.m. reaching their maximum in monsoon and minimum in summer. Acarines were predominant (65.10%) being represented significantly by Scheloribates praeincisus followed by collembolans (22.60%), represented by Lepidocyrtus sp. The other forms like hymenopterans (4.78%), dipterans (2.8%) and coleopterans (2.4%) were numerically low (Chattopadhyay and Subrata Roy, 1993).

In coniferous forest of Lane county, Oregon (USA) both total species number and mean number of oribatid mite species colonizing a litter type decreased with increasing elevation. However there was no significant difference in the mean number of oribatid mite species colonizing a litter type within an elevation (Walter, 1985).

Holt (1985) studied the population changes, distribution and composition of litter Acari and

dominating. The 'mull' soil fauna penetrated to deeper soil horizons than the 'moder' soil fauna (Schaeffer and Schauermann, 1990). Similarly the soil arthropod numbers and biomass in two pine forests of different soils, related to functional groups had been recorded by Teuben and Smidt (1992). Mesofaunal populations of collembolans and oribatid mites in 'mor' and a 'mor moder' forest soils were compared on the basis of their numbers and biomass during spring and late summer period. In the 'mor' forest a more diverse meso faunal community was found. 'Mor' forest consisted of significantly more epigeic collembolans and food specialist oribatids whereas in the 'mor moder' forest, the hemiedaphic collembolans and the non specialistic oribatids were significantly more abundant.

Litter associates were estimated in an oak forest and a mixed oak conifer forest in the Kumaun, Himalaya. The species richness and total abundance of litter microarthropods decreased with the increase in elevation. The share of the collembolans in the total microarthropods population increased while the acarines accounted for a greater share in the sal. Higher population levels and species diversity were sustained by broad leaf species compared to the conifers. The

Collembola of three rain forests in northern Queensland. Numbers in the litter were higher than in the soil of rain forests. Cryptostigmata comprised 41-55 per cent of the total Acari in the litter and 0-4cm soil layer. However 53-75 per cent of Acari and Collembola were found in the 0-4cm soil layer, and 3-20 per cent in the litter. Numbers in the litter were lowest in the dry and highest in the wet season. Straalen et al. (1988) studied in the Netherlands coniferous forests and found that oribatid mite, Platynothrus peltifer (Heminthorus peltifer) and Sminthuridae were most abundant at the most vital sites. There was a correlation with a decrease of the manganese concentration and an increase of the C/N ratio of the litter

In a pine forest litter, Collembola and Acari constituted 97.50 per cent of the total micro arthropods. The microarthropods were positively correlated with maximum loss of litter, but was not related to nitrogen or calcium concentrations (Reddy, 1989).

Sarkar (1990) studied the wood land community structure of soil microarthropods in an undisturbed habitat in Tripura. Acarina was the most dominant group (62.83%) followed by Collembola (22.83%). Among

acarines, Oribatida were dominant (72.85%; 24 species) followed by the Gamasida (17.04%).

Neem leaf litter harboured numerous taxa of microarthropods, of which Collembola and Acarina constituted more than 82 per cent. Fauna occurred in higher numbers during monsoon season. Rainfall and litter moisture showed significant positive linear correlations with the densities of microarthropod taxa (Reddy, 1992).

A comparative study had been made to investigate the influence of vegetational types on seasonal abundance and species composition of soil fauna of banana and orange plantations. The monthly fluctuations of the total number of oribatid mites showed a gradual increase in orange orchards and a gradual decrease in banana orchards, other groups of Acari showed no significant difference in relation to site, vegetational types, time and the interactions among them (Al-Assiuty, et al., 1993).

Paul et al. (1993) reported the changes in density and diversity of soil fauna following three agricultural practices, viz., shifting (Jhum), terrace and valley cultivation as compared to adjoining subtropical forests in Meghalaya. The faunal reduction was highest in the

terrace (62%), followed by the Jhum (35%) and the valley (24%) as compared to adjoining forest. Acarina and Collembola were the most dominant groups. Species diversity was highest in the valley and lowest in the terrace for both the groups. Seasonal dynamics revealed low populations during dry and/or winter months (December-April) and peaks during the monsoons/immediate post monsoons (June-September).

Community structure of oribatids in rubber plantation and adjacent waste land in Tripura were studied. Of the total of 46 oribatid species recorded, 29 being common to both the sites, Scheloribates praeincisus was the most common species in both the sites followed by Haplochthonius simplex in the waste land and Cosmochthonius lonatus diversiseta in the rubber plantation. Species diversity (H) was lower and dominance index (D') was significantly higher in rubber plantation compared to wasteland (Chakraborti and Bhattacharya, 1993).

Singh and Mukharji (1971) made observations on qualitative composition of soil arthropods in some fields in Varanasi of Uttar pradesh. Thirty three genera and thirteen species of Acarina were identified. Mesostigmata and Prostigmata were represented by 12 and

8 genera respectively. The Astigmata were represented only by Tyrophagous. Similarly Cryptostigmata were represented by 12 genera with 15 species and 19 genera of Collembola were recorded. Diplura, Pauropoda, Symphyla, Palpigradi, Uropygi, Schizomida and Pseudoscorpionida were also recorded (Gupta and Mukharji, 1976).

Choudhuri and Banerjee (1975) studied qualitative and quantitative composition of Acari and Collembola in relation to soil organic matter-microbial complex, in uncultivated fields of West Bengal. Cryptostigmatid mites were predominate during the monsoon months (July - August) over other groups of mites such as Mesostigmata, Prostigmata and Astigmata as well as Collembola. Population of both Prostigmata and Astigmata were significantly low in both qualitative and quantitative composition and population size of both Acari and Collembola appeared to be dependent on organic matter - microbes complex operating in soil.

Fourteen groups of soil and litter arthropods with a total of 8787 species were collected in silent valley of kerala. Acarina were encountered in maximum numbers (35.31%) compared to Collembola. The collembolan Idiomerus pallidus formed the dominant group. Acarina

and Collembola constituted more than 50 per cent of the total fauna collected accounting for 35.13 and 24.75 per cent respectively. Whereas Diplura was represented by a minimum number of fauna with only 0.78 per cent. Acarines were mostly represented by cryptostigmatid and mesostigmatid mites. Of these, oribatids were most dominant represented by six genera viz., Haplophorella sp., Rhysotritia sp., Hermanniella sp., Microzetes sp., Pilobates sp. and Galumna Sp. Mesostigmata was represented by four species viz., Veigaia uncato, Hypoapsis indicus, Gamasiphis sp and Paraphytoseius bhadrakalensis (Hazra, 1982).

Species distribution and abundance patterns of microarthropods in surface decomposing leaf litter and mineral soil from 6 vegetational zones along a transect in northern chihuahuan desert was reported by Cepeda-pizzaro and Whifford (1989). A list of 133 species was compiled through out the study period which included 114, 10 and 9 were mites, collembolans and miscellaneous groups, respectively. However, the microarthropod community response to season, change in foliage litter quality during decomposition was measured in litter bags under 10 year old Douglas-fir, pseudotsuga menziesii in Western Oregon. Collembola accounted for 35 per cent of

the total fauna, oribatid mites for 29 per cent. Of 33 taxa, three were significantly more abundant under trees subject to lepidopteran defoliation. Most taxa (23) showed seasonal fluctuations in abundance related to the seasonal pattern of temperature and precipitation and to the pattern of N and Ca mobilization from litter bags. Five taxa showed significant longterm trends in abundance, indicating response to changes in litter quality, perhaps there was a loss of phosphorus and Potash (Schowalter and Sabin, 1991).

Population densities of different groups of microarthropods both in soil and litter during rainy season in tropical dry deciduous forest dominated by Shorea robusta, Butea monosperma and Terminalia tomentosa were studied. Among the Acari, cryptostigmatids constitute 34.25 and 42.15 per cent of the total population in the soil and litter respectively. These were followed by mesostigmatids, prostigmatids and astigmatids in soil and litter. Higher percentage of Collembola were recorded in soil compared to litter. The collembolan population decreased with increase in mesostigmatid population (Singh and Singh, 1975). Crossley et al., (1960) obtained a total of 30,371 arthropods from 215 samples (approximately 3000 sq cm) of pine forest litter taken from oak ridge area during

summer, of which Acarina comprised maximum (82.90%) followed by collembolans (12.2%) and other insects (3.6%).

According to Gunnarsson (1980) the population of protura in oak and spruce wood land soils were 3500 (SE=1100) and 8400 (SE=4400) respectively. In both sites Eosentomon delicatum, E. germanicum and Eosentomon sp. were common. Although E. germanicum dominated in both habitats, the species composition differed between the sites ($P<0.001$). The population density of soil and litter mesofauna of evergreen forest and grass lands in the South West of Kashmir according to Raina et al. (1981) revealed that Acari were the dominant group followed by Collembola in both habitats. The maximum Acari population of 17,599.90/m^2 was recorded. Similarly the collembolan population was also maximum (2,083.99/m^2) in the forest litter. The total density of mesofauna was 20,707.39/m^2 in the forest litter.

Jam et al.,(1986) studied the population density of soil arthropods in the subtropical forest ecosystems at 2 sites in Manipur. First site was dominated by Quercus dealbata, Q. fenestrata and Pyrularia edulis and the second site by Q. griffthii, Rhododendron arborerum and Alnus nepalensis. Maximum population densities were

observed on upper 20cm layer during August and July in both sites respectively. Collembola were the dominant followed by Cryptostigmata, Mesostigmata, Prostigmata and Astigmata. A quantitative study of collembolan communities in four tropical ecosystems, forest, grass land, crop land and polluted crop land near Varanasi in Uttar Pradesh. Species were common in all ecosystems but varied in their population density and frequency of occurrence were Protaphorura, Hypogastrura, Folsomides, Onychiurus, Xenylla, Isotomurus, Paratullbergia, Subisotoma, Lobella, Cyphoderus, Entomobrya, Seira spp. Lepidocrytoides and species of Sminthuridae. Density was high in temperate grassland (8086/m^2), tropical forest (6950/m^2), and tropical grass land (6094/m^2) and low in tropical crop land (5616/m^2) and polluted crop land (3012/m^2) (Singh and Singh, 1978). Singh and Mahajan (1981) reported that a total of 15,183 soil animals were obtained from 360 samples (120 from each habitat) collected in two years period. Acari were dominant in arable and forest soil while in forest litter Collembola dominated. Percentage composition of different groups of Acari studied was more or less similar, recording maximum Cryptostigmata followed by Prostigmata and Mesostigmata with invariably low density of Astigmata.

In California pine forest, more than 100 species of Acarina were recorded. These were found in association with Collembola and a variety of insects and myriapods. A conservative estimate of the diversity of the microarthropod fauna showed about 150 species, with the relatively open parts of the forest floor supporting a population of atleast 200,000/sq.m. Most of the Collembola and Acarina and all of the Protura, Pauropoda, Symphyla and Geophilidae together formed bulk of the total population were found in the mineral subsoil. Litter and humus inhabitants included the Psocoptera, Sminthuridae, Bdelloidea, Raphignathoidea and certain species of Cryptostigmata (Price, 1973). Kim and Hyun (1989) reported presence of collembolan community in Korean white pine (Pinus koraiensis) plantations. The species diversity and number of individuals were more stable in older than in younger plantations. As the site characters changed with the conversion of forest into a tea plantation, there was a drastic change in the population of Symphyla, Collembola, Protura and Acari in relation to deforestation and cultivation of tea (Prabhoo, 1976).

Population fluctuation studies mainly Oribatei and Collembola in relation to climatic and edaphic factors

were made in waste land Shantiniketan in West Bengal by Bhattacharya and Roychoudhuri (1979). The soil fauna exhibited 2 peaks, a pronounced peak during the post monsoon period (September-October) and smaller one during the premonsoon period (May-June). Of the various factors considered the total micro arthropod population showed a significant positive relationship with moisture, temperature of the soil, rainfall in the previous month, mean monthly relative humidity and air temperature, and soil moisture content, whereas the cryptostigmatid population correlated positively with mean monthly relative humidity and soil moisture content. However soil pH exhibited significant negative relationships with the cryptostigmatid, collembolan and total micro arthropod populations.

Bird and Chatarpaul (1986) studied the effect of whole tree and conventional tree harvest on soil microarthropods, Collembola and Acari in a mixed conifer hard wood forest on the canadian shield. Species composition was unaffected by harvesting although there were shifts in the dominance. Total number of microarthropods and numbers of Oribatei, Prostigmata and Mesostigmata found on the unharvested plot were significantly greater than harvested plots. Slightly higher numbers of Collembola were recorded from the

conventional harvest plot. Oribatei, Prostigmata and Collembola were more abundant on the conventional harvest plot. Of the two forest harvesting methods, conventional harvest plot had a lesser impact on soil fauna. Sinha et al., (1988) made observations on the seasonal population fluctuations of Collembola and Acarina in a deciduous forest at Ranchi in Bihar. The cumulative action of several factors was shown to control the seasonal periodicity of Collembola and Acarina.

II.A.1 Collembola Population

Of all the soil microarthropods, Collembola were numerically dominant mesofauna in most soils, and these have received more attention from many soil zoologists in India. About 85 genera have been reported from different parts of India. Notable contributions of this group particularly on their distribution, population densities and seasonal abundance have been made by Takeda (1978), Mitra et al. (1981), Hagvar (1983), Sharma et al. (1984) and prabhoo and Pai (1986) and many others.

Choudhuri and Roy (1967) while working on the Collembola of uncultivated fields in the district of

Nadia, West Bengal, found the maximum population in the monsoon period (July-September) and the minimum population in February and April. However, in a Japanese cedar (Cryptomeria japonica) plantation, Collembola were found to be dominant among the arthropods collected. Seasonal variation in abundance was low and showed small peaks in early summer and winter (Hijii, 1987).

The collembolan populaton of Isotoma trispinata was studied in litter soil and non litter soil of tropical deciduous forest of Bhimbandh, munger (Bihar) by Uddhav et al. (1993). There was considerable reduction in the number of species in the non litter soil as compared to litter soil. Maximum number of species were encountered in the rainy season followed by winter and summer.

Prabhoo (1971) reported forty eight species of soil and litter inhabiting Collembola from the tea growing areas in the Western Ghats and other locatlities in Kerala, of these 23 species, one sub species and genus Indoscopus were new and eight species are additions to Indian fauna. Similarly in californian forest sites at Santa Cruz County, 37 of them were new to the county (Muzzio, 1984).

Fifty seven species of Collembola, most of them undescribed, represented by 4900 individuals collected from 144 sites of a tall Eucalyptus forest at Wog Wog in South Eastern New South Wales in Australia were studied. The fauna was dominated by entomobryids of the genera Paronellides, Lepidosira and Willowsia (Greenslade et al. 1991). Sterzynska (1991) studied the Tilio-carpinetum soils of the mezovian low land and listed 96 species of Collembola. Folsomia quadrioculata and Isotomiella minor were the dominants. Onychiurus affinis was the characteristic species.

Holt (1985) while working on the Acari and Collembola in the litter and soil of three north Queensland rain forests observed 53.75 per cent of the total population of Collembola in the upper soil layer of each site. Dielmann (1989) reported the collembolan fauna in a moder beech wood. Population consisted of 37 species with an average density of 20,000/m^2, 340 mg biomass and a consumption rate of 1.4 per cent of the litter production. The Collembola colonized the freshly fallen leaf litter in a succession of the few dominant species.

Hazra (1976) confirmed the influence of pH on the collembolan fauna of two uncultivated fields of gangetic

West Bengal. Further, the distribution of collembolan population in both cultivated and uncultivated fields was influenced by various soil factors.

The qualitative and quantitative account of soil fauna with special reference to Collembola in a reserve forest floor and a deforested site of West Bengal was studied by Hazra, (1991). The major arthropods extracted from both the sites were Acarina, Collembola, Coleoptera, Diptera, Diplura etc., The deforested site showed marked variation in total arthropod fauna and species diversity of Collembola in comparison to the reserve forest floor. The percentage of Collembola extracted in each month showed maximum in July-August coinciding with the maximum soil moisture, nitrate and organic carbon.

Studies on Collembola in five habitats of pine and hemlock forest at connecticut, USA revealed that the macrofauna of an area obviously had a greater effect on the nature of the soil and humus. Areas with thick layer of decomposing vegetation characteristically supported a more numerous and varied fauna than others (Bellinger, 1954).

II.A.2 Acari Population

Mites are the commonest soil mesofauna in most soils and are particularly abundant in organic wood land and non arable soils. The important orders of soil Acari are Cryptostigmata, Mesostigmata, Astigmata and Prostigmata. over 500 species of Cryptostigmata of 740 genera, 138 families have been described all over the world.

Crossley *et al* (1960) reported that oribatids were abundant in many soil and litter situations. In pine litter, 82.90 per cent of total arthropods constituted soil mites. In California pine forest soil, due to seasonal drought, mean depth of population distribution ranged from 8.5 to 22.4 cm. All groups, except Prostigmata tended to occur at deeper levels during dry period of the year (Price, 1975).

The mite community of the soil of four contrasting sites was studied for two consecutive years. In all 6236 individuals belonging to 38 species of Cryptostigmata were collected. *Scheloribates praeincisus* was the most abundant and frequent species in all the sites. The sites differed in species richness, species diversity and dominance index. Highest species diversity was seen in Acacia forest and lowest diversity was recorded in

case of paddy field which registered highest dominance index (Bhattacharya et al., 1981). Similarly the distribution of oribatid mites in 5 sites of Bulloch county, Georgia, USA was studied by Hagan and Norton (1983). According to him, it was found that a total of 51 oribatid species belonging to 26 families were distributed in the county. Highest species richness was found at sites with the least human disturbance.

Community structure of Oribatei as influenced by industrial waste water was investigated at Durgapur, West Bengal. Two adjacent sites had been compared, one of the sites was frequently exposed to the industrial waste water, containing many toxic substances (polluted site). The unpolluted site was 100m away from polluted site. A total of 6298 and 5986 oribatid mites were collected from the polluted and unpolluted site respectively (Bhattacharya and Bhattacharya, 1983).

Mittmann (1989) reported the mean monthly density of Mesostigmata was 13202/m^2 with Trombidiformes 10549/m^2 and Astigmata 10739/m^2. These community numbers peaked in the spring and in the late autumn during leaf litter fall.

Hazra (1991) studied the reserve forest floor and

deforested soil fauna of West Bengal. The Prostigmata was most dominant occupying 25.28 per cent followed by Mesostigmata and Cryptostigmata with 23.66 per cent and 22.92 per cent respectively in both the sites. In another, study in West Bengal Banerjee (1993) observed the relationship between soil factors and Acari in laterite forest soil of Bankura. Cryptostigmatid mites were found to be predominant over other groups of mites such as Mesostigmata, Prostigmata and Astigmata. Cryptostigmatids belonged to five genera of which, Scheloribates albialatus was the most dominant comprising 20.29 per cent of the total population of mites.

II.A.3 Soil Macrofauna

The structural composition and trophic diversity of the entomofauna associated with litter samples collected from monocultures of Eucalyptus, coffee, tea and natural forest habitats was studied by Annaduari (1988). The total species composition varied between different altitudes and sites. Collembola, Thysanoptera, Dictyoptera, Psocoptera, Dermaptera and Coleoptera were dominant in natural forest litter. Eucalyptus litter had a complex fauna than that of tea or coffee, with the Acari always dominant.

Similarly abundance, biomass and diversity of soil macrofauna in tropical savanna miombo wood land of Zimbabwe and associated managed habitats have been reported by Dangerfield (1990). Millipedes and beetle larvae had the largest biomass and were most abundant within the natural wood land. Abundance and biomass beneath Eucalyptus grandis were comparable with estimates for the natural wood land. Diversity was highest under a small stand of disturbed miombo wood land. Habitat heterogeneity on a small scale can affect the abundance and composition of the soil faunal community. Cutting and burning of forest decreased the abundance and diversity of soil animals, but the coconut plantation and less disturbed secondary forest had developed quite abundant populations (Kaneko and Takeda, 1990).

The soil arthropod macrofauna from cultivated and uncultivated fields belonging to Insecta, Acarina, myriapods and Arachnida and insect larvae mainly of orders Lepidoptera, Hymenoptera, Diptera and Coleoptera have also been recorded (Shannigrahi and Shukla, 1993). According to Majzlan (1986) the dominance value of Collembola was 40.0 per cent, Diptera 27.4 per cent, Hymenoptera 10.1 per cent and 6.1 per cent for

Coleoptera, in an oak forest in Czechoslovokia. The mean density of all arthropods was 2469.2/m^2. The seasonal variations with respect to arthropod abundance were similar to those found in beech forests in male Karparty. Predaceous staphylinids were among the more dominant groups of beetles. The Curculionidae, with 19 species including the Polydrusus marginatus was dominant.

Studies in Spain on communties of numerous species of ants in evergreen oaks showed that the main environmental factor determining the distribution of the ants was the presence of the trees (Quercus ilex) (Acosta Salmeron et al., 1983). Similarly ant communities in an oak forest consisting mainly of Quergus rotundifolia with a few trees of Q. faginea, in Granada Spain were studied for one year. Formica subrufa was among the species that were least abundant in shaded areas and abundant than in open areas species of Camponotus, Plagiolepis and Pheidole. Ant activity was highest during spring season (Tinaut, 1984).

In a study conducted on the distribution of soil arthropods in the forest of Republic Korea, Coleoptera were the dominant group with 41 species belonging to 14 families, 16 species of Collembola and Thysanoptera,

10 of Hymenoptera and 7 of Acari were also recorded (Woo and Lattin, 1989).

Changes in the composition and abundance of soil macrofauna due to shifting cultivation were followed over a period after clearing and burning in North Eastern Thailand. Before clearing and burning, the diversity and biomass in the forest were estimated at 310.4 and 9.6g/m^2. After clearing and burning, both decreased to 155.2 and 4.6g/m^2 respectively. Surface dwelling animals, such as Mollusca, Diplopoda, Coleoptera were severely reduced by the direct heat of the fires (Watanabe and Ruaysoongnern, 1984).

There were changes in the density of soil fauna after clearing and burning in a tropical forest of Garo hills in Meghalaya. Whereas the microarthropods reduced to half of their original density. Many surface dwelling macrofauna such as Blattaria, Orthoptera and certain Coleoptera etc. were severely reduced. Ants were the least affected but their distributions were patchy. Those that completely disappeared were Mollusca, Isopoda and Diplopoda (Darlong and Alfred, 1991). Similarly short term responses of soil and litter invertebrates to a cool autumn burn in Jarrah (Eucalyptus marginata) forest in Western Australia was

studied by Majer (1984). These included immediate density reduction, delayed density and temporary absence following fire. The analyses demonstrated that fire affects the density of both soil and litter fauna. The effects of fire were still apparent even after 13 months of the fire.

The coleopteran fauna of leaf litter in the Kopac state nature reserve near Bratislava, CZechoslovokia revealed the total of 384 soil samples contained 745 specimens belonging to 98 species of 17 families. The most dominant species were the Staphylinidae (36 species, 36.73%) followed by the Carabidae (21 species, 21.42%) and the Curculionidae (18 species, 18.36%) (Drdul, 1988). Loreau (1984) made observations on population density and biomass of Carabidae in a Beech forest community. The total population density of the carabid community reached from 0.5 to 2 individuals/m^2, depending on the year, corresponding to a biomass of 85 to 150 mg/m^2 (fresh mass). In the forest belts of the lower river Don, USSR, 190 species of soil inhabiting Coleoptera were recorded. Carabidae was the dominant with 23 species. The beetle fauna of the forest belts was considerably richer than that of the arable land in the region (Ponomarenko et al., 1984).

Spiders are wide group of organisms, considered as enemies of soil insects. Ground surface spiders in 3 plant communities in Florida revealed that spider diversity was greatest in pond pine with 82 species and 2326 individuals collected from sand pine scrub than flat woods where 48 species with 381 individuals were recorded. Similarly spider species was greatest between pond pine and flat woods, followed by sand pine scrub and flat woods, than pond pine and sand pine scrub (Corey and Taylor, 1988). However Dumpert (1989) reported an average number of 138 $\pm$ 68 spider individuals/m^2 over a period of 10 years from Northern forest of black forest of Florida. Species encountered were Coelotes terrestris, C. inermis, Histopona tarpida and Amaurobius fenestralis. The prey spectra of these species differed only slightly and were mainly of beetles and earwigs.

The main bulk of the collected macrofauna consist of 2 taxonomic groups with Araneae (41.29%) and Diplopoda (37.53%), the density variations in Araneae were temperature related and exhibit annual periodicity, in contrast to those of a Diplopoda where no yearly periodicity was detected. Yet, the courses of density variation of these two groups were negatively inter-

related with a time lag of five months. Glomeris balcanica was found to be the most abundant saprophagous macroarthropod (Iairou and Stamou, 1989).

Millipedes are generally recognised as feeders of dead and disintegrating plant material. Millipedes enrich the soil system, acting as agents of decomposition and as accelerators in the nutrient release. Rangaswamy et al. (1978) recorded 3 species of millipedes of Karnataka State. According to them, millipedes are abundant during rainy season, and counts taken during this season gave more exact estimates of population.

The distribution pattern of 20 species of millipedes in 19 deciduous forests was studied in Belgium. The heterogeneous nature of soil clay percentage and local mean annual temperature (from 7.3^{o}C to 10^{o}C) accounted for a large proportion, at one and the same time, of the diversity and the spatial structure of communities (Kime and Wauthy, 1984). Phillipson and Meyer (1984) reported the presence of 11 species of millipedes in a British beech wood, on a rendzina soil. Analysis of the dispersion pattern showed that millipedes were greatest. Similarly Schallnass (1989) recorded 13 species of Diplopoda in a

moder beech forest in the Northern part of the Black forest. The average density was 24 diplopods/m^2 with a biomass of 140mg dry weight/m^2. Mycogona germanicum was the dominant species with 21 individuals/m^2.

The species diversity of Julid millipede was compared between several habitat types with in the seasonal tropics of grass land research station, Marondera in Zimbabwe. The number of species per site ranged from 1 to 8. However there was considerable variation in diversity and dominance of species between habitats. Relatively homogeneous habitats (riparian forest, pine and eucalyptus plantations) contained few species and were dominated by Alloporus uncinatus whilst more heterogeneous habitats (natural miombo wood land) were relatively species rich. Variation in species composition and diversity is noted as a possible factor influencing the effect of millipede assemblages on nutrient dynamics (Dangerfield and Telford, 1992).

Centipedes are widely distributed in moist habitats throughout the tropical region of the world. They are often found under rocks and bark of decaying fallen trees. They are carnivorous, feeding on aphids, flies, springtails, mites and other smaller centipedes.

Ecological information on centipedes are very meagre. The chilopods community in an 140 year old beech forest (Dentario-Fagetum) near Wuz burg, Germany was investigated. The chilopod community comprised of nine Lithobiomorph species and two Geophilomorph species. Lithobius lusitanus ralesiacus was the most abundant centipede at the base of beech and oak trees but was generally rare in the litter. Lithobius crassipes is known to live in a wide variety of habitats. More than 95 per cent of all chilopod individuals in the litter habitat belonged to three species viz., Lithobius mutabilis, Lithobius (Manotarsobius) curtipes and Strigamia accuminata (Frund and Gur, 1986).

MATERIAL AND METHODS

III. MATERIAL AND METHODS

The present study was carried out from April 1993 to March 1994 at Main Research Station, University of Agricultural Sciences, (UAS), Gandhi Krishi Vignana Kendra (GKVK), Bangalore at an altitude of 930M MSL, longitude $77^{o}35'$ East and latitude $12^{o}58'$ North of the Equator. The soils of the region were red with laterite association with clay loam texture and pH ranging from 6.4-7.5. The study sites were 1) Eucalyptus plantation (Eucalyptus hybrid) 2) Acacia plantation (Acacia auriculiformes) 3) Silveroak plantation (Grevellia robusta) 4) Casuarina plantation (Casuarina equisetifolia) and 5) Barren land.

The physico chemical properties of the soil of these habitats are presented in Appendix-I and II.

III.A Study area

All the study sites were situated very close to each other. The selected habitats had an almost equal area measuring about 3 to 4 hectares each.

III.B Climate

The prevailing climate was tropical monsoonic with bimodal type of rainfall in a year having mean annual

rainfall of 877.7mm. Seasons broadly described for the region include winter (November-February), Summer (March-May) and monsoon (South West (June-September) and (North east (October-December).

Meteorological observations which prevailed during the study period are presented in Table 1.

III.C Description of Study Sites

III.C.1 Eucalyptus plantation

This habitat is situated near dry land farm in Western side of the University Campus. The eucalyptus trees were 25 years of age with spacing of 2M x 2M between trees and rows. The surface area was gently sloping from West to East. The site was covered with few herbs and shrubs with patchy litter layer of canopy vegetation. The location of the eucalyptus sampling site in the GKVK Campus is showed in Fig.1.

Some of the common plant species encountered in this habitat in small numbers include Phyllanthus polyphyllus Willd. (Euphorbiaceae), Lantana camara, Linn. (Verbenaceae) and Heteropogon contortus Beauv. (Gramineae).

Table 1. Meteorological observations recorded from April 1993 to March 1994 at GKVK, UAS, Bangalore.

	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Total Rainfall (mm)	0.00	127.60	145.20	58.50	150.60	328.10	273.40	21.60	65.40	2.00	39.80	00.00
Max.Temperature ^{o}C	34.00	33.60	29.10	27.80	27.00	27.10	26.90	26.00	24.60	26.60	27.90	31.85
Min.Temperature ^{o}C	21.30	20.60	19.40	19.10	18.60	18.10	18.60	17.10	14.70	14.00	16.60	17.00
R.H. (%)	53.50	59.50	69.00	72.50	78.50	76.50	77.00	75.50	69.50	54.50	50.50	51.30
Soil Temperature (5cm depth) ^{o}C at 14 LMT	43.10	39.50	27.00	30.10	30.60	31.20	30.80	29.30	27.50	31.00	20.25	22.50
Soil Temperature (10cm depth) ^{o}C at 14 LMT	39.10	35.70	26.13	28.70	28.30	29.50	28.60	27.50	25.70	27.60	21.50	23.85
Soil Temperature (15cm depth) ^{o}C at 14 LMT	36.10	34.00	26.25	27.40	26.90	27.80	27.30	25.90	24.60	26.00	24.50	26.1

Fig. 1 : The location of the eucalyptus sampling site in the GKVK campus.

Fig. 1.

III.C.2 Acacia plantation

This habitat is situated near dry land farm in the Western side of the University campus. The Acacia plants were planted 12 years before with spacing of 3M x 3M between trees and rows. This area is almost free from human interference, the soil surface was completely covered with the thick leaf litter in an advanced degree of decomposition. The location of the acacia sampling site in the GKVK campus is showed in Fig. 2. Ant nests were found common with peak activity during rainy season. The other plant species encountered in minor form include Canthium parviflorum, Lam. (Rubiaceae), Diospyros melanoxylon Roxb (Ebenaceae), Phyllanthus polyphyllus Willd. (Euphorbiaceae) and Lantana camara Linn. (Verbenaceae).

III.C.3 Silver oak plantation

This area is located at Bettahally which is adjacent to the University campus in the Western side. The silver oak trees were 15 years old with spacing of 2M x 2M between trees and rows. The plantation is slightly interfered by human, and other domestic animals. The location of the sampling site of silver oak plantation in the GKVK campus is shown in Fig. 3.

Fig. 2 : The location of the acacia sampling site in the GKVK campus

Fig. 3 : The location of the silver oak sampling site in the GKVK campus

Fig. 2.

Fig. 3.

The following weed plants were associated with silver oak plantation in minor form viz., Eupatorium triplinerve, Vahl. (Asteraceae), Triumfetta rhomboidea, Jack (Tiliaceae), Mimosa pudica, Linn. (Leguminosae), Aristida adscencionis, Linn. (Graminae) and Apluda aristata, Linn. (Graminae).

III.C.4 Casuarina plantation

This plantation is situated in the eastern side of University Campus with 12 years old trees with a spacing of 2M x 2M between trees and rows. The location of the sampling site of casuarina plantation in the GKVK campus is shown in Fig. 4.

This habitat was also covered with some herbs and shrubs in minor form. It is less disturbed area compared to other habitats. The common plant species associated in this habitat were Arundinella fuscata, Nees. (Graminae), Cenchurus ciliaris, Linn. (Graminae), and Heteropogon contortus, Beauv. (Graminae).

III.C.5 Barren land

This site is situated in the Southern side of the University campus with a gentle slope from South to North. This area is more or less free from any trees

Fig. 4 : The location of the casuarina sampling site
in the GKVK campus

Fig. 4.

Fig. 5 : The location of the barren land sampling site in the GKVK campus

Fig. 5.

except few herbs and patchy grasses. The location of the sampling site of the barren land in the GKVK campus is shown in Fig. 5.

III.D Study period

The litter and soil samples were collected at regular fortnightly intervals for a period of one year from April, 1993 to March, 1994.

III.E Study method

III.E.1 Litter samples

The litter samples were collected from each habitat (except barren land). Five randomly selected sample units were used in each occasion. The collected samples were immediately transferred to aluminium sampling cans of 6cm dia and 15cm height, covered with a lid and labelled, the label contained details of sample number, date of sampling, habitat etc. The samples were transported to the laboratory for faunal extraction.

Different litter samples were also collected from each habitat for estimation of litter moisture status at the time of sampling.

III.E.2 Soil samples

The soil samples were collected randomly from each habitat. Five soil samples were drawn from each habitat at random by using the 'core sampler' (Fig. 6) measuring 12cm dia and 10cm height. The surface litter and weeds were removed carefully from the sampling spot before applying the core sampler, then 'core sampler' was placed on the selected surface and with little force it was pressed and turned clockwise direction until the core was filled with sample. The soil sample was immediately transferred to aluminium cans of 15cm height and 6cm dia and labels were placed for each cans and closed with lid. Different soil samples were also drawn from each habitat for analysing physico-chemical properties of the soils in study area.

III.F Extraction

The extraction of the fauna from litter and soil samples was done in an air conditioned "modified tull gren funnel apparatus" (Macfadyen, 1953) (Fig. 7) in the Soil Biology laboratory at the Department of Entomology, UAS, GKVK, Bangalore. The apparatus is equipped with 80 funnels to extract more number of samples within a stipulated period.

Fig. 6 : 'Core sampler'

Fig. 7 : Modified tull gren funnel apparatus

Fig. 6.

Fig. 7.

III.F.1 Extraction of fauna in "modified tull gren funnel apparatus"

The litter and soil samples were placed carefully in the extraction funnels. A 60 watts bulb was fixed in the baffle board and used as the source of heat on the top of the sample and the samples were allowed for 24 hours. Soil fauna passed through 2mm x 2mm sieve of the sample holder were collected in vials containing 70 per cent alcohol fixed to the lower end of the funnel. These vials were periodically checked to keep the alcohol to desired level. Labels were intact both in soil sample and extracted vial.

III.G Estimation of litter and soil moisture

Known amounts of litter and soil samples were collected separately from different habitats of forests and barren land. The soil samples were dried in an electric oven at $105^{o}C$ for 24 hours in the laboratory to find out the moisture per cent using the following formula

$$\% \text{ moisture content} = \frac{\text{Fresh weight-dry weight}}{\text{Dry weight}} \times 100$$

The extracted fauna were seperated by means of a fine camel hair brush under an ordinary binocular stereo microscope. The specimens were counted in each sample and seperated out into different taxonomical units.

III.H Sampling records

Faunal composition of both litter and soil in terms of number and abundance was recorded seperately for each study site. Some of the specimens of the soil faunal groups were identified based on the identified collections maintained at the Soil Biology laboratory at the Department of Entomology, GKVK campus.

III.I Sample storage

Faunal groups encountered during the study period, at fortnightly intervals were preserved in vials containing 75% ethanol and labelled (name of the group, habitat and date of collection) for further taxonomic identification.

III.J Preparation of specimens for identification

Depending upon the size and degree of sclerotization, the oribatid mites collected during study period were kept for clearing in 1:1 absolute alcohol and 10 per cent lactic acid for 2 weeks to 2 1/2

months. Slides were prepared using a drop of glycerine on clean glass slide and a cover slip was placed and labelled for further identification. The slide mounted oribatid mites were identified upto species level in the Acarology laboratory at University of Calicut, Kerala. Dr.M.A. Haq and Dr.N. Ramani, Specialists in this group assisted in identification of these mites.

III.J.1 Identification of Collembola

The Collembola collected during the study period were preserved in 75 per cent ethanol and later identified with the help of Dr.C.G.A. Pai of the Cochin College, Kochi, Kerala. The identification of Collembola up to the family level as per the keys prepared by Scott (1961) was used.

III.K Data compilation

The data on faunal groups, number and also distribution and abundance were compiled for the study sites so as to obtain monthly faunal abundance and distribution of habitats and to know the diversity indices in different ecosystems.

III.L Statistical analyses

III.L.1 Diversity index

Shannon-weaner diversity index was used to know the species richness of different habitats (Pielou, 1975).

According to Pielou (1975) the diversity of the fauna has been worked out using the following formula

$$e^{H} = - \quad (pi) \quad (Log\ pi)$$

where,

H = index of species diversity

pi = proportion of the total individuals in each group

III.L.2 Measurement of Relative abundance

Relative abundance was calculated for different faunal groups of each habitats.

$$\text{Relative abundance} = \frac{\text{No.of individuals in particular groups}}{\text{Total no. of individuals of all groups}} \times 100$$

III.L.3 Correlation between faunal population and ecological factors

The correlation coefficient studies were worked out to find out the positive relation between the faunal population and maximum temperature, minimum temperature,

mean temperature, soil temperature (at 5cm, 10cm and 15cm depth), relative humidity, rainfall and litter and soil moisture.

III.M Pot culture experiment

In order to find out the effect of eucalyptus plant parts on soil fauna a pot culture experiment was conducted at the Green House in the Department of Entomology, Agricultural College, GKVK Campus, Bangalore during 1993-94. The soil from GKVK farm was collected for this purpose from the upper 10cm depth. The soil sample was dried under shade and powdered to facilitate proper mixing of the eucalyptus leaves, bark and floral parts. The physical and chemical properties of soil tested prior to the experiment are presented in Table 2. The experiment consisted of ten treatments in a completely randomised design replicated thrice. The details of the treatments are given below:

T_1 = 1 Kg soil + 5 g Eucalyptus leaves

T_2 = 1 Kg soil + 10 g Eucalyptus leaves

T_3 = 1 Kg soil + 15 g Eucalyptus leaves

T_4 = 1 Kg soil + 5 g Eucalyptus bark

T_5 = 1 Kg soil + 10 g Eucalyptus bark

T_6 = 1 Kg soil + 15 g Eucalyptus bark

T_7 = 1 Kg soil + 5 g Eucalyptus floral parts

Table 2. Physico chemical properties of soil prior to pot culture experiment

Physical properties		
Mechanical analysis		
1.	*Coarse sand (%)*	*34.55*
2.	*Fine sand (%)*	*38.00*
3.	*Silt (%)*	*8.60*
4.	*Clay (%)*	*18.90*
	Textural class	*Red sandy loam*
Chemical properties		
1.	*PH (1:2.5)*	*5.6*
2.	*EC (dsm^{-1})*	*0.20*
3.	*Organic carbon (%)*	*0.36*
4.	*Available Phosphorus (Kg/ha^{-1})*	*25.34*
5.	*Available Potassium (Kg/ha^{-1})*	*69.67*
6.	*Exchangeable calcium [C.mol(p+) Kg^{-1}]*	*2.53*
7.	*Exchangeable Magnesium [C.mol (p+) Kg^{-1}]*	*0.76*
8.	*DTPA Extractable micronutrients (ppm)*	
	Fe	*10.48*
	Cu	*1.63*
	Zn	*3.67*
	Mn	*31.50*

T_8 = 1 Kg soil + 10 g Eucalyptus floral parts

T_9 = 1 Kg soil + 15 g Eucalytpus floral parts

T_{10} = Control (soil alone)

Watering was done once a week for better decomposition. After six months the soil samples were analysed for their nutrient composition, physical and chemical properties and the data is presented.

III.N Soil analyses for physical and chemical properties

The physical and chemical analysis were carried out at the Department of Soil Science, Agriculture College, University of Agricultural Sciences, Bangalore and Zuari Agrochemicals Ltd., Agricultural Development Laboratory, Malleshwaram, Bangalore.

a. Mechanical analysis

Mechanical analysis was carried out by following the international pipette method as described by Piper (1966).

b. pH and Electrical conductivity

pH of soil was measured in 1:2.5 soil water suspension using ELICO pH meter, with a combined

electrode. The clear supernatant was collected and electrical conductivity was measured using ELICO conductivity bridge (Jackson, 1973).

c. Organic carbon

Organic carbon content of soil was estimated by Walkley and Black wet oxidation method as described by Jackson (1973).

d. Available nitrogen

Available nitrogen was determined by the alkaline permanganate method, as outlined by Subbaiah and Asija (1956).

e. Available phosphorus

Available phosphorus was extracted by Bray's No.1 reagent and it was determined by chlorostannous reduced molybdo phosphoric acid blue colour method as described by Jackson (1973).

f. Available potassium

Available potassium was determined flame photometrically (Jackson, 1973).

g. Micronutrients

Micronutrients such as Zinc, Copper, Iron and Manganese were extracted using a mixture of 0.05m DTPA (Diethyl triamine pentacetic acid) 0.01m $CaCl_2$ and 0.1M TEA (Triethanol amine) buffered at pH 7.3 and determined using atomic absorption spectrophotometer as described by Lindsay and Norvell (1978).

III.O Statistical analyses

Data on soil samples were analysed statistically using standard procedure as outlined by Sunderraj et al. (1972).

EXPERIMENTAL RESULTS

IV. EXPERIMENTAL RESULTS

Investigations were carried out to find out the soil faunal deversity, abundance and distribution in Eucalyptus plantation in comparison with other similar plantations at GKVK Campus, University of Agricultural Sciences, Bangalore during the period from April 1993 to March 1994. The results of these investigations are presented here under.

IV.A. Faunal distribution and diversity in different habitats

The fauna extracted and analysed during the study period in Eucalyptus plantation in comparison with Acacia, Silveroak and Casuarina plantations and Barren land are presented in Table 3.

IV.A.1 Eucalyptus litter

A total of 4658 arthropods were collected from this habitat. Acarina and Collembola constituted 79.91 per cent of the total specimens collected (61.54 and 18.37% respectively). Whereas Diplura was represented by minimum numbers (0.064%). Cryptostigmata (Fig.8) recorded 18.52 per cent belonging to five families and five genera viz., Haplophorella scapellata

Table 3. Distribution and diversity of faunal groups in different habitats

Faunal groups	EL	ES	AL	AS	SL	SS	CL	CS	BL
Isopoda	0.10	-	-	0.072	0.31	0.44	0.16	0.31	-
Symphyla	-	0.10	0.038	-	-	0.71	0.071	0.22	-
Pauropoda	0.32	2.64	0.13	1.44	-	0.53	0.39	2.09	-
Chilopoda	0.12	-	0.36	0.79	0.090	0.089	0.17	0.090	-
Diplopoda	-	-	-	-	0.31	-	0.90	0.31	-
Polyxenidae	-	-	-	-	+	-	+	+	-
Spiders (Araneae)	0.68	0.10	0.51	0.64	0.90	0.35	0.49	0.22	-
Pseudoscorpiones	6.52	1.83	0.24	0.072	1.85	0.26	2.93	0.95	-
Other Acari	43.02	44.80	49.70	43.15	53.47	47.04	42.93	38.88	66.96
Cryptostigmata	18.52	12.21	14.89	19.52	12.19	17.17	14.81	13.68	17.85
Phthiracaridae									
Haplophorella scapellata	+	-	+	+	-	-	+	+	-
Galumnidae									
Galumna sp.	-	-	-	-	-	-	+	-	-
G.flabellifera orientalis	+	+	+	+	-	+	+	-	-
G.alata	-	-	-	-	-	-	+	-	-
Pergalumna sp.	-	-	+	-	-	-	+	+	-
Ceratozetidae									
Ceratozetes polpaicoensis	+	-	+	-	-	-	+	-	-
Scheloribatidae									
Scheloribates sp.	-	-	+	-	-	-	-	+	-
S.praeincisus Var. interruptus	-	-	+	-	-	-	+	-	-
S.praeincisus	+	-	+	-	+	+	-	-	-
S.latipes	-	-	-	+	-	+	+	+	-

Faunal groups	EL	ES	AL	AS	SL	SS	CL	CS	BL
S.rectus	-	-	-	-	-	+	-	+	-
S.thermophilus	-	-	-	+	-	-	-	-	-
Epilohmanniidae									
Epilohmannia pallida	-	-	-	+	-	-	-	-	-
Eremulidae									
Eremulus truncatus	+	-	-	+	-	-	+	-	-
Collembola	18.37	31.46	20.34	24.20	15.89	22.80	27.94	34.19	-
Brachystomellidae	4.08	18.38	16.77	10.00	2.84	4.29	18.44	7.59	-
Brachystomella sp.	+	-	+	-	-	-	+	+	-
Hypogastruridae	13.90	15.48	14.79	21.81	27.84	16.01	27.60	10.71	-
Xenylla sp.	-	-	+	-	+	-	+	-	-
X.reducta	-	-	-	+	+	-	+	+	-
Isotomidae	29.90	38.38	30.53	49.69	25.56	54.68	24.36	53.73	-
Folsomides sp.	+	+	+	+	-	+	+	+	-
Proisotoma sp.	-	+	-	-	-	-	+	+	-
Entomobryidae	44.97	24.51	33.64	16.36	41.19	16.79	24.36	26.05	-
Lepidocyrtus sp.	+	+	+	-	+	-	+	+	-
Cyphoderus sp.	-	+	+	-	-	-	-	+	-
Salina sp.	-	-	+	-	-	-	-	+	-
Sminthuridae	7.12	3.22	4.24	2.12	2.55	8.20	5.21	1.89	-
Sminthurides sp.	+	-	+	-	-	-	+	-	-
Protura	-	0.30	-	0.14	-	0.089	-	0.22	-
Diplura	0.064	0.61	0.076	0.14	0.13	0.17	0.41	0.36	-
Japygidae	+	+	-	+	+	-	+	-	-
Campodeidae	+	-	+	+	-	+	+	+	-

Faunal groups	EL	ES	AL	AS	SL	SS	CL	CS	BL
Thysanura (Silver fish)	0.32	0.40	0.40	0.14	0.13	-	-	-	-
Lepismatidae	-	-	+	-	+	-	-	-	-
Orthoptera	0.47	-	0.55	0.072	0.36	0.089	0.21	-	-
Gryllidae	+	-	+	+	+	+	+	-	-
Embioptera	-	-	-	-	-	-	0.071	-	-
Embiidae	-	-	-	-	-	-	+	-	-
Dictyoptera	0.42	-	0.076	-	0.045	-	0.071	-	-
Blatellidae	+	-	+	-	+	-	+	-	-
Isoptera	0.42	-	-	-	0.63	0.62	0.19	1.22	-
Psocoptera	3.39	1.73	1.91	0.43	1.67	-	1.56	0.36	3.57
Hemiptera	1.20	0.50	1.29	1.0	1.16	0.26	1.14	2.12	-
Reduviidae	+	-	+	+	-	-	-	-	-
Cicadellidae	-	-	+	-	+	-	-	-	-
Balclutha sp.	-	-	-	-	-	-	-	+	-
Agallia sp.	-	-	-	-	-	-	+	-	-
Miridae	-	-	+	-	-	+	-	-	-
Psyllidae	+	-	-	-	+	-	-	-	-
Pseudococcidae	-	-	+	+	-	+	+	+	-
Cydnidae	+	+	+	+	-	-	-	-	-
Fulgoroidea	-	-	-	+	+	-	-	-	-
Aphididae	-	-	-	-	-	+	+	-	-
Lyzidae	+	-	+	+	-	-	+	-	-
Issidae	-	-	+	-	-	-	-	-	-
Thysanoptera	1.91	0.40	4.53	0.72	4.56	1.16	2.72	0.90	0.89
Terebrantia	-	-	+	+	-	-	-	+	+

Faunal groups	EL	ES	AL	AS	SL	SS	CL	CS	BL
Thripidae	-	-	+	+	-	-	-	+	+
Tubulifera	-	-	-	-	+	+	+	-	-
Neuroptera	+	+	-	-	-	+	-	-	-
Myrmeliontidae	0.23	0.20	-	-	-	0.089	-	-	-
Lepidoptera (larva)	0.79	-	1.30	0.14	0.45	0.26	0.62	0.136	-
Pyralidae	-	-	-	-	-	+	-	-	-
Arctiidae	+	-	+	-	+	-	+	-	-
Noctuidae	+	-	+	+	-	+	-	-	-
Amatidae	-	-	-	-	+	-	+	+	-
Psychidae	-	-	-	-	+	-	-	-	-
Diptera (larva)	0.15	0.10	0.36	0.93	1.58	1.25	0.60	0.40	-
Tabanidae	-	-	-	+	-	-	-	+	-
Drosophilidae	+	-	-	+	-	+	-	-	-
Sarcophagidae	-	-	+	-	+	-	-	+	-
Stratiomyidae	-	+	+	-	+	+	+	-	-
Ottitidae	-	-	-	+	-	+	-	-	-
Hymenoptera (Adults)	0.12	0.20	0.038	0.28	0.13	-	0.035	-	1.78
Chalcididae	-	+	-	-	+	-	-	-	-
Scoliidae	+	-	-	-	-	-	-	-	+
Ichneumonidae	-	-	-	+	-	-	+	-	-
Encyrtidae	-	-	+	-	-	-	-	-	-
Formicidae	0.94	2.13	1.89	5.18	0.85	3.84	0.67	2.31	7.14
Monomorium pharaonis	-	-	+	-	-	-	-	-	-
M.wroughtoni	-	-	-	+	-	-	-	+	-
Phidologiton sp.	-	-	+	-	-	-	-	-	-
Plagiolepis exigua	-	-	-	+	-	-	-	-	-

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Faunal groups	EL	ES	AL	AS	SL	SS	CL	CS	BL
Crematogaster rothneyi	+	-	-	-	-	-	-	-	-
Coleoptera (Adult)	0.96	0.30	0.43	0.14	0.45	1.43	0.44	0.27	1.78
Carabidae	-	-	-	+	+	-	-	-	+
Staphylinidae	+	+	-	-	+	-	+	+	-
Scarabaeidae	-	-	-	-	+	-	-	+	-
Elateridae	-	-	+	-	-	+	-	+	-
Tenebrionidae	+	-	-	+	+	-	+	+	+
Chrysomelidae	-	-	+	-	-	+	-	-	-
Scolytidae	-	-	+	-	-	-	-	-	-
Nitidulidae	-	+	-	-	-	-	-	-	-
Curculionidae	+	-	-	-	-	-	+	+	-
Coleoptera (Larva)	0.96	0.20	0.80	0.50	2.21	0.98	0.56	0.77	-
Carabidae	+	-	-	+	-	+	+	-	-
Staphylinidae	-	-	-	+	-	-	-	+	-
Scarabaeidae	-	+	-	-	+	+	-	-	-
Elateridae	-	-	-	-	+	-	-	-	-
Dermestidae	-	+	+	-	+	+	+	+	-
Coccinellidae	-	-	+	-	-	-	-	-	-
Tenebrionidae	-	-	-	-	-	-	-	+	-
Chrysomelidae	+	-	+	-	-	+	-	-	-
Curculionidae	+	-	+	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	+	-	-	-	-

EL : Eucalyptus litter ; ES : Eucalyptus soil ; AL : Acacia litter ; AS : Acacia soil ; SL : Silveroak litter ; SS : Silveroak soil ; CL : Casuarina litter ; Casuarina soil ; BL : Barren land

+ : Present ; - : Absent

Fig. 8 : Cryptostigmata

Fig. 8.

(Phthiracaridae), Galumna flabellifera orientalis (Galumnidae), Ceratozetes polpoicoensis (Ceratozetidae), Scheloribates praeincisus (Scheloribatidae) Eremulus truncatus (Eremulidae).

Among Collembola (Fig.9) Brachystomellidae, Hypogastruridae, Isotomidae, Entomobryidae and Sminthuridae accounted for 4.08, 13.90, 29.90, 44.97 and 7.12 per cent respectively. The species were Brachystomella sp. (Brachystomellidae), Folsomides sp. (Isotomidae), Lepidocyrtus sp. (Entomobryidae) and Sminthurides sp. (Sminthuridae).

The myriapod group comprised of Pauropoda (0.32%) and Chilopoda (0.12%) whereas Symphyla and Diplopoda were not observed. Spiders, Pseudoscorpiones (Fig.10), other acari, psocids, Hemiptera, Thysanoptera, Larval Lepidoptera, ants, coleopteran adults and coleopteran larvae were distributed at 0.68, 6.52, 43.02, 3.39, 1.20, 1.91, 0.79, 0.94, 0.96 and 0.96 per cent respectively.

Isopods (Fig.11) (0.10%), Diplura (0.064%) represented by Japygidae and Campodeidae. Orthoptera (Gryllidae) formed 0.47 per cent, Dictyoptera (Blatellidae) and Isoptera recorded 0.42 per cent each.

Fig. 9 : Collembola

Fig. 10 : Pseudoscorpiones

Fig. 11 : Isopoda

Fig. 9.

Fig. 10.

Fig. 11.

Neuroptera (Myrmeliontidae) occupied 0.23 per cent, dipteran larvae (0.15%) represented by Drosophilidae and Hymenoptera (0.12%) were found relatively in low numbers compared to other faunal groups. Hemiptera included Reduviidae, Psyllidae, Cydnidae and Lyzidae. Lepidoptera comprises Noctuidae and Arctiidae. Among Hymenoptera Scoliidae and Crematogaster rothneyi (Formicidae) were noticed. The adults of coleopterans represented by Staphylinidae, Tenebrionidae and Curculionidae. Coleopteran larvae of Scarabaeidae, Chrysomelidae and Curculionidae were observed.

IV.A.2. Eucalyptus soil

Abundance of soil fauna were noticed least number being 982 compared to other forest plantations. Collembola and Acarina constituted with 31.46 and 57.0 per cent respectively, out of 88.47 per cent of the total soil fauna collected. Cryptostigmata accounted for 12.21 per cent belonging to only one family and a genus viz., Galumna flabellifera orientalis (Galumnidae).

Among Collembola Brachystomellidae constituted 18.38 per cent, Hypogastruridae 15.48 per cent, Isotomidae (38.38%) represented by Folsomides sp. and Proisotoma sp. Similarly Entomobryidae represented by

Lepidocyrtus sp. and Cyphoderus sp. was 24.51 per cent and Sminthuridae was 3.22 per cent.

Pauropods, Pseudoscorpiones, other acari, psocids, ants (Formicidae) were encountered respectively at 2.64, 1.83, 44.80, 1.73 and 2.13 per cent followed by Symphyla (Fig.12) spiders, proturans, diplurans, Thysanura, Hemiptera, Thysanoptera, Neuroptera, dipteran larvae, Hymenoptera, coleopteran larvae which were distributed relatively in lower numbers viz., 0.10, 0.10, 0.30, 0.61, 0.40, 0.50, 0.40, 0.20, 0.10, 0.20, 0.30 and 0.20 per cent respectively. Diplura was represented only by Japygidae. Cydnidae represented the Hemiptera occuring frequently throughout the study period. Dipteran larvae was represented by Stratiomyidae. Hymenoptera comprised Chalcididae. Coleopteran adults was represented by Staphylinidae and Nitidulidae and larvae of Scarabaeidae and Dermestidae.

IV.A.3. Acacia litter

The total soil fauna collected in this habitat was 5229. Acarina and Collembola accounted for 64.59 and 20.34 per cent respectively, out of 84.93 per cent of the total arthropods collected. Symphyla and Hymenoptera were the least recording 0.038 per cent. Cryptostigmata constituted 14.89 per cent. The Oribatei samples

Fig. 12 : Symphyla

Fig. 12.

analysed from this habitat showed that Cryptostigmata was represented by five families and five genera. The species are Haplophorella scapellata Galumna flabellifera orientalis Pergalumna sp. (Galumnidae); Ceratozetes polpoicoensis,(Ceratozetidae); Scheloribates sp. S.praeincisus, S.praeincius var interruptus, (Scheloribatidae).

The Collembola was represented by five families and 7 genera. These were Brachystomellidae (16.77%) with Brachystomella sp.; Hypogastruridae (14.79%) with Xenylla sp.; Isotomidae (30.53%) with Folsomides sp.; Entomobryidae (33.64%) with three species viz., Lepidocyrtus sp. Cyphoderus sp. and Salina sp. and Sminthuridae (4.24%) with only Sminthurides sp.

Other faunal groups such as spiders (0.51%) Pseudoscorpiones (0.24%), Diplura and Blatellidae (0.076% each), Thysanura (0.40%), Gryllidae (0.55%), psocids (1.91%), Hemiptera (1.29%), Thysanoptera (4.53%), lepidopteran larvae (1.30%) dipteran larvae (0.36%), ants (1.89%), coleopteran adults (0.43%) and coleopteran larvae (0.80%). Diplura and Thysanura represented by Campodeidae and Lepismatidae respectively. Reduviidae, Cicadellidae, Miridae, Pseudococcidae, Ccydnidae, Lyzidae and Issidae formed

under Hemiptera. Thripidae were recorded under Thysanoptera. Arctiidae and Noctuidae of Lepidoptera, dipteran larvae belonging to Sarcophagidae and Stratiomyidae. Encyrtidae of adult Hymenoptera, Monomorium pharaonis Linn. Phidologiton sp. (Formicidae) were also included. Among the coleopterans observed, the larval Coleoptera include Dermestidae, Coccinellidae Chrysomelidae and Curculionidae.

IV.A.4. Acacia soil

A total of 1388 soil fauna were extracted during the study period. Acari and Collembola accounted for 62.67 and 24.20 per cent respectively out of 86.87 per cent of the total soil fauna extracted from this habitat. Cryptostigmata accounted for the highest percentage with 19.52 compared to all other habitats. Soil samples analysed for Cryptostigmata from this habitat were represented by five families and five genera viz., Galumna flabellifera orientalis (Galumnidae), Scheloribates latipes (Scheloribatidae), Epilohmannia pallida (Epilohmanniidae), Eremulus truncatus (Eremulidae) and Haplophorella scapellata (Phthiracaridae).

Among collembolan fauna collected Brachystomellidae constituted 10.0 per cent, Hypogastruridae constituted 21.81 and was per cent represented by Xenylla reducta. Whereas Isotomidae accounted for 49.69 per cent which was represented by Folsomides sp. However Entomobryidae and Sminthuridae were noticed at 16.36 and 2.12 per cent respectively.

Among myriapods Pauropoda (1.44%) and Chilopoda (0.75%) were noticed and other groups such as spiders (0.64%), Protura, Diplura and Thysanura 0.14 per cent each were noticed. Psocids (0.43%), Hemiptera (0.10%), thrips (0.72%), lepidopteran larvae (0.14%), dipteran larvae (0.93%), Hymenoptera (0.28%), ants (5.18%), adult coleopteran (0.14%) and coleopteran larvae (0.50%) were observed. Diplura was represented by Japygidae and Campodeidae. Hemiptera consisted of Reduviidae, Pseudococcidae, Cydnidae, Fulgoridae and Lyzidae. Gryllidae, Thripidae, Noctuidae, Tabanidae, Drosophilidae, Ottitidae, Ichneumonidae, Monomorium wroughtoni, Plagiolepis exigua, (Formicidae), Carabidae, Tenebrionidae and Carabidae and Staphylinidae of larval Coleoptera were also recorded from this habitat.

IV.A.5 Silver oak litter

A total of 2214 fauna were collected from the silver oak litter habitat. Acarina and Collembola consisted 81.55 per cent of the total fauna collected (65.66 and 15.89% respectively). Whereas Blatellidae (Dictyoptera) was respresented by a minimum number of specimens (0.045%). Cryptostigmata (12.19%) represented only by Scheloribates praeincisus (Scheloribatidae).

Among Collembola,Brachystomellidae,Hypogastruridae, Isotomidae, Entomobryidae and Sminthuridae recorded 2.84, 27.84, 25.56, 41.19 and 2.55 per cent respectively. The important species were Xenylla reducta, Xenylla sp. (Hypogastruridae) and Lepidocyrtus sp. of Entomobryidae.

Isopods were observed only at 0.31 per cent. In Myriapoda, Chilopoda (0.09%) and Diplopoda (0.31%) were recorded. Polyxenidae (Fig.13) was also seen in this habitat. Spiders and Pseudoscorpiones occurred at 0.90 and 1.85 per cent respectively. Diplura and Thysanura formed 0.13 per cent each. Orthoptera, Isoptera, psocids occurred at 0.36, 0.63 and 1.67 per cent respectively. Hemiptera (1.16%) represented by Cicadellidae, Psyllidae and Fulgoridae. Thysanoptera distributed to an extent of 4.56 per cent. Larval

Fig. 13 : Polyxenidae (Diplopoda)

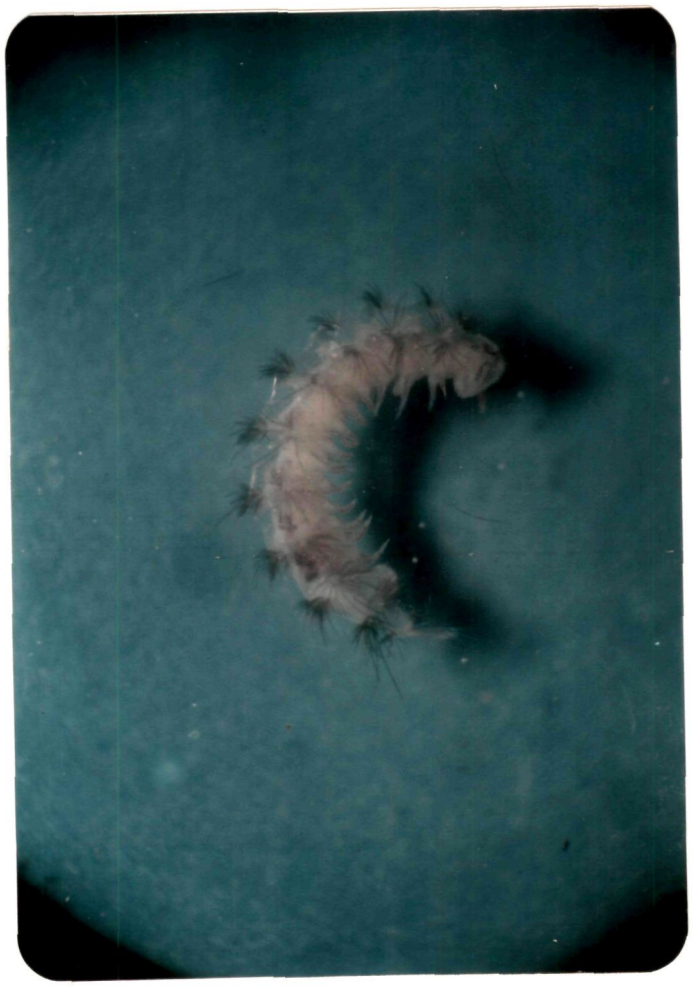

Fig. 13.

Lepidoptera represented by Arctiidae and Amatidae with 0.45 per cent. Sarcophagidae and Stratiomyidae of larval Diptera accounted for 1.58 per cent. Other groups such as Hymenoptera (0.13%) with Chalcididae and Formicidae (0.85%) were present. Coleopteran adults and larvae were represented by Carabidae, Staphylinidae, Scarabaeidae and Tenebrionidae (0.45%) and Carabidae, Staphylinidae (0.50%) respectively.

IV.A.6 Silver oak soil

A total of 1118 soil arthropods were encountered from this habitat. Acari and Collembola combination constituted 87.01 per cent of the total fauna. Among Acarina, Cryptostigmata accounted for 17.17 per cent. Analysed samples of Oribatei revealed that four species were distributed in the study site belonging to two families viz., Galumnidae, Galumna flabellifera orientalis and Scheloribatidae, Scheloribates praeincisus, S.latipes and S.rectus.

Of the collembolans, Brachystomellidae (4.29%), Hypogastruridae (16.0%), Isotomidae (54.68%) with Folsomides sp. Entomobryidae and Sminthuridae formed 16.79 and 8.20 per cent respectively. Diplura was represented by Campodeidae.

Isopods recorded 0.44 per cent. Myriapods include Symphyla, Pauropoda and Chilopoda recorded at 0.71, 0.53 and 0.089 per cent respectively. Other groups such as spiders (0.35%) Pseudoscorpiones (0.26%), Protura (0.089%), Diplura (0.17%), Orthoptera (0.089%) and Isoptera (0.62%) were observed. Among Hemiptera Miridae, Pseudococcidae and Aphididae constituted 0.26 per cent of the total soil fauna collected. The larval Lepidoptera (0.26%) consisted of Pyralidae and Noctuidae. Larval forms of Diptera accounted to 1.25 per cent and was represented by families of Drosophilidae, Stratiomyidae and Ottitidae. Ants recorded 3.84 per cent of the total fauna collected. Elateridae and Chrysomelidae of Coleoptera occupied 1.43 per cent whereas larval Carabidae, Scarabaeidae, Dermestidae and Chrysomelidae constituted 0.98 per cent.

Casuarina litter

A maximum of 5615 soil fauna were encountered from this habitat compared to other habitats. Collembola and Acarina contributed 27.94 and 57.74 per cent respectively, out of 85.68 per cent of the total soil fauna. Cryptostigmata contributed 14.81 per cent comprised of five families and six genera viz., Galumna sp. G.flabellifera orientalis, G.alata, Pergalumna sp.

(Galumnidae). Ceratozetes polpoicoensis (Ceratozetidae), Scheloribates praeincisus Var interruptus, S.latipes (Scheloribatidae), Eremulus truncatus (Eremulidae).

Among Collembola, Brachystomellidae (18.44%), Hypogastruridae (27.60%), Isotomidae (24.36%), Entomobryidae (24.36%), Sminthuridae (5.21%) were recorded in this habitat.

Isopods constituted about 0.16 per cent, whereas myriapods including Symphyla, Pauropoda, Chilopoda, Diplopoda occurred at 0.071, 0.39, 0.17 and 0.90 per cent respectively. Polyxenidae was frequently recorded from this habitat. Other groups such as spiders (0.49%) and Pseudoscorpiones (2.93%) were present. Members of Japygidae and Campodeidae of Diplura constituted 0.41 per cent. Gryllidae, Embiidae, Blatellidae, Isoptera, psocids were encountered respectively at 0.21, 0.071, 0.071, 0.19, 1.56 per cent.

Hemiptera (1.14%) was represented by Agallia sp. of Cicadellidae, Pseudococcidae, Aphididae and Lyzidae. Thysanoptera (2.72%) comprised only by Tubulifera. Larval Lepidoptera (0.62%) was represented by Arctiidae and Amatidae. Similarly larval Diptera was represented only by Stratiomyidae (0.60%), Hymenoptera including

Ichneumonidae (0.035%) and Formicidae Ants (0.67%) were recorded. Adult and larval Coleoptera including Staphylinidae, Tenebrionidae, Carabidae (0.44%) and Dermestidae (0.56%) were recorded.

IV.A.8 Casuarina soil

This study site recorded 2199 number of soil fauna throughout the study period. Acarina and Collembola constitute 86.75 per cent of the total soil fauna collected. Other acari and Crypotostigmata contributed 38.88 and 13.68 per cent respectively. Collembola accounted to 34.19 per cent which was maximum compared to rest of the habitats.

From the Acari collections of this habitat, Oribatei contained three families and three genera viz., Haplophorella scapellata, Pergalumna sp. (Galumnidae), Scheloribates sp. S.latipes and S.rectus (Scheloribatidae).

The collembolans Brachystomellidae, Hypogastruridae Isotomidae, Entomobryidae and Sminthuridae were 7.59, 10.71, 53.73, 26.05 and 1.89 per cent respectively.

Myriapoda had maximum representation from this study site. Pauropoda contributed 2.09 per cent followed by Diplopoda (0.31%), Symphyla (0.22%) and Chilopoda

(0.090%). Protura (0.22%), Diplura (0.36%), Isoptera (0.22%) and psocids accounted to 0.36 per cent. Balclutha sp. of Cicadellidae was collected only from this habitat, and also Pseudococcidae respresented Hemiptera. Thysanoptera (Thripidae) (0.90%), Isoptera (0.31%), Lepidoptera larvae (0.13%) with Amatidae were present. Dipteran larvae constituted 0.40 per cent and was represented by a family Tabanidae. Ants were encountered at 2.31 per cent having Monomorium wroughtoni as a frequently occuring species. Among coleopteran adults, Staphylinidae, Scarabaeidae, Elateridae and Tenebrionidae constituted 0.27 per cent. Whilst larval Coleoptera was 0.77 per cent represented mainly by Staphylinidae and Dermestidae.

IV.A.9 Barren land

A total of 112 belonging to six different groups of soil faunal communities viz., acarines, psocids, thrips, hymenopteran adults, ants and adult Coleoptera was found distributed in this habitat.

Among these acarines accounted for 84.81 per cent with other acarines 66.96 and Cryptostigmata constituting 17.85 per cent. Collembolans were not observed in this habitat.

Psocids accounted for 3.57 per cent, thrips (0.89%) represented by Thripidae. Adult Hymenoptera (Scoliidae) 1.78 per cent, Ants contributed 7.14 per cent and adult Coleoptera with 1.78 per cent which was represented by Carabidae and Tenebrionidae.

IV.a.1 Eucalyptus

The soil faunal diversity in eucalyptus habitat was observed to be more in litter compared to the faunal diversity in soil (Table 4). The species abundance relationship and the maximum faunal diversity was observed in litter with 2.010 when compared to soil with 1.444. The maximum diversity was observed during January both in litter and soil. The minimum diversity in litter was 1.311 during October and was 0.706 during March in soil. The average faunal diversity was 1.700 for litter compared to 1.113 in soil. Faunal diversity was observed to fluctuate through out the year and was more or less stable from August to December in litter. Similarly it was more or less stable in soil from July to December (Fig.14). The litter harboured a maximum of 15 groups during May and where as soil haroboured 8 groups during November. The minimum number of 8 groups were recorded during April and December in litter and only three groups was noticed in soil during April and March

Table 4. Shannon - weaner diversity index for soil fauna collected from Eucalyptus plantation

	Litter			Soil		
Month	N	OTU	Diversity	N	OTU	Diversity
April-93	19	8	1.789	3	3	0.867
May	318	15	1.668	11	4	1.113
June	132	14	1.900	17	4	1.247
July	160	13	1.999	24	4	0.974
August	272	14	1.663	69	5	1.171
September	280	11	1.360	60	6	1.174
October	548	12	1.311	167	6	1.142
November	200	10	1.628	68	8	1.146
December	121	8	1.508	30	6	1.342
January-94	91	14	2.010	14	5	1.444
February	89	12	1.825	22	4	1.032
March	100	12	1.742	10	3	0.706
			X = 1.700			X = 1.113

N = Total number of arthropods collected

OTU = Operational Taxonomic Units

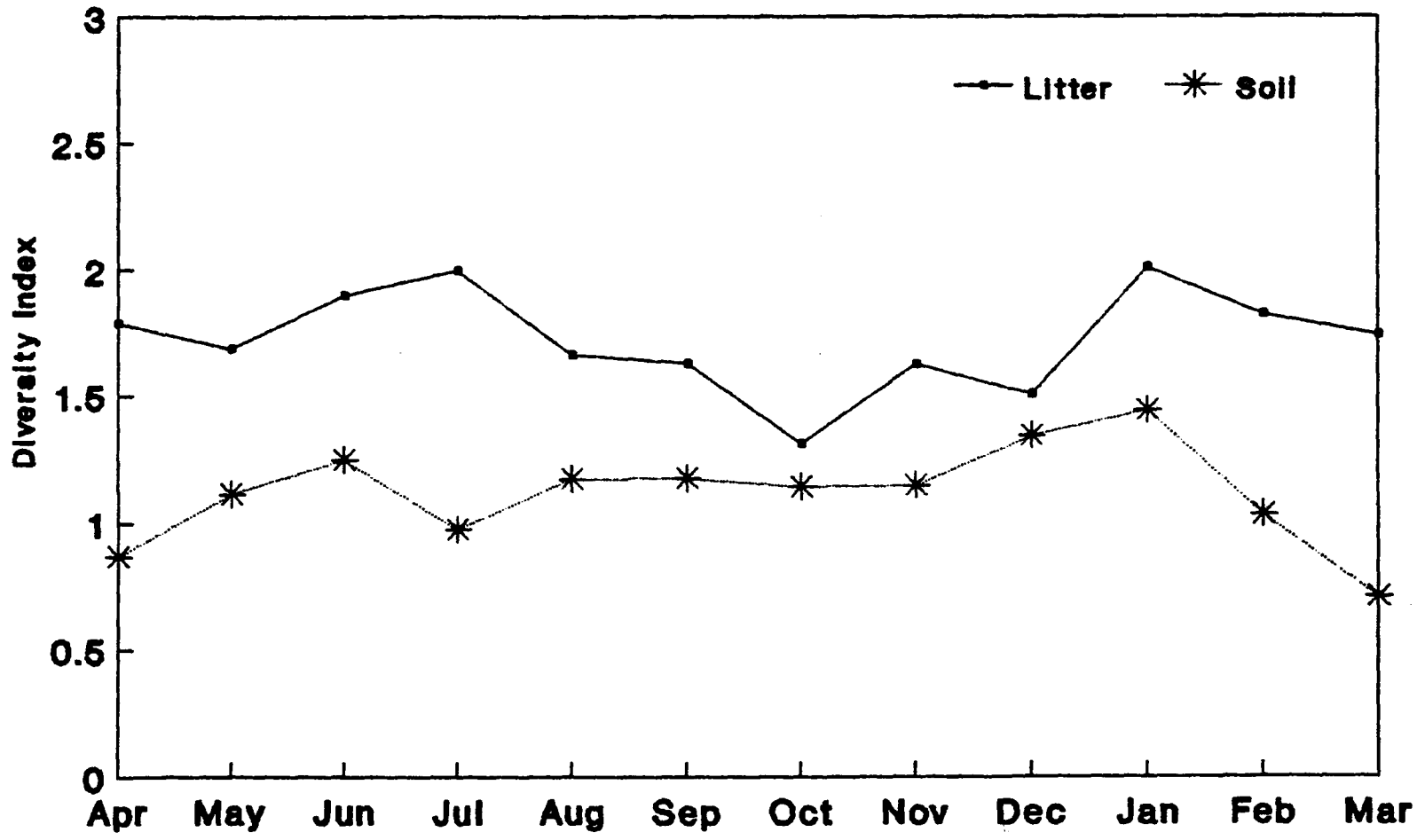

Fig.14: Diversity of soil fauna in Eucalyptus litter and soil

(Fig.15). The total number of individuals collected reached a maximum of 548 and 167 in litter and soil respectively during October. A minimum total number of individuals were recorded in litter and soil was 19 and 3 respectively, during April (Table 4).

IV.a.2 Acacia

The diversity of the soil fauna in this habitat was maximum in litter compared to soil (Table 4). The highest diversity value in case of litter was 1.827 compared to 1.634 in soil. The maximum diversity of soil fauna was observed in litter and soil during January and May respectively. The minimum diversity of 1.059 in litter and 1.072 in soil was recorded during November and December respectively. The average faunal diversity during the study period was 1.553 in litter compared to 1.295 in the soil. Faunal diversity fluctuated through out the year and there was more or less stable faunal distribution from July-September in litter and June-October and December to February in soil (Fig.16). The litter harboured a maximum of 14 groups during June, whereas in soil, a maximum of 11 groups were encountered in May. A minimum number of 7 and 4 groups were noticed in litter and soil during April and June respectively (Fig.17). The total number of individuals collected was

Table 4. (Contd.)

Shannon - weaner diversity index for soil fauna collected from Acacia plantation

	Litter			Soil		
Month	N	OTU	Diversity	N	OTU	Diversity
April-93	21	7	1.784	20	5	1.386
May	216	13	1.582	90	11	1.634
June	212	14	1.758	28	4	1.102
July	206	10	1.413	43	6	1.282
August	409	10	1.212	60	5	1.178
September	301	12	1.313	110	8	1.274
October	234	13	1.558	98	7	1.300
November	529	13	1.059	51	7	1.508
December	155	11	1.675	74	5	1.072
January-94	100	12	1.827	39	5	1.154
February	96	11	1.759	41	5	1.100
March	86	13	1.690	44	8	1.554
			X = 1.553			X = 1.295

N = Total number of arthropods collected

OTU = Operational Taxonomic Units

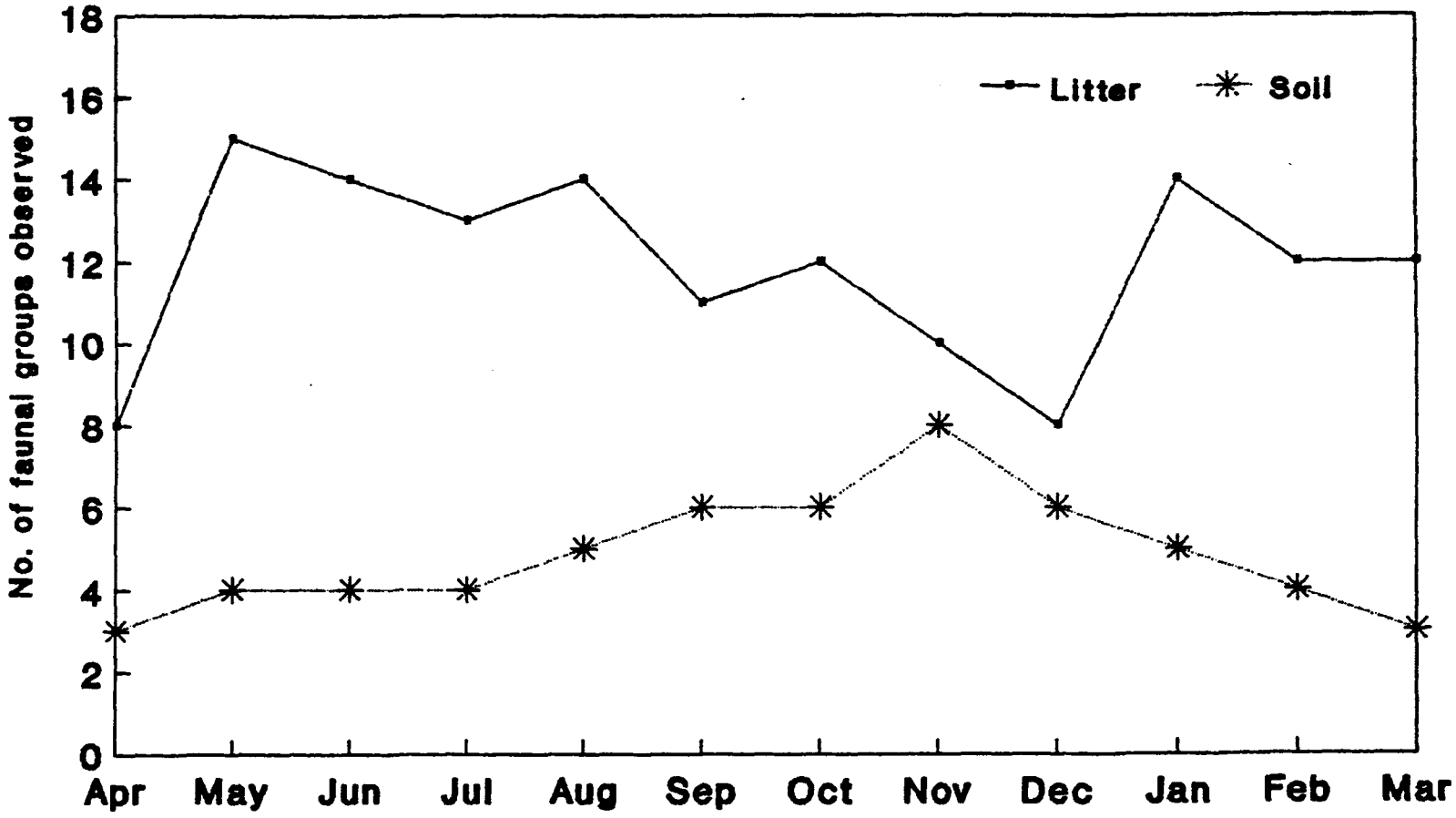

Fig.15: Different faunal groups observed in Eucalyptus litter and soil

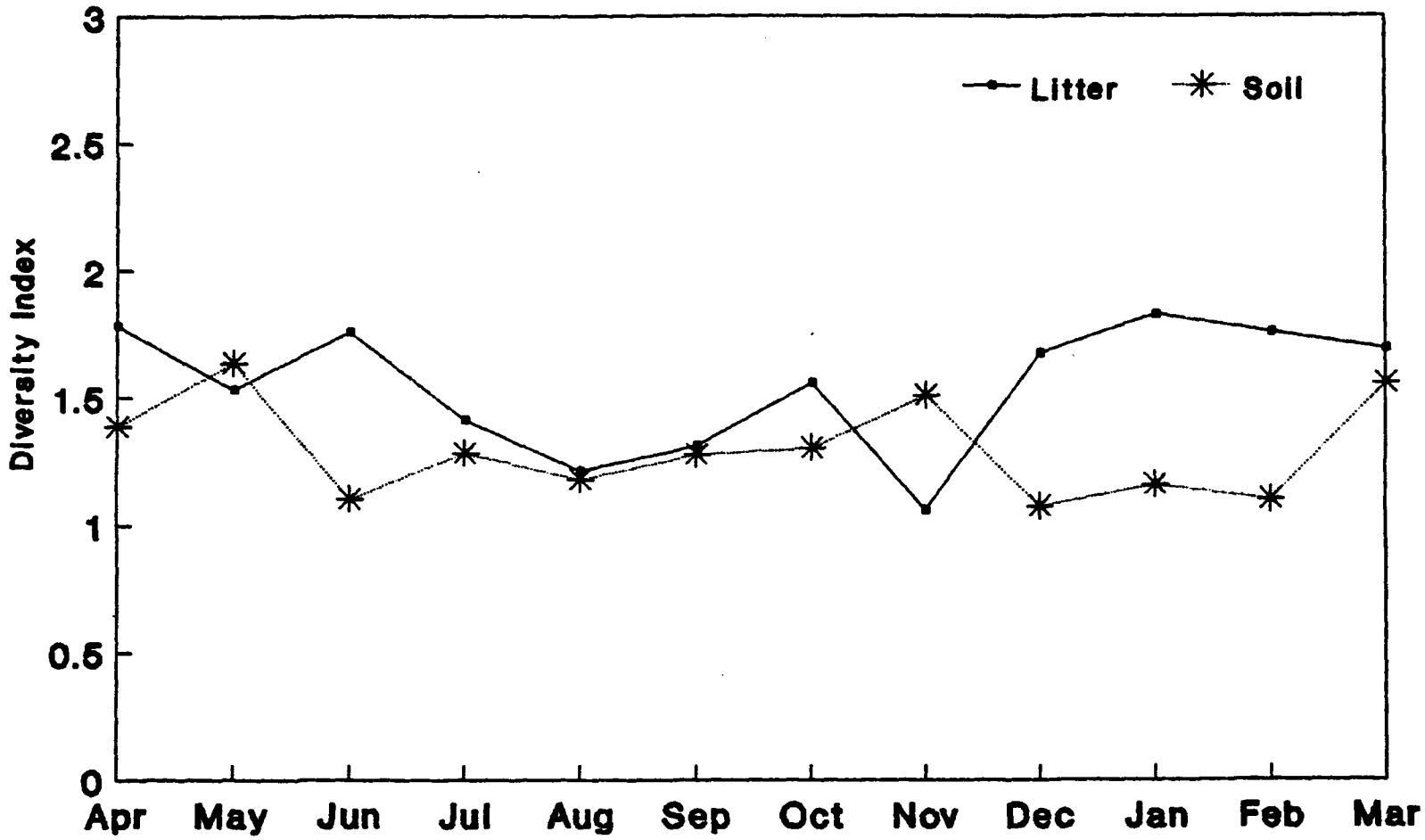

Fig.16: Diversity of soil fauna in Acacia litter and soil

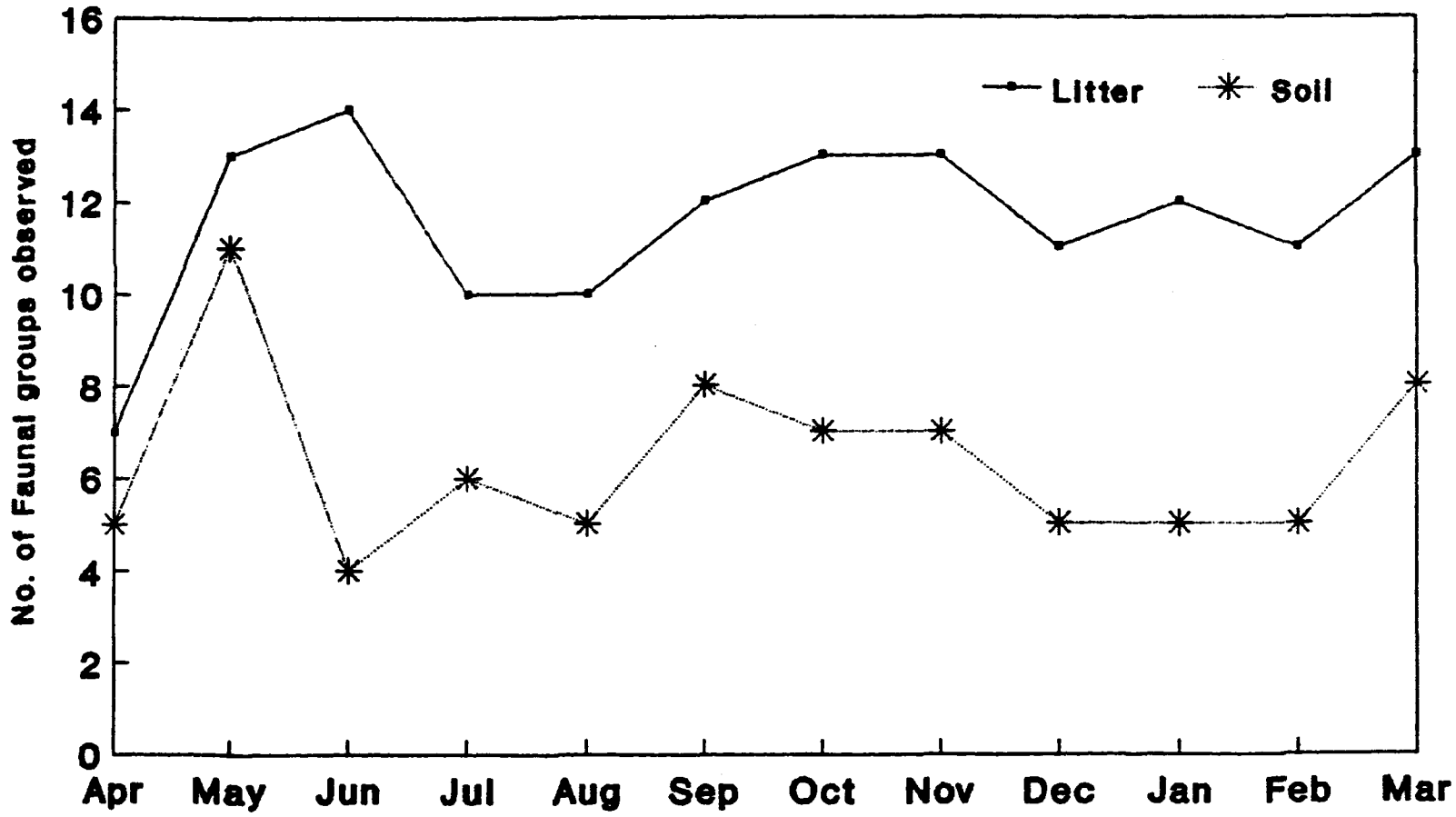

Fig.17: Different faunal groups observed in Acacia litter and soil

a maximum of 529 and 110 during November and September in litter and soil respectively. The minimum total number of fauna collected was 21 and 20 in litter and soil respectively during April (Table 4).

IV.a.3 Silver oak

The faunal diversity in silver oak was maximum in litter compared to soil (Table 4). The diversity indices recorded a maximum of 2.119 in litter as compared to 1.546 in soil. The peak diversity of the fauna was observed in litter and soil during February and April respectively. The minimum diversity was 1.057 and 1.061 for litter and soil during September and July respectively. The average faunal diversity was highest in litter with 1.508 as against 1.300 in soil. Diversity fluctuation was observed throughout the year and the trend was more or less stable both in litter and soil. Similarly it was more or less stable from July to November in both litter and soil (Fig.18). The litter harboured a maximum of 13 groups during November and soil had 9 groups during August. A minimum of 5 groups were recorded during April in litter compared to soil whereas minimum number of 4 groups were found in June, December and January (Fig.19). The total number of fauna was recorded a maximum of 228 in litter and 128 in soil

Table 4. (Contd.)

Shannon - weaner diversity index for soil fauna collected from Silver oak plantation

	Litter			Soil		
Month	N	OTU	Diversity	N	OTU	Diversity
April-93	16	5	1.166	17	6	1.546
May	81	11	1.719	64	7	1.293
June	114	11	1.680	36	4	1.175
July	70	6	1.194	29	5	1.061
August	228	12	1.251	128	9	1.218
September	206	10	1.057	98	8	1.318
October	116	8	1.383	60	5	1.234
November	148	13	1.440	46	6	1.415
December	49	6	1.450	24	4	1.140
January-94	45	10	1.864	17	4	1.211
February	60	12	2.119	26	6	1.494
March	33	9	1.779	33	7	1.502
			X = 1.508			X = 1.300

N = Total number of arthropods collected

OTU = Operational Taxonomic Units

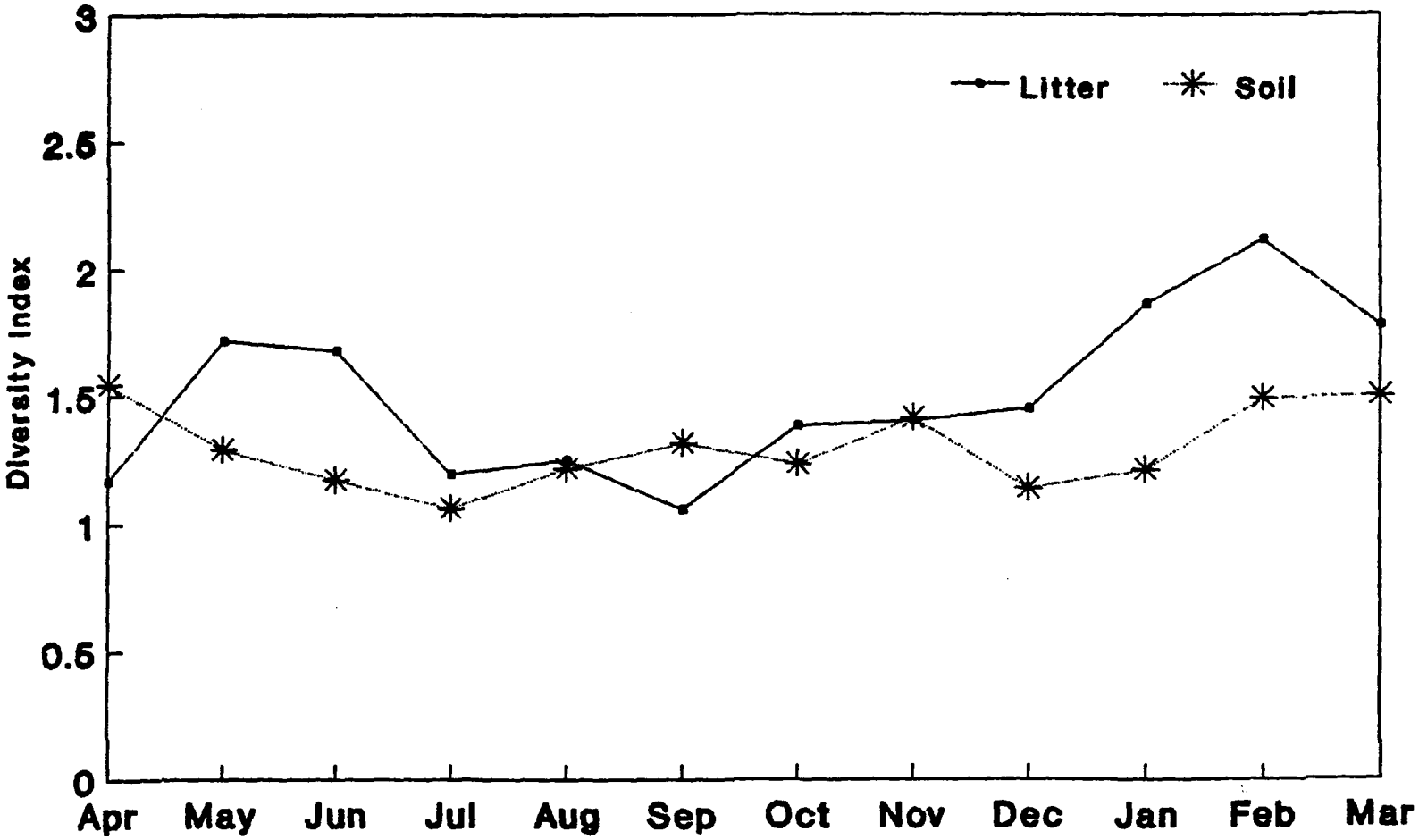

Fig.18: Diversity of soil fauna in Silver oak litter and soil

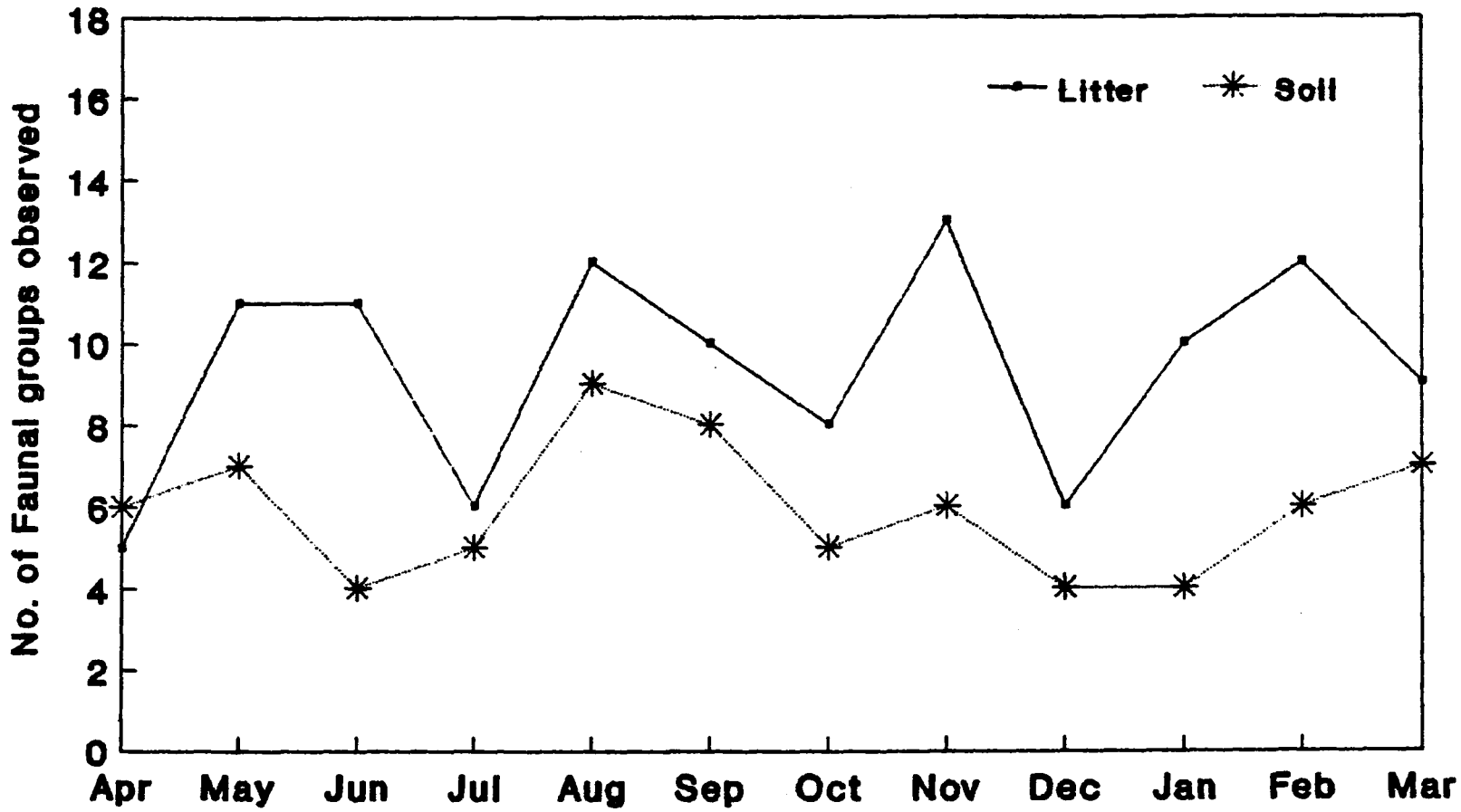

Fig.19: Different faunal groups observed in silver oak litter and soil

during October. The minimum total number of individuals observed was 16 during April in case of litter whereas in soil it was noticed both during April and January with 17 number of arthropods (Table 4).

IV.a.4 Casuarina

The diversity of soil fauna in casuarina was maximum in litter compared to soil as in the case of other plantations. (Table 4). The highest diversity value was 2.158 in litter recorded during April as compared to the highest diversity of 2.003 in soil during the same period.

The maximum diversity was observed during April both in litter and soil and the minimum diversity with respect to litter and soil were 1.191 and 1.009 during October and January respectively. The average faunal diversity was found to be maximum of 1.637 for litter compared to 1.451 in soil. Faunal diversity fluctuated throughout the year but was more or less similar both in case of litter and soil, during the study period (Fig.20). The litter harboured a maximum of 15 groups during August and December. However, the maximum of 12 groups were recorded in soil during November. The minimum number of groups (9) were noticed during June

Table 4. (Contd.)

Shannon - weaner diversity index for soil fauna collected from Casuarina plantation

	Litter			Soil		
Month	N	OTU	Diversity	N	OTU	Diversity
April-93	47	14	2.158	23	10	2.003
May	93	10	1.539	56	8	1.405
June	127	9	1.714	137	5	1.208
July	169	12	1.603	88	5	1.199
August	613	15	1.437	180	9	1.352
September	387	12	1.242	167	6	1.154
October	304	9	1.191	149	8	1.455
November	565	13	1.360	111	12	1.750
December	277	15	1.595	116	9	1.362
January-94	67	12	1.887	27	3	1.009
February	56	13	2.097	24	8	1.699
March	81	11	1.826	32	10	1.827
			X = 1.637			X = 1.451

N = Total number of arthropods collected

OTU = Operational Taxonomic Units

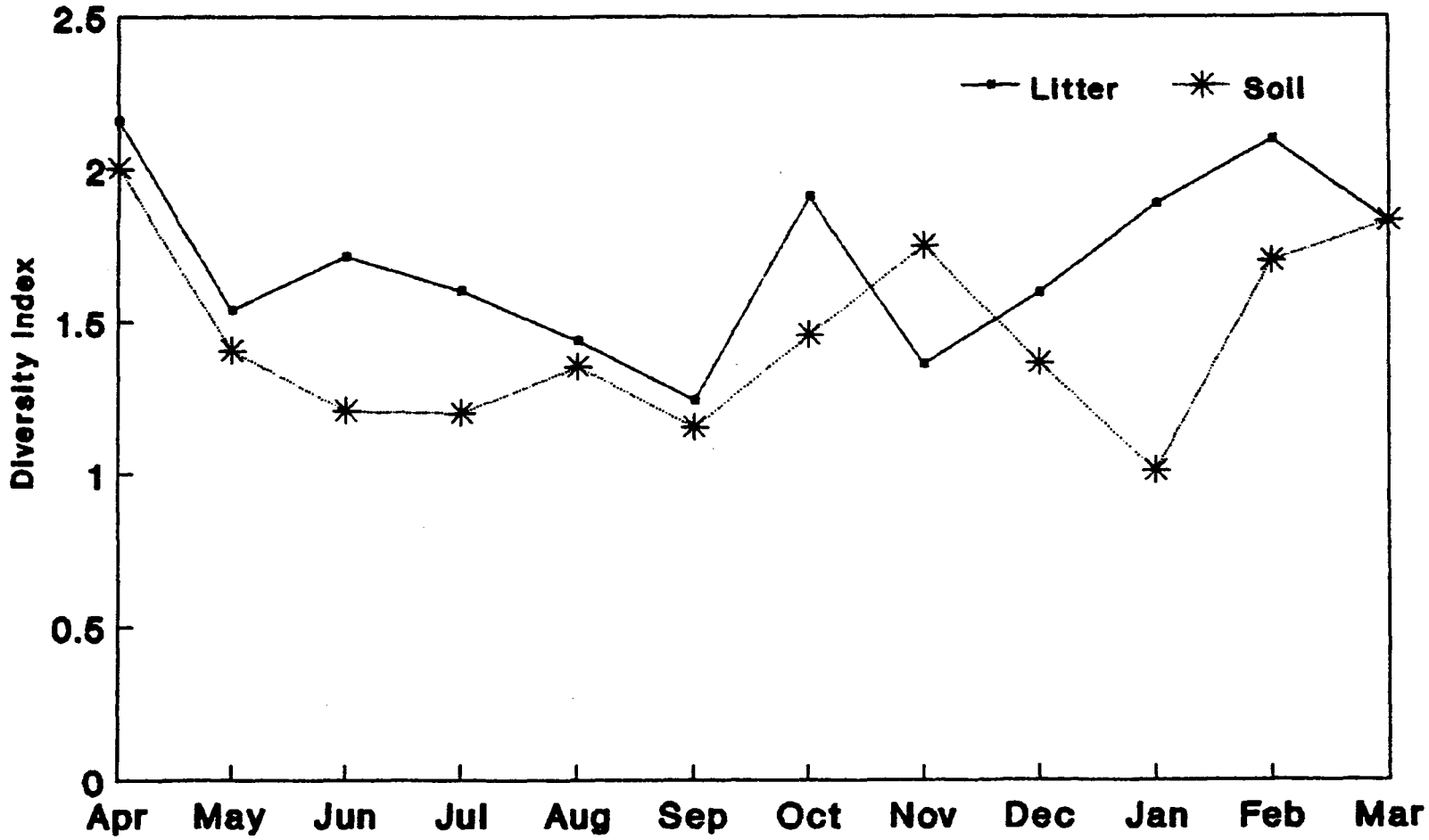

Fig.20: Diversity of soil fauna in Casuarina litter and soil

and October in litter. However, only 3 groups was found in soil during January (Fig.21). The total number of individuals collected was maximum with 565 and 180 from litter and soil during November and August respectively. A minimum total number of species of 47 and 23 were recorded both in litter and soil respectively during April (Table 4).

IV.a.5 Barren land

The peak diversity of 0.851 was observed in barren land during December. The minimum diversity of 0.318 was observed in October (Table 4) and the fauna were completely absent during June (Fig.22).

The average faunal diversity of 0.312 was recorded during the study period. The soil in barren land harboured a maximum of 4 groups during December and minimum of one group was recorded in April, July, August, September and February (Fig. 23).

IV.a.6 Correlation between soil faunal population and ecological factors

The results of correlation studies are presented in the Table 5. Of the nine variables considered, relative humidity, rainfall and moisture content (litter and soil) significantly positively correlated with the

Table 4. (Contd.)

Shannon - weaner diversity index for soil fauna collected from Barren land

Month	N	OTU	Diversity
April-93	3	1	0.318
May	3	2	0.801
June	0	0	0
July	1	1	0
August	9	1	0
September	1	1	0
October	4	2	0.318
November	15	3	0.624
December	21	4	0.851
January-94	8	2	0.43
February	2	1	0
March	4	2	0.405
		X =	0.312

N = Total number of arthropods collected

OTU = Operational Taxonomic Units

Table 5. Coefficient of correlation calculated between faunal population and ecological factors in different habitats

	Maximum Temp.	Minimum Temp.	Mean Temp.	Soil temperature 5cm	10cm	15cm	Relative humidity	Rainfall	Moisture
Eucalyptus litter	-0.1899	0.2384	-0.0116	0.1338	0.1028	0.0218	0.6248*	0.7745*	0.8683* (ELM)
Eucalyptus soil	-0.4627	0.0119	-0.2869	-0.0726	-0.1138	-0.2283	0.6522*	0.6426*	0.8288* (ESM)
Acacia litter	-0.4747	0.0687	-0.2686	-0.0264	-0.0747	-0.2386	0.8342*	0.4517	0.7608* (ALM)
Acacia soil	-0.2625	-0.0314	-0.1719	0.1045	0.0745	-0.0110	0.5050	0.7857*	0.7791* (ASM)
Silver oak litter	-0.3837	0.1090	-0.1929	-0.0499	-0.0751	-0.1985	0.7253*	0.6330*	0.7349* (SLM)
Silver oak soil	-0.1363	0.2306	0.0187	0.0980	0.0818	0.0116	0.5652	0.5550	0.4075 (SSM)
Casuarina litter	-0.5596	-0.0659	-0.3834	-0.0586	-0.1080	-0.2909	0.8191*	0.3912	0.6998* (CLM)
Casuarina soil	-0.5260	0.1016	-0.2861	-0.0573	-0.1026	-0.2762	0.9299*	0.7664*	0.7382* (CSM)
Barren land	0.4446	-0.1978	-0.3708	0.0169	-0.0498	-0.1685	0.4271	0.2710	0.3953 (BLSM)

* Significant at 5% level

ELM = Eucalyptus litter moisture ; ESM = Eucalyptus soil moisture ; ALM = Acacia litter moisture ; ASM = Acacia soil moisture ; SLM = Silver oak litter moisture ; SSM = Silver oak soil moisture ; CLM = Casuarina litter moisture ; CSM = Casuarina soil moisture ; BLSM = Barren land soil moisture.

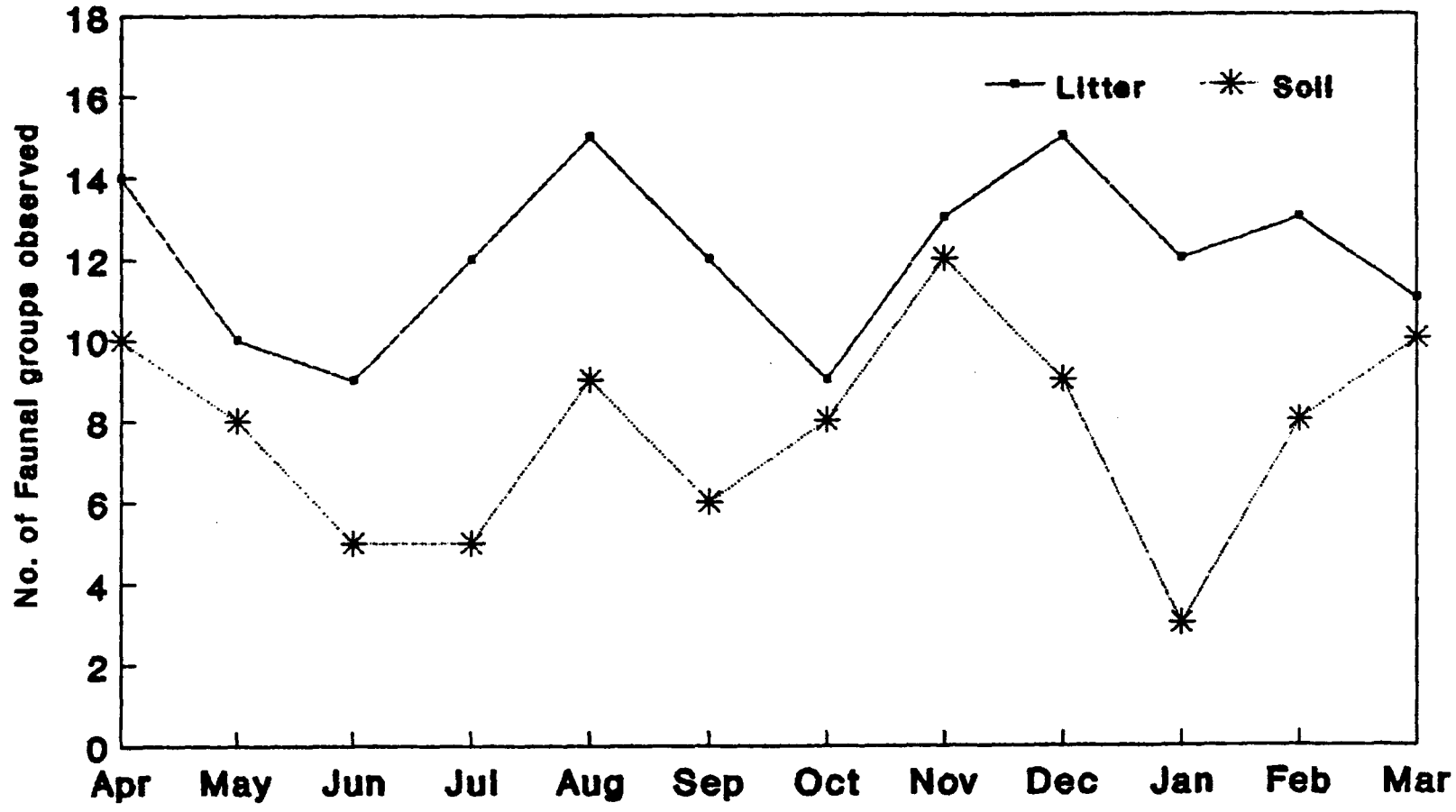

Fig.21: Different faunal groups observed in Casuarina litter and soil

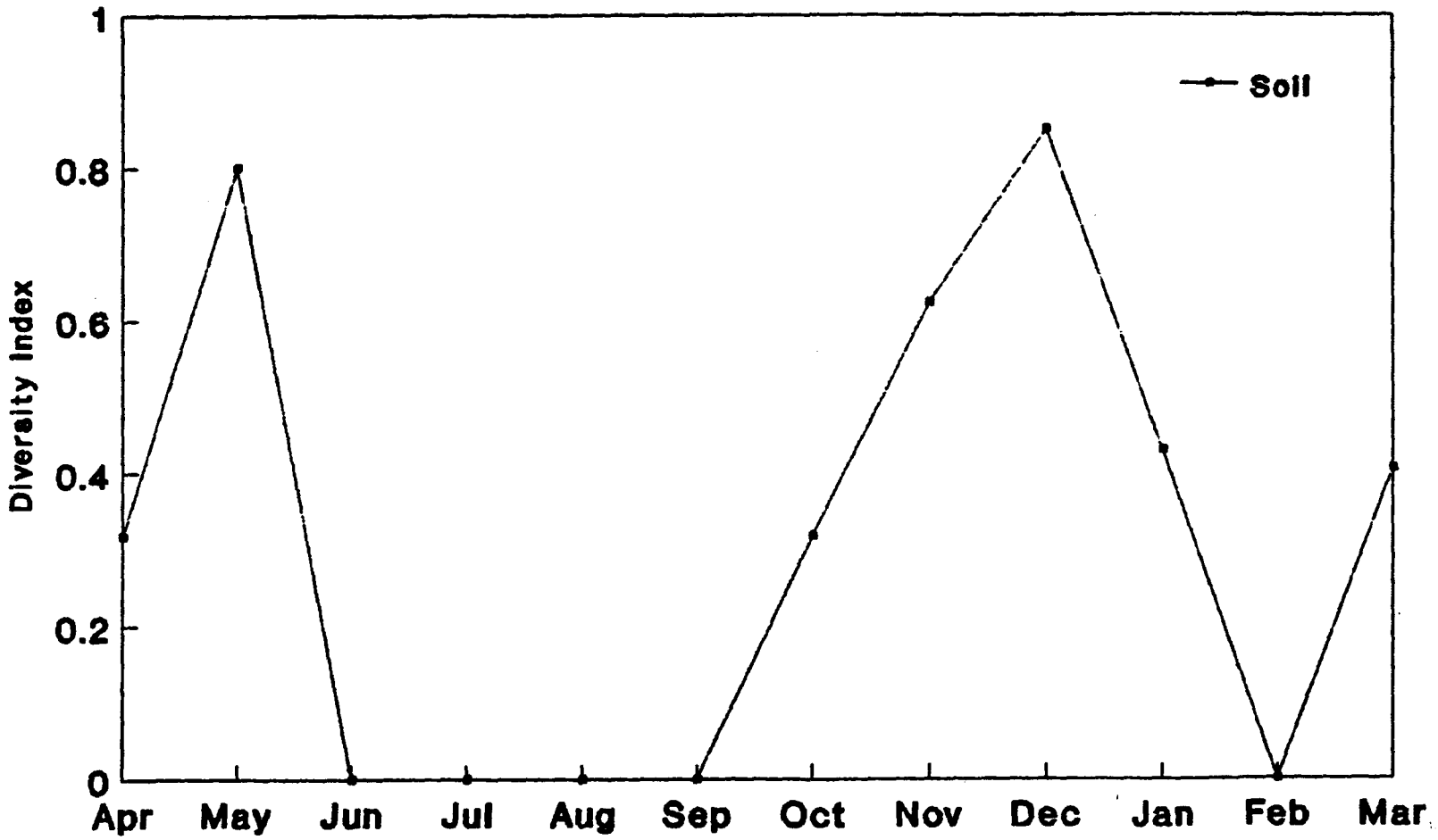

Fig.22: Diversity of soil fauna in barren land soil

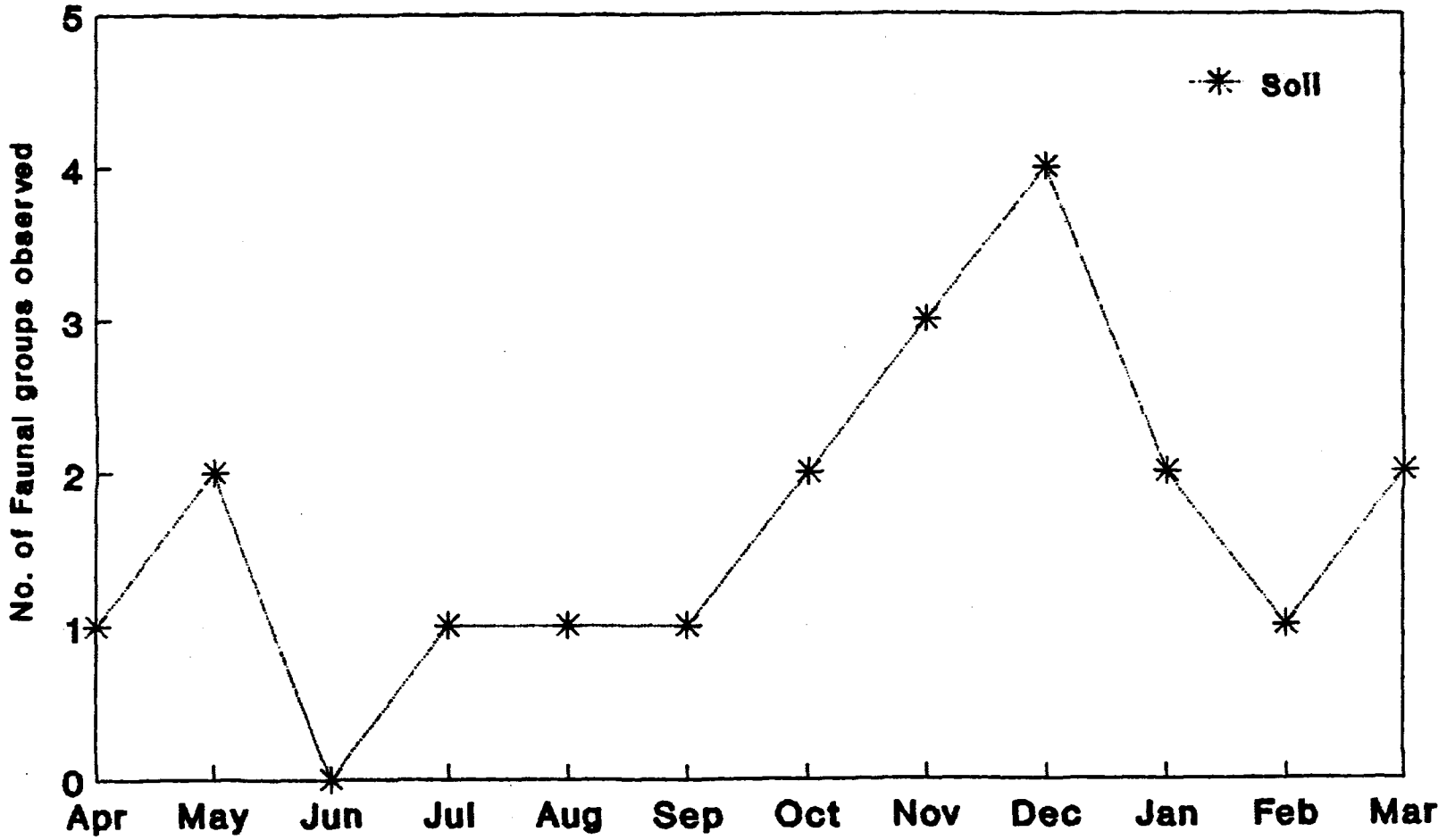

Fig.23: Different faunal groups observed in Barren land soil

eucalyptus litter, eucalyptus soil, silver oak litter and casuarina soil faunal population and non significant correlated with maximum, minimum and mean temperature, soil temperature at 5, 10 and 15cm depth of soil.

The soil faunal population of acacia litter and casuarina litter appeared to show significant positive correlation with relative humidity and moisture content (litter and soil) and it was non significant correlation with rainfall, maximum, minimum and mean temperature, soil temperature at 5, 10 and 15cm depth of soil. The faunal population in Acacia soil showed significant positive correlation with rainfall and moisture content (litter and soil) and it was non significant with relative humidity, maximum, minimum and mean temperature, soil temperature at 5, 10 and 15cm depth of soil. Whereas the faunal population in silver oak soil and barren land, the correlation co-efficient values indicated that, they were non significant with all the variables.

IV.B. Comparative faunal diversity of Eucalyptus plantation with other similar forest plantations

In this investigation, it was observed that in all the habitats studied Acarine constituted more than 50

per cent of the total fauna recorded whereas Collembola ranged from 15.89 to 34.19 per cent. The maximum total fauna was recorded from the litter of Casuarina followed by Acacia, Eucalyptus and Silveroak. Similarly the maximum total fauna was recorded from the soils of Casuarina followed by Acacia, Silver oak and Eucalyptus plantations and least fauna was found in Barren land.

In all these habitats, Acari constituted maximum followed by Collembola. However collembolan population was not noticed in the barren land. The variation in the relative abundance under each habitat of different groups are presented in the following pages.

IV.B.1 Litter fauna

The distribution of Acari in eucalyptus litter was 68.75 per cent of the total fauna and it was less than the acacia litter fauna (72.58%) and slightly more than silver oak (65.85%) and casuarina litter (57.83%). Among Acarina, Oribatei accounted for 30.10 per cent in eucalyptus litter, which was maximum compared to litter fauna of casuarina (25.65%), acacia (23.06%) and silver oak (18.56%) (Table 6 and Fig.24).

Collembolan fauna was recorded at 20.52 per cent in eucalyptus litter, which was relatively more than silver

Table 6. Relative abundance of Acari in different forest habitats

Acari	Eucalyptus litter		Eucalyptus soil		Acacia litter		Acacia soil		Silver oak litter		Silver oak soil		Casuarina litter		Casuarina soil	
	Total	R.A.%	Total	R.A%	Total	R.A%	Total	R.A%	Total	R.A.%	Total	R.A%	Total	R.A%	Total	R.A%
Cryptostigmata	863.00	30.10	120.00	21.42	779.00	23.06	271.20	31.14	270.00	18.56	192.00	26.74	832.00	25.65	301.00	26.03
Other acari	2004.00	69.89	440.00	78.57	2599.00	76.94	599.00	68.85	1184.00	81.43	526.00	73.25	2411.00	74.35	855.00	73.96
Total	2867.00		560.00		3378.00		870.00		1454.00		718.00		3243.00		1156.00	

R.A. = Relative abundance

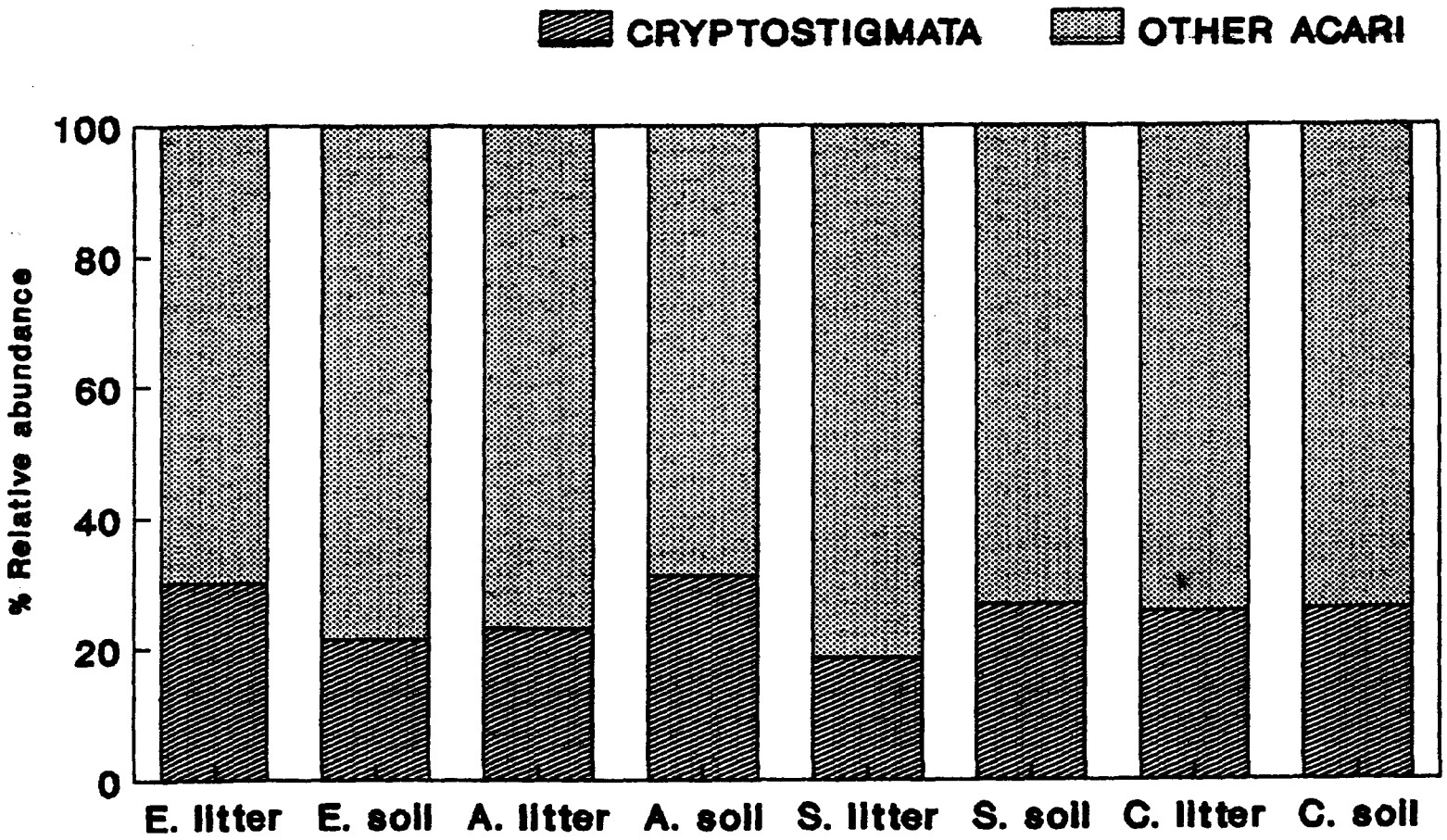

Fig.24: Relative abundance of Acari in different habitats

Table 7. Relative abundance of Collembola in different forest habitats

Collembola	Eucalyptus litter		Eucalyptus soil		Acacia litter		Acacia soil		Silver oak litter		Silver oak soil		Casuarina litter		Casuarina soil	
	Total	R.A.Z	Total	R.AZ	Total	R.AZ	Total	R.AZ	Total	R.A.Z	Total	R.AZ	Total	R.AZ	Total	R.AZ
Entomobryidae	385.00	44.97	76.00	24.51	357.00	33.64	54.00	16.36	145.00	41.19	43.00	16.79	383.00	24.36	192.00	26.05
Isotomidae	256.00	29.90	119.00	38.38	324.00	30.53	164.00	49.69	98.00	25.56	140.00	54.68	383.00	24.36	396.00	53.73
Hypogastruridae	119.00	13.90	48.00	15.48	157.00	14.79	72.00	21.81	98.00	27.84	41.00	16.01	434.00	27.60	79.00	10.71
Brachystomellidae	35.00	4.00	57.00	18.38	178.00	16.77	33.00	10.00	10.00	2.84	11.00	4.29	290.00	18.44	56.00	7.59
Sminthuridae	61.00	7.12	10.00	3.22	45.00	4.24	7.00	2.12	9.00	2.55	21.00	8.20	82.00	5.21	14.00	1.89
Total	856.00		310.00		1061.00		330.00		352.00		256.00		1572.00		737.00	

R.A. : Relative abundance

Table 8. Relative abundance of Myriapoda in different forest habitats

	Eucalyptus litter		Eucalyptus soil		Acacia litter		Acacia soil		Silver oak litter		Silver oak soil		Casuarina litter		Casuarina soil	
	Total	R.A.Z	Total	R.AZ	Total	R.AZ	Total	R.AZ	Total	R.A.Z	Total	R.AZ	Total	R.AZ	Total	R.AZ
Symphyla	-	-	1	3.70	2.0	7.14	-	-	-	-	8.00	53.33	4.00	4.59	5.00	8.33
Pauropoda	15.00	71.42	26.00	96.29	7.00	25.00	20.00	64.51	-	-	6.00	40.00	22.00	25.28	46.00	76.66
Chilopoda	6.00	28.57	-	-	19.00	67.85	11.00	35.48	2.00	22.22	1.00	6.66	10.00	11.49	2.00	3.33
Diplopoda	-	-	-	-	-	-	-	-	7.00	77.77	-	-	51.00	58.62	7.00	11.66
Total	21.00		27.00		28.00		31.00		9.00		15.00		87.00		60.00	

R.A. : Relative abundance

Table 9. Relative abundance of some important soil fauna in different forest habitats

Microarthropods	Eucalyptus litter		Eucalyptus soil		Acacia litter		Acacia soil		Silver oak litter		Silver oak soil		Casuarina litter		Casuarina soil	
	Total	R.A.%	Total	R.A%	Total	R.A%	Total	R.A%	Total	R.A.%	Total	R.A%	Total	R.A%	Total	R.A%
Isopoda	5.00	0.11	-	-	-	-	1.00	0.08	7.00	0.31	5.00	0.44	9.00	0.16	7.00	0.31
Myriapoda	21.00	0.50	27.00	2.86	28.00	0.60	31.00	2.33	9.00	0.40	15.00	1.34	87.00	1.55	60.00	2.73
Acari	2867.00	68.75	560.00	59.44	3378.00	72.58	870.00	65.41	1454.00	65.85	718.00	64.39	3243.00	57.83	1156.00	52.76
Other Arachnida	336.00	8.05	19.00	2.01	40.00	0.85	10.00	0.75	61.00	2.76	7.00	0.62	193.00	3.44	26.00	1.18
Collembola	856.00	20.52	310.00	32.90	1061.00	22.79	330.00	24.81	352.00	15.94	256.00	22.86	1572.00	27.98	737.00	34.32
Other insects	41.00	1.00	5.00	0.53	48.00	1.03	16.00	1.20	306.00	13.85	72.00	6.45	468.00	8.34	139.00	6.34
Ants	44.00	1.05	21.00	2.22	99.00	2.12	72.00	5.41	19.00	0.86	43.00	3.85	38.00	0.67	51.00	2.32
Total	4170.00		942.00		4654.00		1330.00		2208.00		1116.00		5610.00		2176.00	

R.A. = Relative abundance

Table 10. Relative abundance of other insect fauna in different forest habitats

Microarthropods	Eucalyptus litter		Eucalyptus soil		Acacia litter		Acacia soil		Silver oak litter		Silver oak soil		Casuarina litter		Casuarina soil	
	Total	R.A.%	Total	R.A%	Total	R.A%	Total	R.A%	Total	R.A.%	Total	R.A%	Total	R.A%	Total	R.A%
Diplura	3.00	0.56	6.00	9.67	4.00	0.59	2.00	1.61	3.00	1.03	2.00	1.80	8.00	1.78	8.00	4.84
Protura	-	-	3.00	4.83	-	-	2.00	1.61	-	-	1.00	1.80	-	-	5.00	3.03
Thysanura	15.00	2.81	-	-	21.00	3.12	2.00	1.61	3.00	1.03	-	-	-	-	-	-
Blattodea	20.00	3.75	-	-	4.00	0.59	-	-	1.00	0.34	-	-	4.00	0.89	-	-
Isoptera	20.00	3.75	-	-	-	-	-	-	14.00	4.84	7.00	6.30	11.00	2.45	27.00	16.36
Psocoptera	158.00	29.69	17.00	27.41	100.00	14.90	6.00	4.83	37.00	12.80	-	-	88.00	19.64	8.00	4.84
Hemiptera	56.00	10.52	5.00	8.06	54.00	8.04	6.00	4.83	7.00	2.42	1.00	1.80	20.00	4.46	11.00	6.66
Thysanoptera	189.00	16.72	4.00	6.45	237.00	35.32	10.00	8.06	101.00	34.94	13.00	11.71	153.00	34.15	20.00	12.12
Lepidoptera (L)	37.00	6.95	-	-	68.00	10.13	2.00	1.61	10.00	3.46	3.00	2.70	35.00	7.81	3.00	1.81
Diptera (L)	7.00	1.31	1.00	1.61	19.00	2.83	13.00	10.48	35.00	12.11	14.00	12.61	34.00	7.58	9.00	5.45
Ants	44.00	8.27	21.00	33.87	99.00	14.75	72.00	58.06	19.00	6.57	43.00	38.73	38.00	8.48	51.00	30.90
Coleoptera (L)	45.00	8.45	2.00	3.22	42.00	6.25	7.00	5.64	49.00	16.59	11.00	9.90	32.00	7.14	17.00	10.30
Coleoptera (A)	38.00	7.14	3.00	4.83	23.00	3.42	2.00	1.61	10.00	3.46	16.00	14.41	25.00	5.58	6.00	3.63
Total	532.00		62.00		671.00		124.00	289.00		111.00		448.00		165.00		

R.A. = Relative abundance

oak litter fauna (15.94%) and less than the litter fauna of casuarina (27.98%) and acacia (22.79%) (Table 9 and Fig.25).

Among Collembola Entomobryidae recorded maximum in eucalyptus litter (44.97%) followed by silver oak litter (41.19%), acacia litter (33.64%) and casuarina litter (24.36%). Isotomidae constituted 29.90, 30.53, 25.56 and 24.36 per cent in eucalyptus, acacia, silver oak and casuarina litter respectively. The members of Hypogastruridae accounted for 13.90 per cent in eucalyptus litter, 27.84 per cent in silver oak litter, 27.60 per cent, in casuarina litter 14.79 per cent, in acacia litter whereas Brachystomellidae accounted for 4.08 per cent in eucalyptus litter. It was relatively less than the casuarina (18.44%) and acacia litter (16.77%) and slightly more than silver oak litter (2.84%). Sminthurids recorded maximum in eucalyptus litter (7.12%) followed by casuarina (5.21%), acacia (4.24%) and silver oak litter (2.55%) (Table 7 and Fig.26). The distribution of diplurans was 0.56, 0.59, 1.03 and 1.78 per cent in eucalyptus, acacia, silver oak and casuarina litter respectively (Table 10).

Isopods occupied 0.11 per cent in eucalyptus litter and 0.31 and 0.16 per cent in silver oak and casuarina

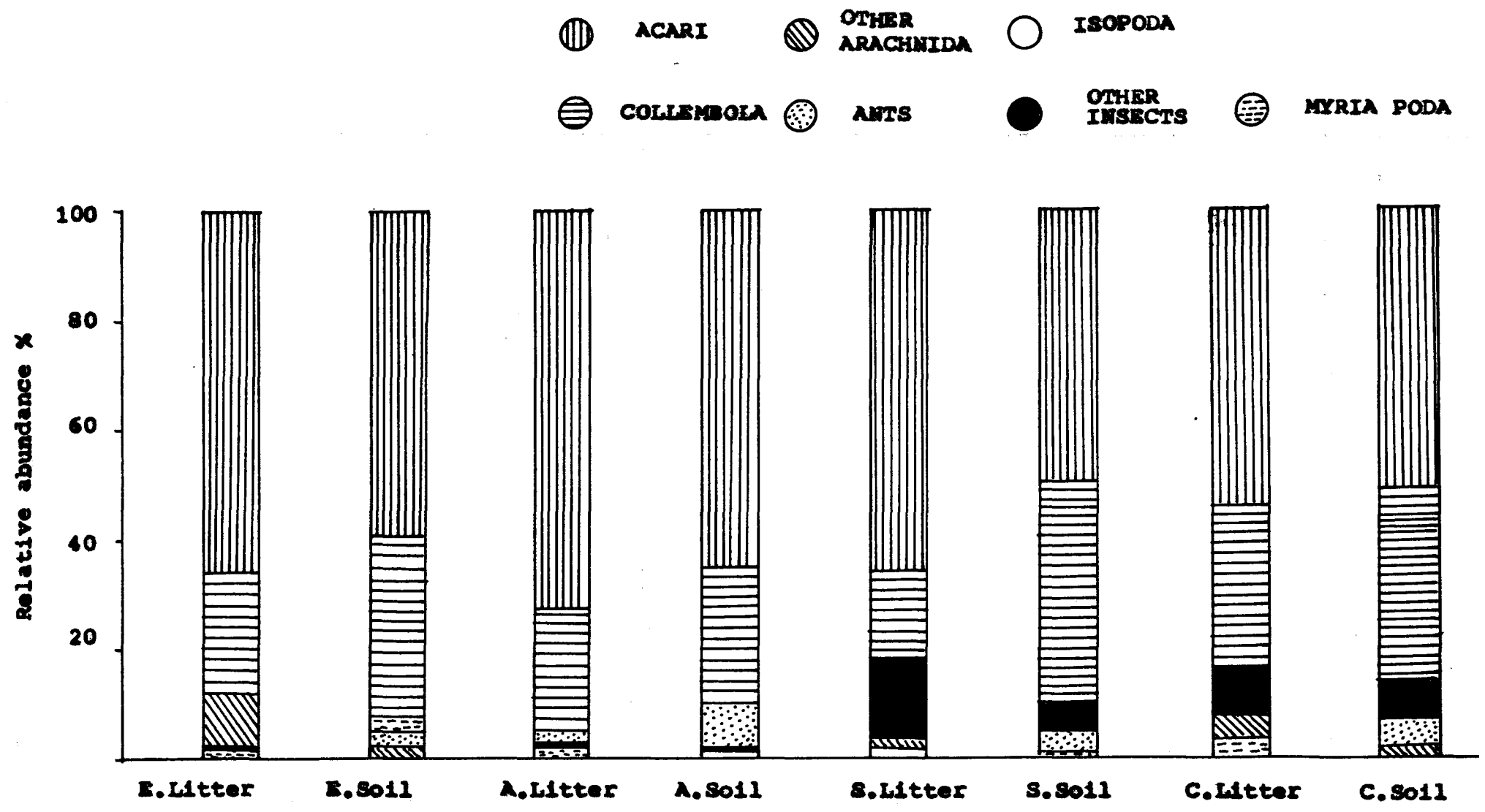

Fig: 25: Relative abundance of Soil fauna in different habitats

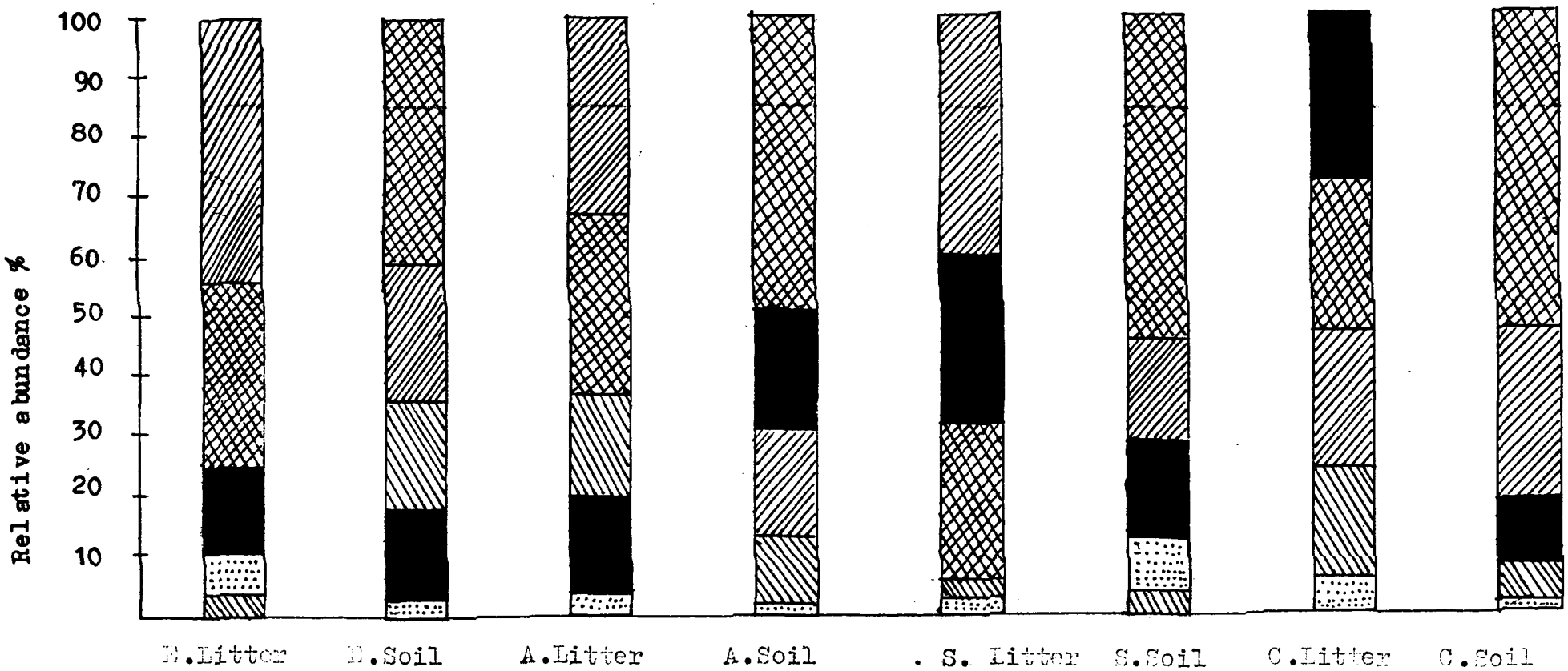

Fig.26: Relative abundance of Collembola in different habitats during the study period

litter. However it was not noticed in acacia litter during the study period (Table 9).

Eucalyptus litter had recorded 0.50 per cent of Myriapoda population, which was comparatively less than in case of casuarina litter (1.55%). Acacia and silver oak litter recorded 0.60 and 0.40 per cent respectively (Table 9). Among Myriapoda, symphylans were not encountered both in eucalyptus and silver oak litter. However acacia and casuarina litter harboured 7.14 and 4.59 per cent. Pauropods recorded relatively maximum in eucalyptus litter (71.42%) followed by casuarina (25.28%) and acacia litter (25.0%). Their population was completely absent in silver oak litter. The Chilopoda population in eucalyptus litter was 28.57 per cent which was more than in case of silver oak (22.22%) and casuarina litter (11.49%) and it was less than the acacia litter (67.85%) (Table 8). Diplopods were not observed in eucalyptus and acacia litter. However, in silver oak and casuarina Polyxenus sp. was recorded 77.77 and 58.62 per cent respectively. However this species was numerically high in casuarina litter.

Other arachnids (Pseudoscorpiones and spiders) were relatively abundant in eucalyptus litter (8.05%) compared to casuarina (3.44%), silver oak (2.76%) and acacia litter (0.85%) (Table 9).

Among other insect fauna recorded from eucalyptus litter, psocids were relatively higher in percentage composition (29.69%) compared to casuarina (19.64%), acacia (14.90%) and silver oak litter (12.80%) (Table 10). Thrips contributed 16.72, 35.32, 34.94 and 34.15 per cent in eucalyptus, acacia, silver oak and casuarina litter respectively. Bugs recorded maximum in eucalyptus litter (10.52%) followed by acacia (8.04%), casuarina (4.46) and silver oak litter (2.42%). Ant population in eucalyptus litter was 8.27 per cent which is similar to the distribution in casuarina litter (8.48%) and slightly more than the silver oak litter (6.57%) and comparatively less than the acacia litter (14.75%) (Table 10). Termite fauna was 3.75 per cent in eucalyptus and 4.84 per cent in silver oak litter. But their population was numerically higher in eucalyptus litter (20) compared to silver oak litter (14), and casuarina litter recorded in case of 2.45 per cent. However they were not recorded from acacia litter. Similarly roaches were found maximum in eucalyptus litter (3.75%) followed by casuarina (0.89%), acacia (0.59%) and silver oak litter (0.34%). Silverfish accounted for 2.81, 3.12 and 1.03 per cent in eucalyptus, acacia and silver oak litter respectively. However they were not collected from casuarina litter.

Coleopteran adults were found maximum in eucalyptus litter (7.14%) compared to casuarina (5.58%) silver oak (3.46%) and acacia litter (3.42%). Larvae of Coleoptera were distributed to an extent of 8.45, 16.59, 7.14 and 6.25 per cent respectively in eucalyptus, silver oak casuarina and acacia litter. Lepidoptera larvae recorded from eucalyptus litter was 6.95 per cent and was higher in acacia (10.13%) casuarina (7.81) and was least in silver oak litter (3.46%). Minimum dipteran larvae were recorded from eucalyptus litter (1.31%) compared to silver oak, casuarina and acacia litter recorded 12.11, 7.58 and 2.83 per cent respectively (Table 10).

IV.B.2 Soil fauna

The relative abundance of Acari fauna in eucalyptus soil was 59.44 per cent which was less than acacia (65.41%) and silver oak soil (64.39%) and slightly higher than casuarina soil (52.76%) (Table 6). But casuarina soil numerically had maximum number of Acari fauna compared to other habitats. Among Acari fauna, oribatid mites were least abundant in eucalyptus soil (21.42%) compared to acacia (31.14%), silver oak (26.74%) and casuarina soil (26.03%) (Table 6 and Fig.24).

Collembolan fauna in eucalyptus soil constituted 32.90 per cent comparatively more than the acacia (24.81%) and silver oak soil (22.86%) and less than the casuarina soil (34.32%) (Table 9 and Fig.25). Among collembolan fauna, entomobryids accounted for 24.51, 26.05, 16.79 and 16.36 per cent in eucalyptus, casuarina silver oak and acacia soil respectively. Isotomids were least abundant in eucalyptus soil (38.38%) compared to silveroak (54.68%), casuarina (53.73%) and Hypogastruridae represented 15.48, 21.81, 16.01 and 10.71 per cent in eucalyptus, acacia, silver oak and casuarina soil respectively. Eucalyptus soil recorded relatively more Brachystomellidae (18.38%) compared to acacia soil (10.0%), casuarina soil (7.59%) and silver oak soil (4.29%). Sminthurids in eucalyptus, silver oak acacia and casuarina soil were 3.22, 8.20, 2.12 and 1.89 per cent respectively (Table 7 and Fig.26). Diplurans and proturans, were 9.67, 4.84, 1.80, 1.61 and 4.83, 3.03, 1.80, 1.61 per cent in eucalyptus, silver oak casuarina and acacia soil respectively.

Isopods were not recorded from eucalyptus soil. However in soils of acacia, silver oak and casuarina they recorded 0.07, 0.44 and 0.31 per cent respectively (Table 9 and Fig.25).

Myriapod population in eucalyptus soil was 2.86 per cent followed by casuarina (2.73%), acacia (2.33%) and silver oak soils (1.34%). Among myriapods, the abundance of symphylans was 3.70 per cent in eucalyptus soil compared to 53.33 and 8.33 per cent in silver oak and casuarina soils respectively. Symphylans were absent in acacia soils. Eucalyptus soil recorded the maximum pauropods (96.29%) (Table 8) compared to casuarina (76.66%), acacia (64.51%) and silver oak soils (40.0%). Chilopods were not observed in eucalyptus soil and they were found maximum in acacia soil (35.48%) followed by silver oak (6.66%) and casuarina soils (3.33%). Diplopods were not recorded in soils of eucalyptus, acacia and silver oak. However in case of casuarina soil their distribution was 11.66 per cent.

Eucalyptus soil had relatively maximum population of other arachnids at 2.01 per cent followed by casuarina (1.18%), acacia (0.75%) and silver oak soils (0.62%) (Table 9).

Among other insect fauna, psocids recorded maximum in eucalyptus soil (27.41%) compared to acacia (4.83%) and they were absent in silver oak soil. Thrips were least abundant in eucalyptus soil (6.45%) compared to casuarina (12.12%) and acacia soils (8.06%). Bugs

recorded maximum in eucalyptus soil (8.06%) followed by casuarina (6.66%), acacia (4.83%) and silver oak soils (1.80%). Ant population was 33.87 per cent, in eucalyptus soil and 58.06 per cent in acacia soil (Fig.25), 38.73 per cent in silveroak and 30.90 per cent in casuarina soils. Both in eucalyptus and acacia soils, termites were not observed even though they were found in casuarina and silver oak soils accounting for 16.30 and 6.30 per cent respectively. In all these soil habitats, roaches were not recorded. Silverfish was recorded only from acacia soil (1.61%) and was absent in other habitats. Coleopteran adults were 4.83, 14.41, 3.63 and 1.61 per cent in eucalyptus, silver oak, casuarina and acacia soils respectively. Larvae of Coleoptera were least abundant in eucalyptus soil (3.22%) compared to casuarina (10.30%). Lepidopteran larvae were not encountered during the study period in eucalyptus soil.

The minimum number of dipteran larvae were recorded from eucalyptus soil (1.61%) and maximum in silver oak soil (12.61%) followed by acacia (10.48) and casuarina soils (5.45%) (Table 10).

IV.C Seasonal variation of soil fauna as influenced by different habitats

The distribution of soil faunal communities during different months in respect of their habitats from April 1993 to March 1994 varied considerably. Table 11 gives an account of mean total number of soil fauna distributed in different habitats.

IV.C.1 Eucalyptus litter

The mean number of soil fauna in this habitat was maximum (219.0) during October and minimum (7.6) during April. Two peaks were observed during October (219.0) and in May (127.8). A sudden fall in faunal population was observed from June onwards and population increased gradually upto September (111.8) and suddenly rose to reach the maximum peak in October (219.0) and a sudden fall in population was observed from October to February (Table 11 and Fig.27).

Isopods were noticed only during August to October (0.2-0.6). Similarly the myriapod population was recorded during May, September, October and March (0.2-3.2). Pauropods were found to be maximum (3.0) only during May and chilopods (0.2-0.6) were also observed during May, September, October and March (Table 13).

Table 11. Distribution of soil fauna in different study sites during different months

Habitat	Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Eucalyptus-litter	38.0	7.6	639.0	127.8	263.0	52.6	325.0	65.0	543.0	108.6	559.0	111.8	1095.0	219.0	399.0	79.8	239.0	47.8	181.0	36.2	177.0	35.4	198.0	39.6
Eucalyptus-soil	6.0	1.2	21.0	4.2	33.0	6.6	50.0	10.0	139.0	27.8	119.0	23.8	333.0	66.6	133.0	26.6	58.0	11.6	27.0	5.4	56.0	11.2	17.0	3.4
Acacia-litter	42.0	8.4	432.0	86.4	423.0	84.6	411.0	82.2	818.0	163.6	601.0	120.2	625.0	125.0	1006.0	201.2	309.0	61.8	199.0	39.8	192.0	38.4	171.0	34.2
Acacia-soil	40.0	8.0	179.0	35.8	65.0	13.0	85.0	17.0	119.0	23.8	22.0	4.4	195.0	39.0	102.0	20.4	148.0	29.6	78.0	15.6	87.0	17.4	81.0	16.2
Silveroak-litter	32.0	6.4	159.0	31.8	224.0	44.8	139.0	27.8	355.0	71.0	411.0	82.2	231.0	46.2	295.0	59.0	95.0	19.0	88.0	17.6	120.0	24.0	63.0	12.6
Silver-oak-soil	32.0	6.4	128.0	25.6	72.0	14.4	57.0	11.4	255.0	51.0	196.0	39.2	83.0	16.6	91.0	18.2	48.0	9.6	33.0	6.6	51.0	10.2	70.0	14.0
Casuarina-litter	92.0	18.4	186.0	37.2	253.0	50.6	333.0	66.6	1226.0	245.2	770.0	154.0	615.0	123.0	1128.0	225.6	553.0	110.6	134.0	26.8	111.0	22.2	205.0	41.0
Casuarina-soil	45.0	9.0	112.0	22.4	274.0	54.8	163.0	32.6	359.0	71.8	333.0	66.6	293.0	58.6	221.0	44.2	232.0	46.4	53.0	10.6	47.0	9.4	67.0	13.4
Barren land	6.0	1.2	7.0	1.4	0.0	0.0	2.0	0.4	17.0	3.4	2.0	0.4	30.0	6.0	10.0	2.0	27.0	5.4	4.0	0.8	6.0	1.2	2.0	0.4
	333.0		1863.0		1607.0		1565.0		3831.0		3013.0		3500.0		3385.0		1709.0		797.0		847.0		874.0	

T = Total ; M = Mean

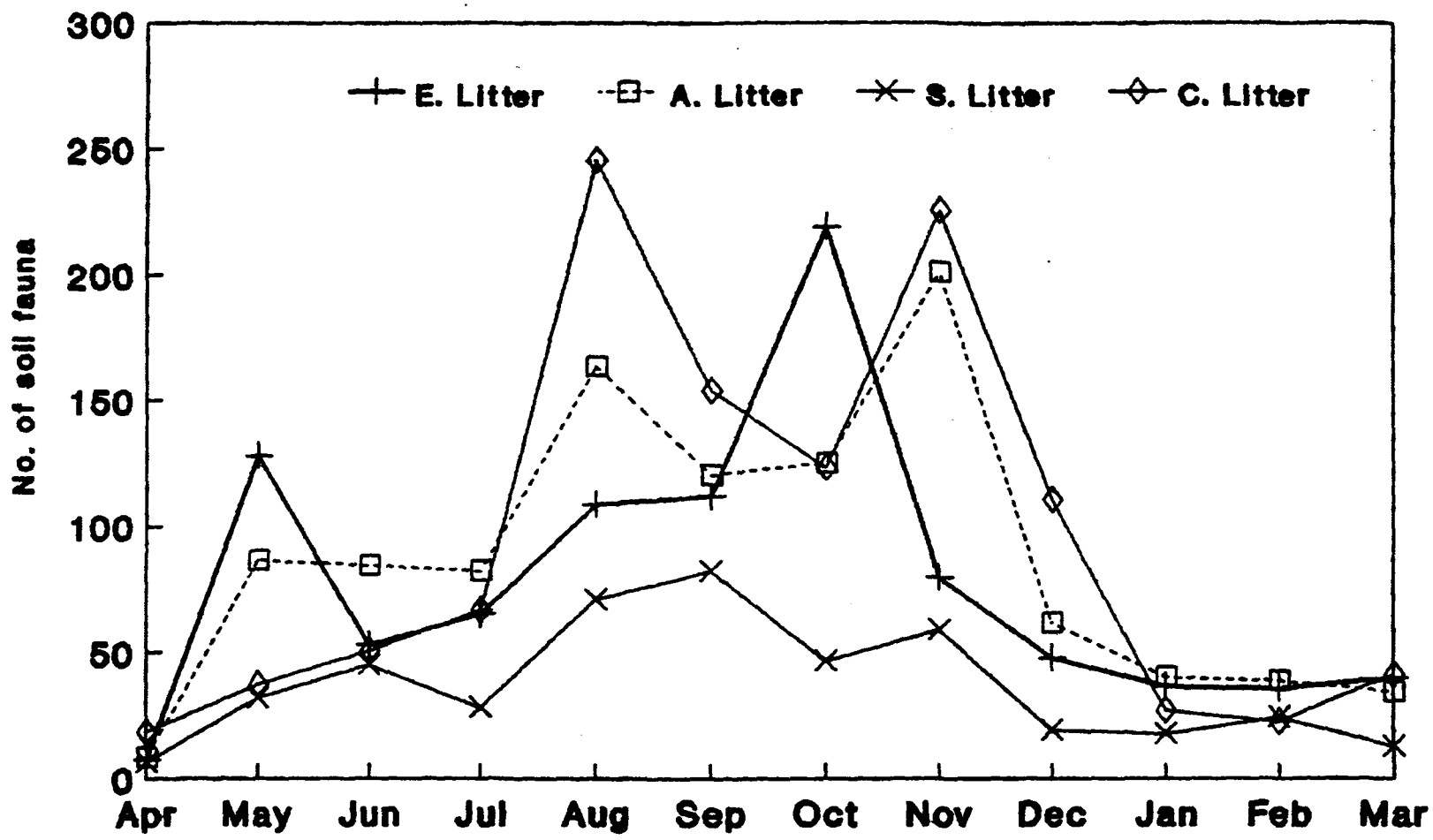

Fig.27: Distribution of soil fauna in different litter habitats

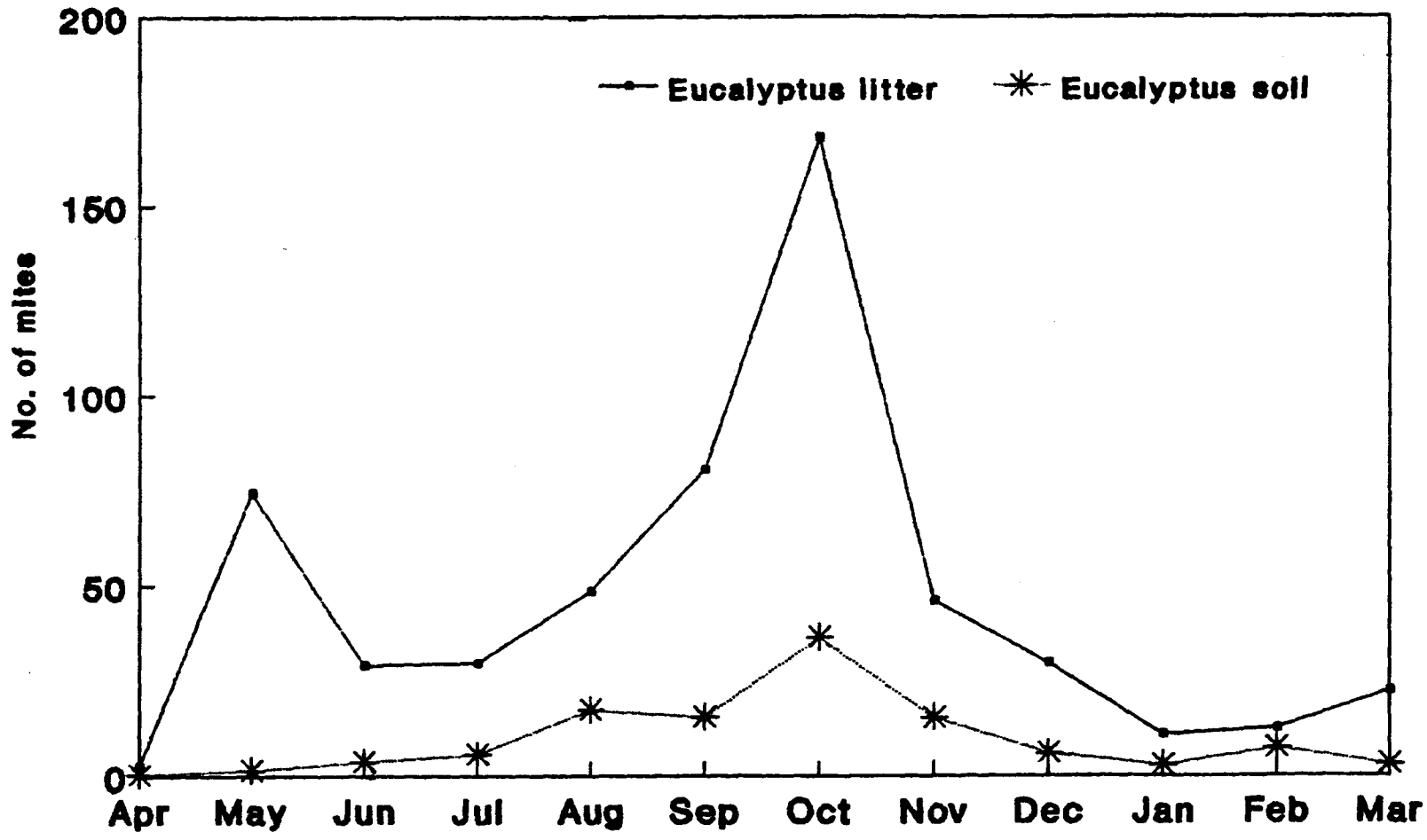

Fig.28: Distribution of Acari in Eucalyptus plantation

Table 13. Fluctuation in the Myriapoda population during the study period in different habitats

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Symphyla	EL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ES	-	-	-	-	-	-	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-	-	-	2.0	0.4	-	-	-	-	-	-	-	-	-	-
	AS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SS	-	-	2.0	0.2	-	-	2.0	0.4	1.0	0.2	-	-	3.0	0.6	-	-	-	-	-	-	-	-	-	-
	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.8
	CS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.8	-	-	-	-	-	-	1.0	0.2
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pauropoda	EL	-	-	15.0	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ES	-	-	1.0	0.2	-	-	-	-	-	-	6.0	1.2	-	-	19.0	3.8	-	-	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-	3.0	0.6	-	-	4.0	0.8	-	-	-	-	-	-	-	-
	AS	-	-	-	-	-	-	-	-	1.0	0.2	8.0	1.6	-	-	11.0	2.2	-	-	-	-	-	-	-	-
	SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SS	-	-	-	-	-	-	-	-	1.0	0.2	5.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-
	CL	-	-	-	-	-	-	-	-	7.0	1.4	4.0	0.8	4.0	0.8	7.0	1.4	-	-	-	-	-	-	-	-
	CS	1.0	0.2	-	-	-	-	2.0	0.4	22.0	4.4	8.0	1.6	5.0	1.0	8.0	1.6	-	-	-	-	-	-	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Chilopoda	EL	-	-	1.0	0.2	-	-	-	-	-	-	1.0	0.2	3.0	0.6	-	-	-	-	-	-	-	-	1.0	0.2
	ES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AL	1.0	0.2	3.0	0.6	2.0	0.4	-	-	-	-	4.0	0.8	-	-	3.0	0.6	-	-	2.0	0.4	3.0	0.6	1.0	0.2
	AS	2.0	0.4	-	-	3.0	0.6	-	-	-	-	1.0	0.2	-	-	2.0	0.4	-	-	-	-	1.0	0.2	2.0	0.4
	SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	1.0	0.2
	SS	-	-	-	-	-	-	-	-	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CL	-	-	-	-	5.0	1.0	1.0	0.2	1.0	0.2	-	-	-	-	1.0	0.2	-	-	-	-	-	-	2.0	0.4
	CS	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diplopoda	EL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SL	-	-	-	-	1.0	0.2	-	-	3.0	0.6	2.0	0.4	-	-	-	-	-	-	-	-	-	-	1.0	0.2
	SS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CL	1.0	0.2	-	-	-	-	6.0	1.2	5.0	1.0	8.0	1.6	5.0	1.0	5.0	1.0	11.0	2.2	2.0	0.4	6.0	1.2	2.0	0.4
	CS	1.0	0.2	-	-	2.0	0.4	-	-	1.0	0.2	1.0	0.2	-	-	-	-	1.0	0.2	-	-	1.0	0.2	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

T = Total ; M = Mean
EL = Eucalyptus litter ; ES = Eucalyptus soil ; AL = Acacia litter ; AS = Acacia soil ; SL = Silver oak litter ; SS = Silver oak soil ; CL = Casuarina litter ; CS = Casuarina soil ;

The mites attained pronounced peak during post monsoon period during October (168.20) and was less pronounced during May (74.4) (Fig.28). Population was least in April (7.6), June (52.6) and July (65.0) where the population gradually increased to reach a maximum in October (168.20) suddenly decreased till February (35.4) and slightly shot up during March (39.6).

Figure 29 gives the population fluctuation of Cryptostigmata in the eucalyptus litter where the population showed two distinct peaks during May (37.2) and October (39.8). In this habitat the lowest population was recorded in the summer month of April (1.0). The population increased suddenly to reach the maximum during May (37.2) and decreased during June-July. It gradually increased to reach the maximum during October and again decreased from November to February when population declined slowly.

The distribution of other acari ranged from 1.8 in April to 128.4 in October (Table 14). Similarly the mean number of arachnids ranged from 0.2 in April to 10.8 in October. Their population was more or less steady from May-July (23.8-37.2).

The collembolan fauna encountered from this habitat

Table 14. Distribution of Acari during different months in different habitats

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Other Acari	EL	9.8	1.8	186.8	37.2	186.8	21.2	119.8	23.8	233.8	46.6	295.8	59.8	642.8	128.4	158.8	38.8	118.8	23.6	29.8	5.8	48.8	8.8	77.8	15.4
	ES	2.8	8.4	6.8	1.2	15.8	3.8	28.8	4.8	72.8	14.4	69.8	13.8	131.8	26.2	67.8	13.4	26.8	5.2	6.8	1.2	12.8	2.4	15.8	3.8
	AL	11.8	2.2	128.8	25.6	124.8	24.8	163.8	32.6	498.8	99.6	354.8	78.8	267.8	53.4	692.8	138.4	136.8	27.2	71.8	14.2	78.8	14.8	85.8	17.8
	AS	9.8	1.8	32.8	6.4	21.8	4.2	45.8	9.8	67.8	13.4	119.8	23.8	87.8	17.4	38.8	7.6	88.8	16.8	36.8	7.2	41.8	8.2	24.8	4.8
	SL	4.8	8.8	79.8	15.8	125.8	25.8	86.8	17.2	217.8	43.4	271.8	54.2	117.8	23.4	165.8	33.8	39.8	7.8	31.8	6.2	32.8	6.4	18.8	3.6
	SS	9.8	1.8	78.8	14.8	34.8	6.8	21.8	4.2	149.8	29.8	99.8	19.8	24.8	4.8	36./8	7.2	18.8	3.6	14.8	2.8	22.8	4.4	38.8	6.8
	CL	24.8	4.8	71.8	14.2	93.8	18.6	164.8	32.8	565.8	113.8	457.8	91.4	388.8	61.6	312.8	62.4	257.8	51.4	48.8	8.8	29.8	5.8	91.8	18.2
	CS	14.8	2.8	46.8	9.2	85.8	17.8	42.8	8.4	179.8	35.8	175.8	35.8	118.8	22.8	79.8	15.8	62.8	12.4	25.8	5.8	13.8	2.6	25.8	5.8
	BL	2.8	8.4	4.8	8.8	-	-	2.8	8.4	17.8	3.4	2.8	8.4	25.8	5.8	5.8	1.8	15.8	3.8	3.8	8.6	-	-	-	-
Cryptost-igmata	EL	5.8	1.8	186.8	37.2	39.8	7.8	29.8	5.8	185.8	21.8	188.8	21.6	199.8	39.8	88.8	16.8	38.8	6.8	25.8	5.8	22.8	4.4	35.8	7.8
	ES	-	-	1.8	8.2	4.8	8.8	8.8	1.6	14.8	2.8	8.8	1.6	58.8	18.8	9.8	1.8	4.8	8.8	8.8	1.6	24.8	4.8	-	-
	AL	8.8	1.6	133.8	26.6	35.8	7.8	24.8	4.8	137.8	27.4	81.8	16.2	152.8	38.4	139.8	27.8	28.8	4.8	15.8	3.8	21.8	4.2	14.8	2.8
	AS	3.8	8.6	64.8	12.8	11.8	2.2	12.8	2.4	18.8	3.6	36.8	7.2	28.8	4.8	29.8	5.8	38.8	7.6	18.8	3.6	16.8	3.2	6.8	1.2
	SL	2.8	8.4	15.8	3,8	9.8	1.8	12.8	2.4	54.8	18.8	54.8	18.8	25.8	5.8	57.8	11.4	19.8	3.8	7.8	1.4	11.8	2.2	5.8	1.8
	SS	5.8	1.8	31.8	6.2	7.8	1.4	5.8	1.8	32.8	6.4	38.8	6.8	18.8	3.6	28.8	4.8	8.8	1.6	8.8	1.6	14.8	2.8	14.8	2.8
	CL	6.8	1.2	41.8	8.2	37.8	7.4	31.8	6.2	259.8	51.8	137.8	27.4	54.8	18.8	198.8	39.6	34.8	6.8	9.8	1.8	3.8	8.6	23.8	4.6
	CS	7.8	1.4	32.8	6.4	48.8	9.6	17.8	3.4	38.8	7.6	43.8	8.6	39.8	7.8	36.8	7.2	16.8	3.2	8.8	1.6	9.8	1.8	8.8	1.6
	BL	-	-	2.8	8.4	-	-	-	-	-	-	-	-	-	-	3.8	8.6	9.8	1.8	-	-	5.8	1.8	1.8	8.2

T = Total ; M = Mean
EL = Eucalyptus litter ; ES = Eucalyptus soil ; AL = Acacia litter ; AS = Acacia soil ; SL = Silver oak litter ; SS = Silver oak soil ; CL = Casuarina litter ; CS = Casuarina soil
BL = Barren land

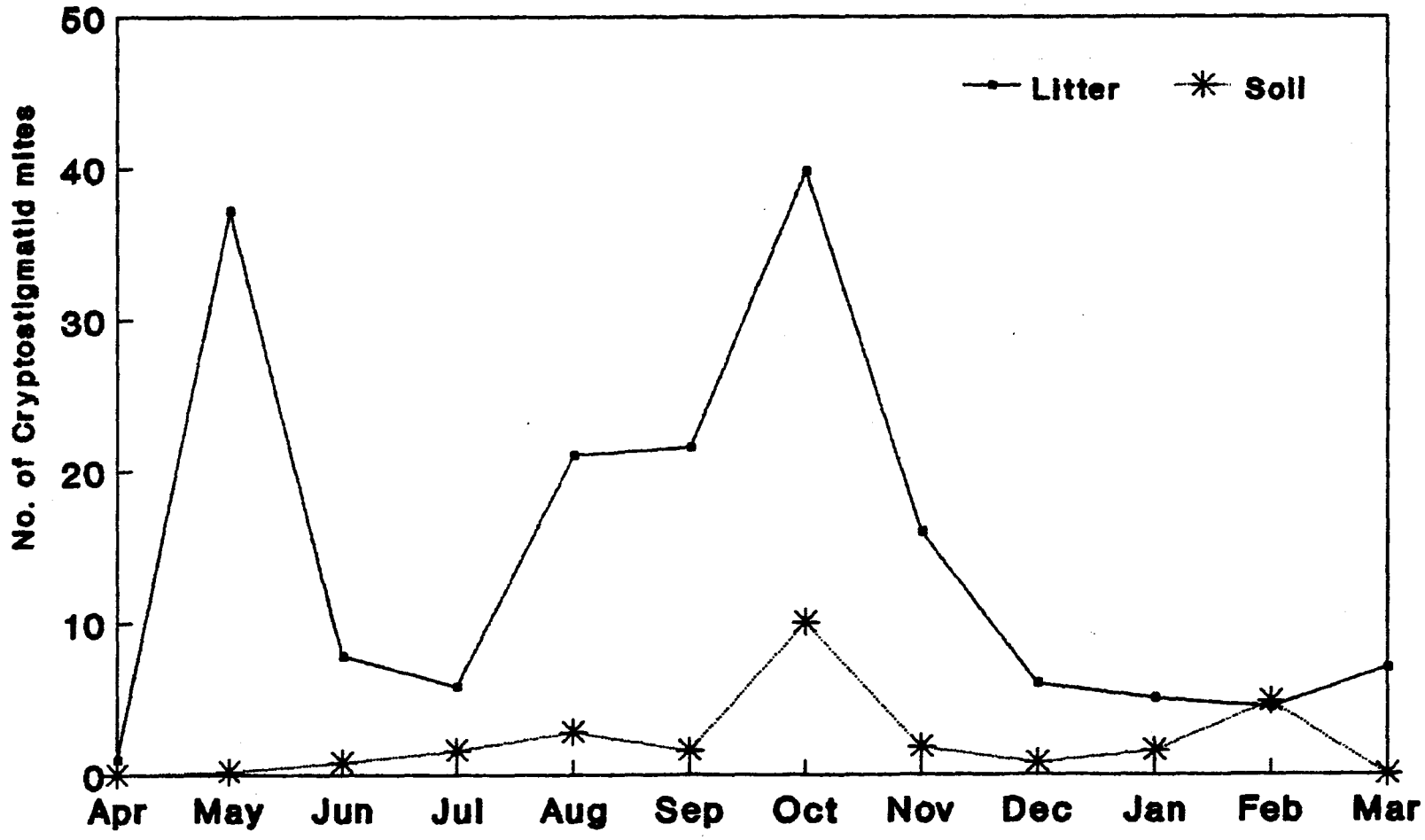

Fig.29:Distribution of cryptostigmatid mites in Eucalyptus plantation

had two peaks in May (30.6) and October (25.8) (Fig.30). Least number of fauna was recorded in April (2.4). However the population was constant from November to February (13.0-15.8). Population varied from 2.4 (April) to 30.6 (May) in which entomobryids were maximum in August (11.8) and least in April (1.4). A less prominent peak was also observed in November (9.0) and January (10.0) (Fig.31). Isotomids had a pronounced peak in May (17.0) and less prominent peak in October (7.6) and February (5.6) (Fig.32). The isotomids population recorded least in April (0.6), July (0.8), December (2.0) and January (1.2). Their number more or less steady during June (3.6), September (3.4), November (3.2) and March (3.8). The maximum Hypogastruridae population was reached in September (8.0) and the minimum in April (0.4). A small peak was observed in October (6.0). Their population remained constant during January to March (0.6-1.2) and in November, May and August it ranged from 0.8-1.2. The members of Hypogastruridae were considerably high (13.9%) compared to Brachystomellidae (4.08%) and Sminthuridae (7.12%). But their population was less compared to Entomobryidae (44.97%) and Isotomidae (29.90%). The Brachystomellidae population in eucalyptus litter ranged from 0.2 during January and February to 2.6 in October (Table 15). Their

Table 15. Distribution of Collembola, Diplura and Protura during different months of the study

		Apr.'94		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Collembola	EL	7.0	1.4	37.0	7.4	9.0	1.8	30.0	6.0	59.0	11.8	24.0	4.8	36.0	7.2	45.0	9.0	37.0	7.4	50.0	10.0	30.0	6.0	21.0	4.2
Entomobryidae	ES	-	-	6.0	1.2	-	-	5.0	1.0	2.0	0.4	-	-	35.0	7.0	9.0	1.8	6.0	1.2	2.0	0.4	4.0	0.8	6.0	1.2
	AL	7.0	1.4	12.0	2.4	28.0	5.6	80.0	16.0	30.0	6.0	20.0	4.0	51.0	10.2	45.0	9.0	20.0	4.0	16.0	3.2	22.0	4.4	26.0	5.2
	AS	1.0	0.2	8.0	1.6	-	-	-	-	4.0	0.8	2.0	0.4	10.0	2.0	-	-	3.0	0.6	7.0	1.4	6.0	1.2	13.0	2.6
	SL	14.0	2.8	8.0	1.6	15.0	3.0	-	-	13.0	2.6	5.0	1.0	19.0	3.8	11.0	2.2	15.0	3.0	13.0	2.6	16.0	3.2	16.0	3.2
	SS	1.0	0.2	2.0	0.4	7.0	1.4	1.0	0.2	-	-	2.0	0.4	9.0	1.8	-	-	8.0	1.6	4.0	0.8	7.0	1.4	2.0	0.4
	CL	9.0	1.8	17.0	3.4	27.0	5.4	22.0	4.4	28.0	5.6	18.0	3.6	20.0	4.0	157.0	31.4	31.0	6.2	24.0	4.8	16.0	3.2	14.0	2.8
	CS	2.0	0.4	3.0	0.6	50.0	10.0	11.0	2.2	1.0	0.2	23.0	4.6	10.0	2.0	22.0	4.4	53.0	10.6	12.0	2.4	-	-	5.0	1.0
	DL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isotomidae	EL	3.0	0.6	85.0	17.0	18.0	3.6	4.0	0.8	12.0	2.4	17.0	3.4	38.0	7.6	16.0	3.2	10.0	2.0	6.0	1.2	28.0	5.6	19.0	3.8
	ES	2.0	0.4	3.0	0.6	6.0	1.2	5.0	1.0	21.0	4.2	18.0	3.6	28.0	5.6	12.0	2.4	7.0	1.4	4.0	0.8	9.0	1.8	4.0	0.8
	AL	1.0	0.2	60.0	12.0	70.0	14.0	37.0	7.4	9.0	1.8	26.0	5.2	35.0	7.0	27.0	5.4	20.0	4.0	14.0	2.8	18.0	3.6	7.0	1.4
	AS	4.0	0.8	4.0	0.8	9.0	1.8	-	-	13.0	2.6	27.0	5.4	37.0	7.4	15.0	3.0	14.0	2.8	10.0	2.0	14.0	2.8	17.0	3.4
	SL	3.0	0.6	1.0	0.2	8.0	1.6	7.0	1.4	9.0	1.8	11.0	2.2	12.0	2.4	15.0	3.0	7.0	1.4	3.0	0.6	8.0	1.6	6.0	1.2
	SS	6.0	1.2	12.0	2.4	13.0	2.6	8.0	1.6	25.0	5.0	17.0	3.4	18.0	3.6	23.0	4.6	4.0	0.8	5.0	1.0	1.0	0.2	8.0	1.6
	CL	4.0	0.8	19.0	3.8	13.0	2.6	22.0	4.4	79.0	15.8	16.0	3.2	85.0	17.0	103.0	20.6	14.0	2.8	9.0	1.8	6.0	1.2	13.0	2.6
	CS	-	-	16.0	3.2	54.0	10.8	46.0	9.2	85.0	17.0	59.0	11.8	50.0	10.0	33.0	6.6	40.0	8.0	6.0	1.2	3.0	0.6	1.0	0.2
	DL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Hypogastr-uridae	EL	2.0	0.4	6.0	1.2	-	-	-	-	5.0	1.0	44.0	8.8	30.0	6.0	4.0	0.8	15.0	3.0	4.0	0.8	6.0	1.2	3.0	0.6
	ES	1.0	0.2	2.0	0.4	-	-	-	-	1.0	0.2	6.0	1.2	30.0	6.0	2.0	0.4	4.0	0.8	2.0	0.4	-	-	-	-
	AL	-	-	-	-	7.0	1.4	-	-	41.0	8.2	30.0	6.0	23.0	4.6	26.0	5.2	18.0	3.6	3.0	0.6	9.0	1.8	-	-
	AS	4.0	0.8	4.0	0.8	5.0	1.0	4.0	0.8	11.0	2.2	13.0	2.6	15.0	3.0	2.0	0.4	6.0	1.2	1.0	0.2	1.0	0.2	6.0	1.2
	SL	-	-	8.0	1.6	8.0	1.6	10.0	2.0	19.0	3.8	37.0	7.4	13.0	2.6	2.0	0.4	-	-	1.0	0.2	-	-	-	-
	SS	-	-	-	-	-	-	8.0	1.6	11.0	2.2	12.0	2.4	2.0	0.4	-	-	8.0	1.6	-	-	-	-	-	-
	CL	-	-	-	-	14.0	2.8	27.0	5.4	108.0	21.6	34.0	6.8	35.0	7.0	106.0	21.2	39.0	7.8	2.0	0.4	-	-	5.0	1.0
	CS	1.0	0.2	-	-	8.0	1.6	12.0	2.4	3.0	0.6	13.0	2.6	17.0	3.4	-	-	14.0	2.8	2.0	0.4	8.0	1.6	1.0	0.2
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brachysto-maellidae	EL	-	-	4.0	0.8	6.0	1.2	-	-	3.0	0.6	-	-	13.0	2.6	7.0	1.4	-	-	1.0	0.2	1.0	0.2	-	-
	ES	-	-	-	-	4.0	0.8	-	-	10.0	2.0	-	-	33.0	6.6	7.0	1.4	1.0	0.2	1.0	0.2	1.0	0.2	-	-
	AL	-	-	21.0	4.2	52.0	10.4	41.0	8.2	6.0	1.2	22.0	4.4	7.0	1.4	13.0	2.6	5.0	1.0	9.0	1.8	2.0	0.4	-	-
	AS	-	-	4.0	0.8	2.0	0.4	13.0	2.6	-	-	-	-	7.0	1.4	-	-	4.0	0.8	3.0	0.6	-	-	-	-
	SL	-	-	-	-	-	-	-	-	7.0	1.4	-	-	-	-	2.0	0.4	-	-	1.0	0.2	-	-	-	-
	SS	-	-	-	-	-	-	3.0	0.6	-	-	5.0	1.0	3.0	0.6	-	-	-	-	-	-	-	-	-	-
	CL	1.0	0.2	9.0	1.8	9.0	1.8	1.0	0.2	31.0	6.2	52.0	10.4	35.0	7.0	106.0	21.2	39.0	7.8	2.0	0.4	-	-	5.0	1.0
	CS	-	-	2.0	0.4	17.0	3.4	12.0	2.4	-	-	2.0	0.4	11.0	2.2	-	-	12.0	2.4	-	-	-	-	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T
Sainthur-idae	EL	-	-	21.0	4.2	3.0	0.6	2.0	0.4	6.0	1.2	5.0	1.0	12.0	2.4	7.0	1.4	-	-	-	-	-	-	5.0
	ES	-	-	-	-	-	-	-	-	-	-	-	-	9.0	1.8	1.0	0.2	-	-	-	-	-	-	-
	AL	-	-	23.0	4.6	5.0	1.0	-	-	6.0	1.2	-	-	8.0	1.6	1.0	0.2	2.0	0.4	-	-	-	-	-
	AS	-	-	6.0	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	-
	SL	-	-	-	-	-	-	-	-	-	-	-	-	2.0	0.4	2.0	0.4	-	-	-	-	5.0	1.0	-
	SS	-	-	-	-	3.0	0.6	-	-	16.0	3.2	2.0	0.4	-	-	-	-	-	-	-	-	-	-	-
	CL	2.0	0.4	5.0	1.0	4.0	0.8	-	-	19.0	3.6	-	-	7.0	1.4	43.0	8.6	2.0	0.4	1.0	0.2	-	-	-
	CS	2.0	0.4	1.0	0.2	3.0	0.6	-	-	1.0	0.2	2.0	0.4	4.0	0.8	-	-	-	-	-	-	-	-	1.0
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diplura	EL	-	-	-	-	-	-	-	-	1.0	0.2	2.0	0.4	-	-	-	-	-	-	-	-	-	-	-
	ES	-	-	-	-	-	-	-	-	3.0	0.6	-	-	-	-	-	-	3.0	0.6	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	1.0	0.2	-	-	-	-	3.0	0.6	-	-	-	-	-	-	-
	AS	-	-	-	-	-	-	-	-	-	-	-	-	2.0	0.4	-	-	-	-	-	-	-	-	-
	SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	0.4	-	-	1.0
	SS	-	-	-	-	-	-	-	-	1.0	0.2	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-
	CL	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.0
	CS	-	-	-	-	-	-	-	-	1.0	0.2	-	-	3.0	0.6	-	-	2.0	0.4	-	-	-	-	2.0
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Protura	EL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.0	0.6	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AS	-	-	2.0	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CS	-	-	-	-	-	-	-	-	-	-	-	-	5.0	1.0	-	-	-	-	-	-	-	-	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

T = Total ; M = Mean
EL = Eucalyptus litter ; ES = Eucalyptus soil ; AL = Acacia litter ; AS = Acacia soil ; SL = Silver oak litter ; SS = Silver oak soil ; CL = Casuarina litter ; CS = Casuarina soil ;
BL = Barren land

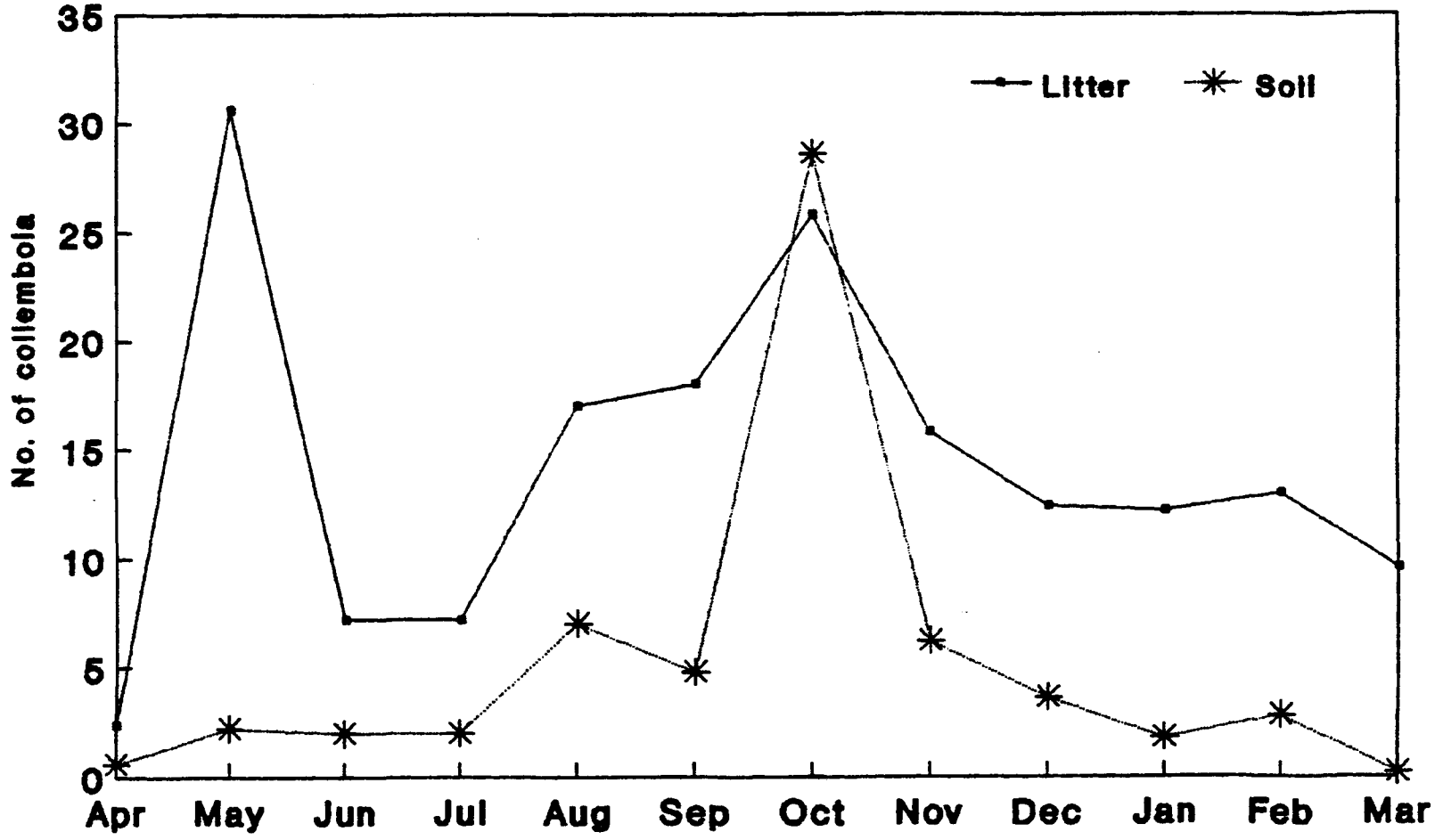

Fig.30.Distribution of Collembola in in Eucalyptus plantation

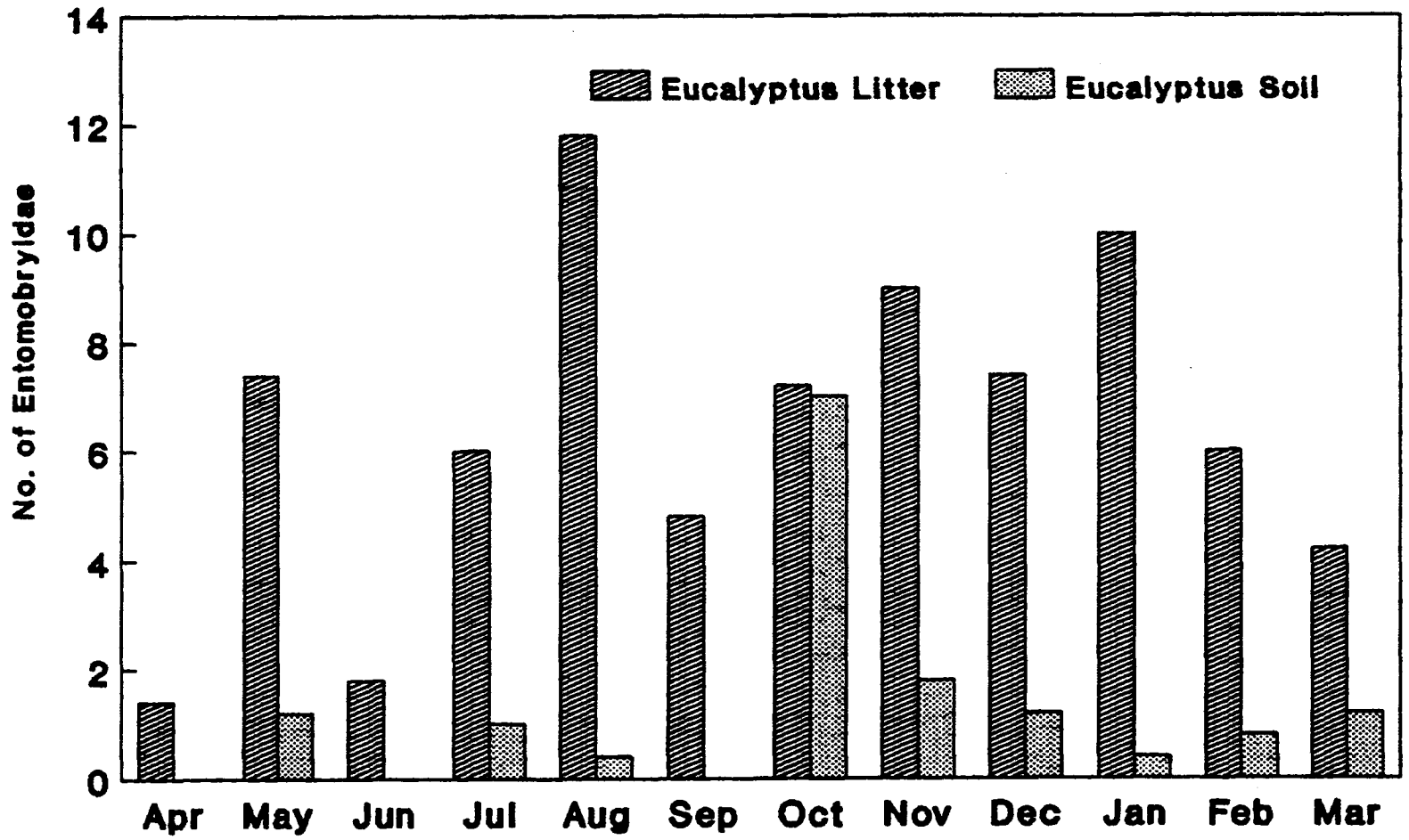

Fig.31: Population fluctuation of Entomobryidae in Eucalyptus plantation

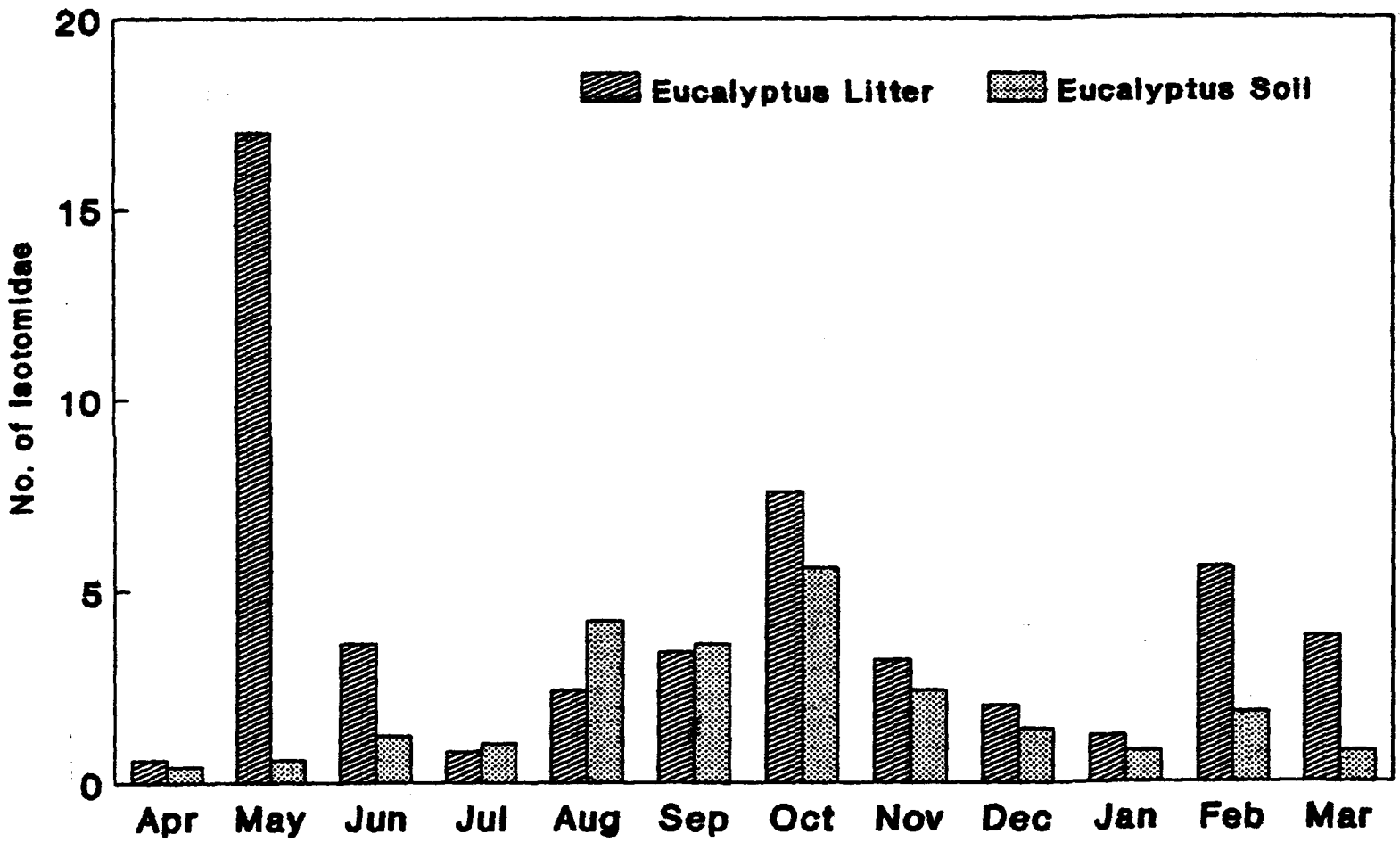

Fig.32: Population fluctuation of Isotomidae in Eucalyptus plantation

number remained almost steady (0.6-1.2) from May-June and August. Brachystomellidae were least among collembolans of this habitat. Sminthurid population in this habitat varied from 0.4 (July) to 4.2 (May) (Table 15). However, the population became steady during June-September, November and March (0.4-1.4). Diplurans were collected only during August-September (0.2-0.4).

Pterygota were maximum (22.2) during July and minimum (2.2) during April. Population remained steady (3.8-13.2) during remaining months of the study period (Table 12). Psocids and thrips were 0.2-8.2 and 0.2-5.0 respectively. Psocids were constant from November to March (0.2-1.2). The highest number of (11.2) hemipterans were recorded from this habitat compared to all other habitats (Table 16). The maximum and minimum population of hemipterans was recorded in July (4.2) and September - October (0.2) respectively. Ant population varied between the narrow range of 0.2 (January) to 2.4 (July). During rest of the year their population were more or less constant, and absent during June, December and February (Table 16). Coleopteran adult constituted 0.2-1.4 numbers of the total fauna. Coleopteran larvae accounted for 0.2-3.2 the number being maximal in the eucalyptus litter compared to other habitats. Lepidopteran larvae were more during October (2.4) and

Table 12. Distribution of different groups of soil fauna during the study period from April 1993 to March 1994.

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Isopoda	EL	-	-	-	-	-	-	-	-	1.0	0.2	1.0	0.2	3.0	0.6	-	-	-	-	-	-	-	-	-	-
	ES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	-	-	-	-
	SL	-	-	-	-	-	-	-	-	2.0	0.4	-	-	-	-	5	1.0	-	-	-	-	-	-	-	-
	SS	4.0	0.8	-	-	-	-	-	-	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CL	4.0	0.8	-	-	-	-	-	-	1.0	0.2	2.0	0.4	2.0	0.4	-	-	-	-	-	-	-	-	-	-
	CS	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.8	-	-	-	-	-	-	1.0	0.2	2.0	0.4
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myriapoda	EL	-	-	16.0	3.2	-	-	-	-	-	-	1.0	0.2	3.0	0.6	-	-	-	-	-	-	-	-	1.0	0.2
	ES	-	-	1.0	0.2	-	-	1.0	0.2	-	-	6.0	1.2	-	-	19.0	3,8	-	-	-	-	-	-	-	-
	AL	1.0	0.2	3.0	0.6	2.0	0.4	-	-	-	-	7.0	1.4	2.0	0.4	7.0	1.4	-	-	2.0	0.4	3.0	0.6	1.0	0.2
	AS	2.0	0.4	-	-	3.0	0.6	-	-	1.0	0.2	9.0	1.8	-	-	13.0	2.6	-	-	-	-	1.0	0.2	2.0	0.4
	SL	-	-	-	-	1.0	0.2	-	-	3.0	0.6	2.0	0.4	-	-	-	-	-	-	-	-	1.0	0.2	2.0	0.4
	SS	-	-	2.0	0.4	-	-	2.0	0.4	3.0	0.6	5.0	1.0	3.0	0.6	-	-	-	-	-	-	-	-	-	-
	CL	1.0	0.2	-	-	5.0	1.0	7.0	1.4	13.0	2.6	12.0	2.4	9.0	1.8	13.0	2.6	11.0	2.2	2.0	0.4	6.0	1.2	8.0	1.6
	CS	3.0	0.6	-	-	2.0	0.4	2.0	0.4	23.0	4.6	9.0	1.8	5.0	1.0	12.0	2.4	1.0	0.2	-	-	1.0	0.2	2.0	0.4
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Acari	EL	14.0	2.8	372.0	74.4	145.0	29.0	148.0	29.6	243.0	48.6	403.0	80.6	841.0	168.2	230.0	46.0	148.0	29.6	54.0	10.8	62.0	12.4	112.0	22.4
	ES	2.0	0.4	7.0	1.4	19.0	3.8	28.0	5.6	86.0	17.2	77.0	15.4	181.0	36.2	76.0	15.2	30.0	6.0	14.0	2.8	36.0	7.2	15.0	3.0
	AL	19.0	3.8	261.0	52.2	159.0	31.8	187.0	37.4	635.0	127.0	435.0	87.0	419.0	83.8	831.0	166.2	156.0	31.2	86.0	17.2	91.0	18.2	99.0	19.8
	AS	12.0	2.4	96.0	19.2	32.0	6.4	57.0	11.4	85.0	17.0	155.0	31.0	107.0	21.4	67.0	13.4	118.0	23.6	54.0	10.8	57.0	11.4	30.0	6.0
	SL	6.0	1.2	94.0	18.8	134.0	26.8	98.0	19.6	271.0	54.2	325.0	65.0	142.0	28.4	222.0	44.4	58.0	11.6	38.0	7.6	43.0	8.6	23.0	4.6
	SS	13.0	2.6	181.0	28.2	41.0	8.2	26.0	5.2	181.0	36.2	129.0	25.8	42.0	8.4	56.0	11.2	26.0	5.2	22.0	4.4	36.0	7.2	44.0	8.8
	CL	30.0	6.0	112.0	22.4	130.0	26.0	195.0	39.0	824.0	164.8	594.0	118.8	382.0	72.4	510.0	102.0	291.0	58.2	49.0	9.8	32.0	6.4	114.0	22.8
	CS	21.0	4.2	78.0	15.6	133.0	26.6	59.0	11.8	217.0	43.4	219.0	43.6	149.0	29.8	115.0	23.0	78.0	15.6	33.0	6.6	22.0	4.4	33.0	6.6
	BL	2.0	0.4	6.0	1.2	-	-	2.0	0.4	17.0	3.4	2.0	0.4	25.0	5.0	8.0	1.6	24.0	4.8	3.0	0.6	5.0	1.0	1.0	0.2
Other arachnids	EL	1.0	0.2	32.0	6.4	31.0	6.2	27.0	5.4	52.0	10.4	31.0	6.2	54.0	10.8	51.0	10.2	6.0	1.2	18.0	3.6	22.0	4.4	11.0	2.2
	ES	1.0	0.2	1.0	0.2	-	-	-	-	3.0	0.6	4.0	0.8	2.0	0.4	2.0	0.4	1.0	0.2	1.0	0.2	4.0	0.8	-	-
	AL	-	-	4.0	0.8	6.0	1.2	2.0	0.4	6.0	1.2	8.0	1.6	3.0	0.6	2.0	0.4	2.0	0.4	1.0	0.2	2.0	0.4	3.0	0.6
	AS	3.0	0.6	1.0	0.2	-	-	4.0	0.8	1.0	0.2	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-
	SL	-	-	2.0	0.4	7.0	1.4	2.0	0.4	10.0	2.0	8.0	1.6	5.0	1.0	4.0	0.8	7.0	1.4	7.0	1.4	9.0	1.8	-	-
	SS	4.0	0.8	-	-	-	-	-	-	1.0	0.2	1.0	0.2	-	-	1.0	0.2	-	-	-	-	-	-	-	-
	CL	6.0	1.2	7.0	1.4	30.0	6.0	25.0	5.0	31.0	6.2	22.0	4.4	19.0	3.8	13.0	2.6	22.0	4.4	7.0	1.4	9.0	1.8	2.0	0.4
	CS	3.0	0.6	2.0	0.4	-	-	-	-	5.0	1.0	2.0	0.4	-	-	2.0	0.4	-	-	-	-	2.0	0.4	10.0	2.0
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Collembola	EL	12.0	2.4	153.0	30.6	36.0	7.2	34.0	7.2	85.0	17.0	90.0	18.0	129.0	25.8	79.0	15.8	62.0	12.4	61.0	12.2	65.0	13.0	48.0	9.6
	ES	3.0	0.6	11.0	2.2	10.0	2.0	10.0	2.0	35.0	7.0	24.0	4.8	143.0	28.6	31.0	6.2	18.0	3.6	9.0	1.8	14.0	2.8	1.0	0.2
	AL	9.0	1.8	116.0	23.2	162.0	32.4	158.0	31.6	92.0	18.4	98.0	19.6	124.0	24.6	112.0	22.4	67.0	13.4	42.0	8.4	51.0	10.2	33.0	6.6
	AS	11.0	2.2	26.0	5.2	20.0	4.0	17.0	3.4	28.0	5.6	42.0	8.4	69.0	13.8	17.0	3.4	27.0	5.4	21.0	4.2	22.0	4.4	36.0	7.2
	SL	17.0	3.4	17.0	3.4	31.0	6.2	17.0	3.4	48.0	9.6	53.0	10.6	46.0	9.2	32.0	6.4	22.0	4.4	18.0	3.6	29.0	5.8	22.0	4.4
	SS	6.0	1.2	14.0	2.8	23.0	4.6	20.0	4.0	52.0	10.4	38.0	7.6	32.0	6.4	23.0	4.6	20.0	4.0	9.0	1.8	8.0	1.6	10.0	2.0
	CL	16.0	3.2	50.0	10.0	69.0	13.8	72.0	14.4	264.0	52.8	120.0	24.0	182.0	36.4	527.0	105.4	166.0	33.2	41.0	8.2	26.0	5.2	36.0	7.2
	CS	5.0	1.0	22.0	4.4	132.0	26.4	81.0	16.2	102.0	20.4	97.0	19.4	100.0	20.0	55.0	11.0	119.0	23.8	20.0	4.0	11.0	2.2	8.0	1.6
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pterygota	EL	11.0	2.2	66.0	13.2	54.0	10.8	111.0	22.2	66.0	13.2	31.0	6.2	65.0	13.0	39.0	7.8	19.0	3.8	46.0	9.2	27.0	5.4	26.0	5.2
	ES	-	-	1.0	0.2	4.0	0.8	11.0	2.2	12.0	2.4	8.0	1.6	7.0	1.4	5.0	1.0	3.0	0.6	3.0	0.6	3.0	0.6	1.0	0.2
	AL	13.0	2.6	48.0	9.6	74.0	14.8	59.0	11.8	94.0	18.8	43.0	8.6	77.0	15.4	51.0	10.2	80.0	16.0	66.0	13.2	45.0	9.0	34.0	6.8
	AS	12.0	2.4	53.0	10.6	-	-	7.0	1.4	4.0	0.8	12.0	2.4	15.0	3.0	5.0	1.0	3.0	0.6	2.0	0.4	7.0	1.4	13.0	2.6
	SL	9.0	1.8	43.0	8.6	51.0	10.2	22.0	4.4	21.0	4.2	23.0	4.6	38.0	7.6	32.0	6.4	8.0	1.6	25.0	5.0	38.0	7.6	15.0	3.0
	SS	6.0	1.2	11.0	2.2	8.0	1.6	9.0	1.8	15.0	3.0	22.0	4.4	6.0	1.2	11.0	2.2	2.0	0.4	2.0	0.4	7.0	1.4	16.0	3.2
	CL	34.0	6.8	17.0	3.4	20.0	4.0	39.0	7.8	93.0	18.6	20.0	4.0	41.0	8.2	65.0	13.0	63.0	12.6	33.0	6.6	38.0	7.6	38.0	7.6
	CS	13.0	2.6	10.0	2.0	7.0	1.4	21.0	4.2	11.0	2.2	7.0	1.4	32.0	6.4	37.0	7.4	33.0	6.6	-	-	10.0	2.0	10.0	2.0
	BL	4.0	0.8	1.0	0.2	-	-	-	-	-	-	-	-	6.0	1.2	2.0	0.4	3.0	0.6	1.0	0.2	1.0	0.2	1.0	0.2

T = Total ; M = Mean
EL = Eucalyptus litter ; ES = Eucalyptus soil ; AL = Acacia litter ; AS = Acacia soil ; SL = Silver oak litter ; SS = Silver oak soil ; CL = Casuarina litter ; CS = Casuarina soil ;
BL = Barren land

Table 16. Distribution of soil Pterygota during different months in various habitats

		Apr.'94		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Psocoptera	EL	-	-	41.0	8.2	20.0	4.0	41.0	8.2	17.0	3.4	19.0	3.8	9.0	1.8	3.0	0.6	1.0	0.2	1.0	0.2	-	-	6.0	1.2
	ES	-	-	-	-	-	-	-	-	-	-	7.0	1.4	6.0	1.2	1.0	0.2	3.0	0.6	-	-	-	-	-	-
	AL	3.0	0.6	11.0	2.2	26.0	5.2	23.0	4.0	11.0	2.2	3.0	0.6	8.0	1.6	1.0	0.2	9.0	1.8	1.0	0.2	4.0	0.8	3.0	0.6
	AS	-	-	1.0	0.2	-	-	3.0	0.6	-	-	-	-	-	-	-	-	2.0	0.4	-	-	-	-	-	-
	SL	1.0	0.2	15.0	3.0	8.0	1.6	4.0	0.8	-	-	4.0	0.8	3.0	0.6	-	-	-	-	-	-	1.0	0.2	1.0	0.2
	SS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	CL	-	-	6.0	1.2	5.0	1.0	7.0	1.4	35.0	7.0	7.0	1.4	8.0	1.6	13.0	2.6	6.0	1.2	-	-	1.0	0.2	-	-
	CS	2.0	0.4	2.0	0.4	-	-	-	-	2.0	0.4	-	-	-	-	2.0	0.4	-	-	-	-	-	-	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.8	-	-	-	-	-	-	-	-	-	-
Hemiptera	EL	2.0	0.4	13.0	2.6	2.0	0.4	21.0	4.2	7.0	1.4	1.0	0.2	1.0	0.2	-	-	-	-	3.0	0.6	2.0	0.4	4.0	0.8
	ES	-	-	-	-	-	-	2.0	0.4	-	-	-	-	-	-	3.0	0.6	-	-	-	-	-	-	-	-
	AL	-	-	15.0	3.0	1.0	0.2	7.0	1.4	8.0	1.6	1.0	0.2	10.0	2.0	9.0	1.8	-	-	1.0	0.2	-	-	2.0	0.4
	AS	-	-	2.0	0.4	-	-	4.0	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	2.0	0.4	2.0	0.4	2.0	0.4	-	-
	SS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2
	CL	-	-	4.0	0.8	3.0	0.6	2.0	0.4	-	-	-	-	-	-	1.0	0.2	3.0	0.6	2.0	0.4	2.0	0.4	3.0	0.6
	CS	-	-	2.0	0.4	-	-	2.0	0.4	-	-	-	-	5.0	1.0	1.0	0.2	-	-	-	-	1.0	0.2	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Thysano-ptera	EL	1.0	0.2	-	-	-	-	7.0	1.4	9.0	1.0	4.0	0.8	25.0	5.0	8.0	1.6	14.0	2.0	10.0	2.0	11.0	2.2	-	-
	ES	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	-	-	-	-	1.0	0.2	2.0	0.4	-	-
	AL	1.0	0.2	2.0	0.4	26.0	5.2	24.0	4.8	29.0	5.8	17.0	3.4	14.0	2.8	22.0	4.4	34.0	6.8	37.0	7.4	20.0	4.0	11.0	2.2
	AS	-	-	-	-	-	-	-	-	-	-	5.0	1.0	-	-	-	-	-	-	-	-	5.0	1.0	-	-
	SL	-	-	10.0	2.0	8.0	1.6	9.0	1.0	4.0	0.8	6.0	1.2	19.0	3.8	3.0	2.6	6.0	1.2	14.0	2.8	12.0	2.4	-	-
	SS	5.0	1.0	-	-	-	-	-	-	-	-	1.0	0.2	2.0	0.4	-	-	-	-	-	-	1.0	0.2	4.0	0.8
	CL	2.0	0.4	2.0	0.4	11.0	2.2	13.0	2.6	15.0	3.0	8.0	1.6	20.0	4.0	17.0	3.4	32	6.4	14.0	2.8	6.0	1.2	13.0	2.6
	CS	5.0	1.0	2.0	0.4	-	-	5.0	1.0	-	-	-	-	-	-	3.0	0.6	3.0	0.6	-	-	-	-	2.0	0.4
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	-	-	-	-	-	-
Hymenop-tera (Ants)	EL	3.0	0.6	2.0	0.4	-	-	12.0	2.4	5.0	1.0	2.0	0.4	11.0	2.2	3.0	0.6	-	-	1.0	0.2	-	-	5.0	1.0
Formicidae	ES	-	-	-	-	-	-	9.0	1.8	10.0	2.0	-	-	-	-	1.0	0.2	-	-	1.0	0.2	-	-	-	-
	AL	-	-	4.0	0.8	7.0	1.4	3.0	0.6	21.0	4.2	8.0	1.6	20.0	4.0	9.0	1.8	21.0	4.2	2.0	0.4	4.0	0.8	-	-
	AS	12.0	2.4	44.0	8.8	-	-	-	-	1.0	0.2	1.0	0.2	7.0	1.4	4.0	0.8	-	-	1.0	0.2	1.0	0.2	1.0	0.2
	SL	-	-	-	-	6.0	1.2	-	-	3.0	0.6	1.0	0.2	-	-	2.0	0.4	-	-	2.0	0.4	5.0	1.0	-	-
	SS	-	-	7.0	1.4	-	-	4.0	0.8	12.0	2.4	14.0	2.8	-	-	4.0	0.8	-	-	-	-	2.0	0.4	-	-
	CL	6.0	1.2	-	-	-	-	-	-	3.0	0.6	-	-	-	-	14.0	2.8	-	-	3.0	0.6	6.0	1.2	6.0	1.2
	CS	2.0	0.4	1.0	0.2	-	-	-	-	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2
	BL	4.0	0.8	1.0	0.2	-	-	-	-	-	-	-	-	1.0	0.2	2.0	0.4	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Coleoptera (Adults)	EL	1.0	0.2	2.0	0.4	4.0	0.8	3.0	0.6	4.0	0.8	3.0	0.6	7.0	1.4	5.0	1.0	-	-	3.0	0.6	3.0	0.6	3.0	0.6
	ES	-	-	-	-	-	-	-	-	1.0	0.2	1.0	0.2	-	-	-	-	-	-	-	-	1.0	0.2	-	-
	AL	3.0	0.6	2.0	0.4	2.0	0.4	-	-	3.0	0.6	2.0	0.4	8.0	1.6	-	-	-	-	1.0	0.2	-	-	2.0	0.4
	AS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	0.4
	SL	2.0	0.4	2.0	0.4	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	4.0	0.8	-	-
	SS	-	-	2.0	0.4	8.0	1.6	3.0	0.6	1.0	0.2	1.0	0.2	-	-	-	-	-	-	-	-	-	-	1.0	0.2
	CL	8.0	1.6	-	-	-	-	1.0	0.2	1.0	0.2	1.0	0.2	-	-	2.0	0.4	1.0	0.2	4.0	0.8	3.0	0.6	4.0	0.8
	CS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.0	1.0	1.0	0.2
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	-	-	1.0	0.2

T = Total ; M = Mean
EL = Eucalyptus litter ; ES = Eucalyptus soil ; AL = Acacia litter ; AS = Acacia soil ; SL = Silver oak litter ; SS = Silver oak soil ; CL = Casuarina litter ; CS = Casuarina soil ;
BL = Barren land

Table 17. Distribution of Larval Lepidoptera, Diptera and Coleoptera in different habitats in different months

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Order Lepidoptera	EL	-	-	2.0	0.4	8.0	1.6	4.0	0.8	0.2	0.4	1.0	0.2	12.0	2.4	-	-	1.0	0.2	3.0	0.6	2.0	0.4	2.0	0.4
	ES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0	-	-	-	-	-	-
	AL	2.0	0.4	-	-	18.0	3.6	1.0	0.2	1.0	0.2	10.0	2.0	5.0	1.0	6.0	1.2	3.0	0.6	8.0	1.6	10.0	2.0	4.0	0.8
	AS	-	-	2.0	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SL	-	-	-	-	6.0	1.2	1.0	0.2	1.0	0.2	2.0	0.4	-	-	-	-	-	-	-	-	-	-	-	-
	SS	-	-	-	-	-	-	2.0	0.4	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	-	-
	CL	1.0	0.2	1.0	0.2	-	-	3.0	0.6	11.0	2.2	2.0	0.4	4.0	0.8	-	-	3.0	0.6	2.0	0.4	3.0	0.6	5.0	1.0
	CS	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	1.0	0.2	1.0	0.2	-	-	-	-	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera	EL	-	-	-	-	-	-	6.0	1.2	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ES	-	-	-	-	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AL	-	-	-	-	7.0	1.4	-	-	-	-	1.0	0.2	7.0	1.4	-	-	2.0	0.4	1.0	0.2	-	-	1.0	0.2
	AS	-	-	2.0	0.4	-	-	-	-	-	-	3.0	0.6	8.0	1.6	-	-	-	-	-	-	-	-	-	-
	SL	3.0	0.6	8.0	1.6	3.0	0.6	-	-	4.0	0.8	6.0	1.2	-	-	-	-	-	-	2.0	0.4	7.0	1.4	2.0	0.4
	SS	1.0	0.2	-	-	-	-	-	-	1.0	0.2	-	-	-	-	7.0	1.4	-	-	-	-	-	-	5.0	1.0
	CL	3.0	0.6	-	-	-	-	1.0	0.2	8.0	1.6	1.0	0.2	5.0	1.0	13.0	2.6	2.0	0.4	1.0	0.2	-	-	-	-
	CS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.0	1.0	4.0	0.8	-	-	-	-	-	-
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		Apr.'93		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan.'94		Feb		Mar	
		T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M	T	M
Coleoptera	EL	2.0	0.4	2.0	0.4	4.0	0.8	16.0	3.2	14.0	2.8	1.0	0.2	-	-	-	-	2.0	0.4	1.0	0.2	1.0	0.2	2.0	0.4
	ES	-	-	1.0	0.2	-	-	-	-	1.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	AL	3.0	0.6	11.0	2.2	-	-	4.0	0.8	9.0	1.8	-	-	5.0	1.0	2.0	0.4	2.0	0.4	2.0	0.4	1.0	0.2	3.0	0.6
	AS	-	-	2.0	0.4	-	-	-	-	3.0	0.6	-	-	-	-	-	-	-	-	1.0	0.2	1.0	0.2	-	-
	SL	-	-	7	1.4	27	5.4	4.0	0.8	2.0	0.4	1.0	0.2	2.0	0.4	6.0	1.2	-	-	-	-	-	-	-	-
	SS	-	-	2.0	0.4	-	-	-	-	1.0	0.2	3.0	0.6	-	-	-	-	-	-	-	-	1.0	0.2	4.0	0.8
	CL	2.0	0.4	3.0	0.6	-	-	6.0	1.2	8.0	1.6	1.0	0.2	4.0	0.8	1.0	0.2	2.0	0.4	2.0	0.4	-	-	3.0	0.6
	CS	1.0	0.2	2.0	0.4	-	-	-	-	2.0	0.4	-	-	6.0	1.2	1.0	0.2	1.0	0.2	-	-	1.0	0.2	3.0	0.6
	BL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

T = Total ; M = Mean
EL = Eucalyptus litter ; ES = Eucalyptus soil ; AL = Acacia litter ; AS = Acacia soil ; SL = Silver oak litter ; SS = Silver oak soil ; CL = Casuarina litter ; CS = Casuarina soil ;
BL = Barren land

ranged from 0.2-1.6 in the remaining period. Dipteran larvae (0.2-1.2) was recorded only during July-August (Table 17).

IV.C.2 Eucalyptus soil

Eucalyptus soil recorded the maximum number of fauna (66.6) during October and the lowest (1.2) in April. Soil fauna fluctuated during study period with two peaks during October (66.6) and August (27.8). The population gradually increased to reach the maximum in August and October. Further fauna gradually decreased (Fig. 31). Myriapods varied between 0.2-3.8 and were found only during May, July, September and November. Among myriapods pauropods constituted maximum fauna followed by symphylans with very few numbers (Table 13).

The population of Acari (36.2) had reached maximum in October and minimum (0.4) was during April. Population of total acari and Oribatei followed the fluctuation pattern of total soil fauna which exhibited a peak in October (Fig.28 and 29).

Similarly the collembolan fluctuation followed the pattern of total soil fauna which exhibited a peak during October (Fig. 30). Entomobryids recorded highest in October (7.0) and was less during August and January

(0.4) (Fig.31). Their population remained steady during rest of the period varying from 1.0 to 1.8. Isotomidae fluctuated from 0.4 (April) to 5.6 (October). There were two peaks (Fig.32) the prominent being in October (5.6) and a less pronounced one in August (4.2) whereas the population became constant during April-July (0.4-1.2) and December-March (0.8-1.8).

Hypogastruridae varied between 0.2 (April and August) to 6.0 (October). During other period of the study their population was almost constant. Hypogastruridae collections were poor in this habitat (15.48) compared to other habitats except in case of silveroak soil. Members of Brachystomellidae recorded more during October (6.6) and showed steady from December to Febraury (0.2). Sminthuridae was observed only in October (1.8) and November (0.2) and was absent during rest of the year (Table 15). Diplurans were noticed in August and December (3 numbers). Proturans were encountered from this habitat during December (3 number). The pauropods populatiton was higher (5.2) compared to symphylans (0.2). Arachnids were found to be constant varied from 0.2-0.8. The population of pterygota recorded maximum and minimum during August (2.4) and May (0.2) respectively. Population of

pterygota remained constant during rest of the period (0.6-2.2) being absent in April (Table 12). Other soil fauna such as psocids (0.2-14), Thrips (0.2-0.4), hemipterans (0.4-0.6), ants (0.2-2.0), coleopteran adult (0.6), coleopteran larvae (0.4) and dipteran larvae (0.2) were recorded (Table 17).

IV.C.3 Acacia litter

The total soil fauna obtained from this habitat showed three peaks i.e., in May (86.4), August (163.6) and November (201.2) (Table 11). The highest peak population was recorded during November. In these peaks total soil fauna exhibited a considerable fluctuation. There was a sudden increase of the population during April to May (8.4-86.4) and it was steady during May-July (86.4-82.2) and again increased upto August (163.6) to reach its maximum from August to September, with a slight decline and further increased to reach its maximum peak in November (201.2). However a sudden decline of the population was observed during December (61.8) and later became constant (Fig.27). Symphylans were noticed only during October (0.4) and pauropods in September and November (0.6 and 0.8 respectively). Among the myriapods, Chilopoda was distinctly high in this habitat compared to other forest plantations (0.2-0.8) (Table 13).

The distribution of Acari during different months in this habitat was evident (Fig.34). The total fauna with three peaks were observed in May (52.2), August (127.0) and November (166.2). However the prominent peak was in November followed by August and May. Acari was minimum in April (3.8) and more or less constant in June-July (31.8-37.4) and then there was a sudden increase during August (127.0) to reach its peak and slight fall was noticed during September (87.0) and October (83.8). The fall in population during December (61.8) was observed and later it was steady upto March (34.2-39.8) (Table 12).

The total number of oribatids obtained in this habitat showed three peaks in May (26.6), August (27.4), October and November (30.4 and 27.8 respectively). The population of Oribatei had reached more or less the same magnitude (Fig.35). Though the peak was observed in October and November, their number was almost same. The population was more or less constant from June-July (4.8-7.0) and December-March (2.8-4.2) (Table 14).

The population of Collembola which occurred in this habitat exhibited an irregular trend of fluctuation as it was maximum in June-July (31.6-32.4) minimum in April

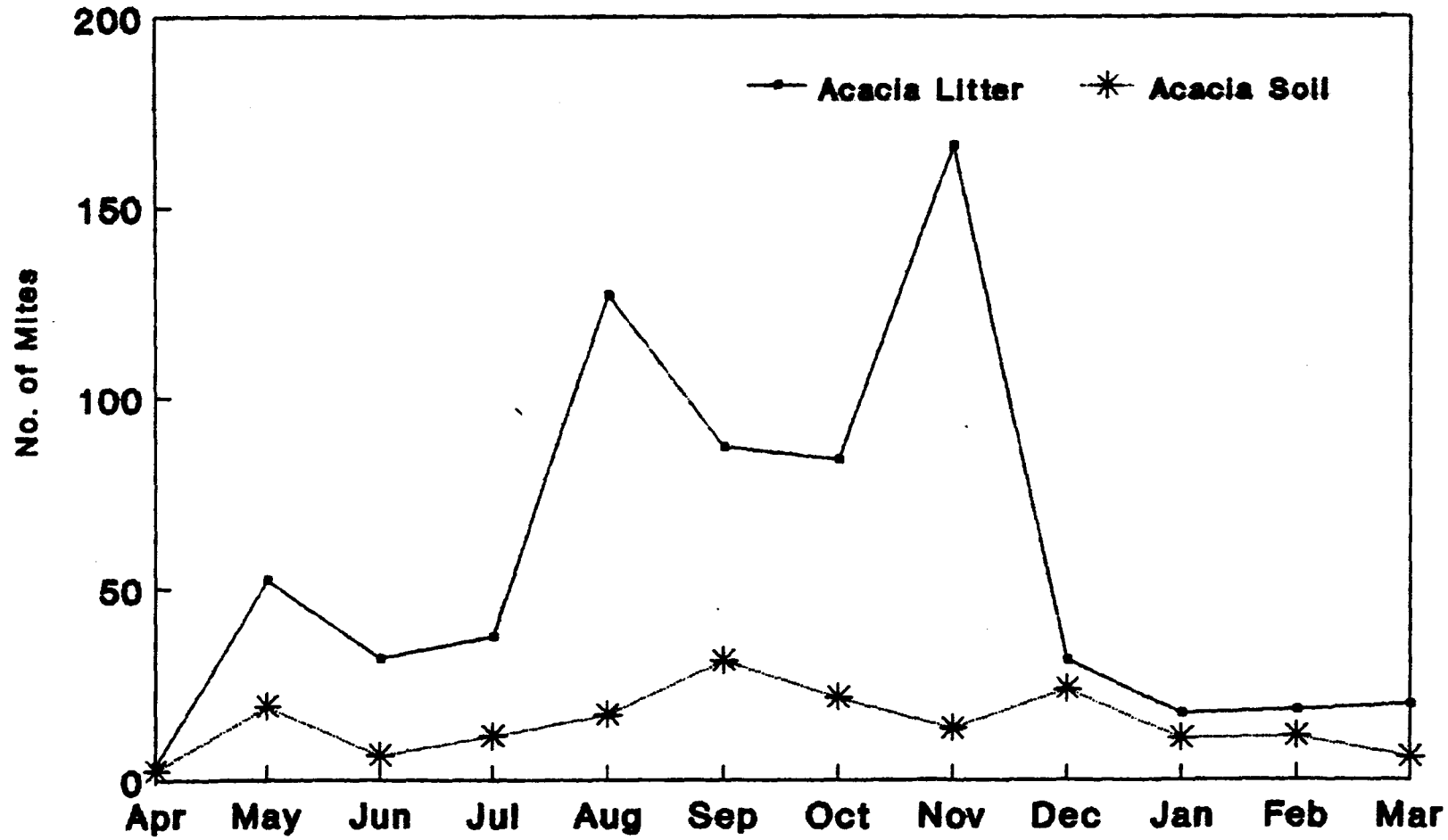

Fig.34:Distribution of Acari in Acacia plantation

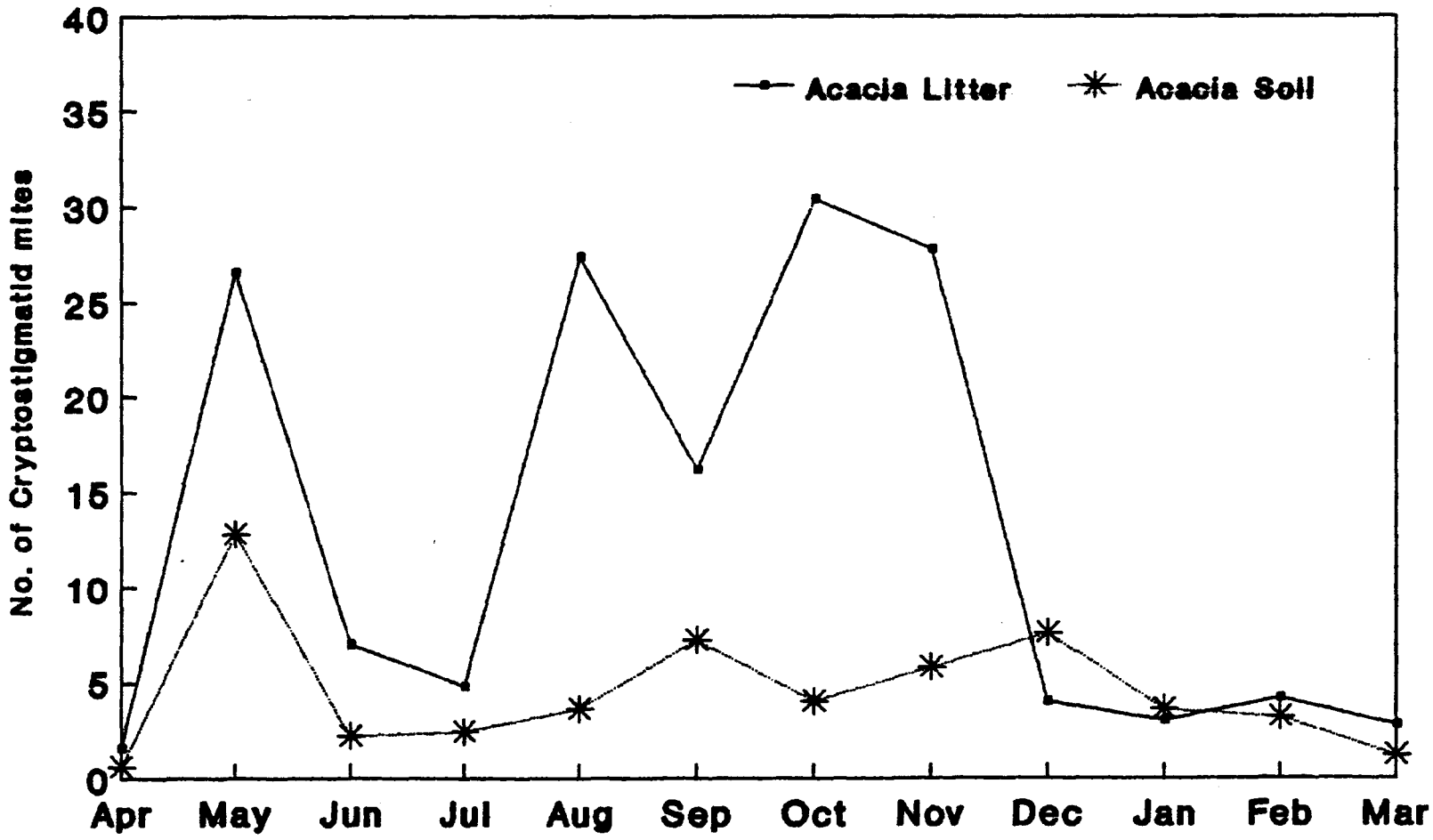

Fig.35:Distribution of Cryptostigmatid mites in Acacia plantation

(1.8) and more or less constant in August-November (18.4-24.6) followed by gradual decline upto January (8.4) there was a little rise in February (10.2) and again decreased during March (6.6) (Fig.36) (Table 12). The entomobryids in total appears to show a prominent peak with a gradual increase from April (0.2) and attained a peak in July (7.4), gradual decrease upto September (5.2) and exhibited the second peak in October (7.0) and remained constant from December-March (3.2-5.2) (Fig.37) (Table 15). The population peaks of isotomids appeared during May-June (12.0-14.0) and was least in April (0.2) (Table 15 and Fig.38). However the population oscillated during remaining period between 1.4-7.4. Hypogastruridae showed a maximum in August (8.2) and minimum in January (0.6). However the population was not recorded during May, July and March, and it was constant during rest of the period (1.4-6.0). The abundance of Brachystomellidae was maximum in June (10.4) and minimum in February (0.4). They varied between 1.0-8.2 during rest of the period (Table 15). Sminthurids were maximum during May (4.6) and was in smaller numbers during the months of June August, October, November and December (0.2-1.6). In August (0.2) and November (0.6) diplurans were observed in this habitat (Table 15).

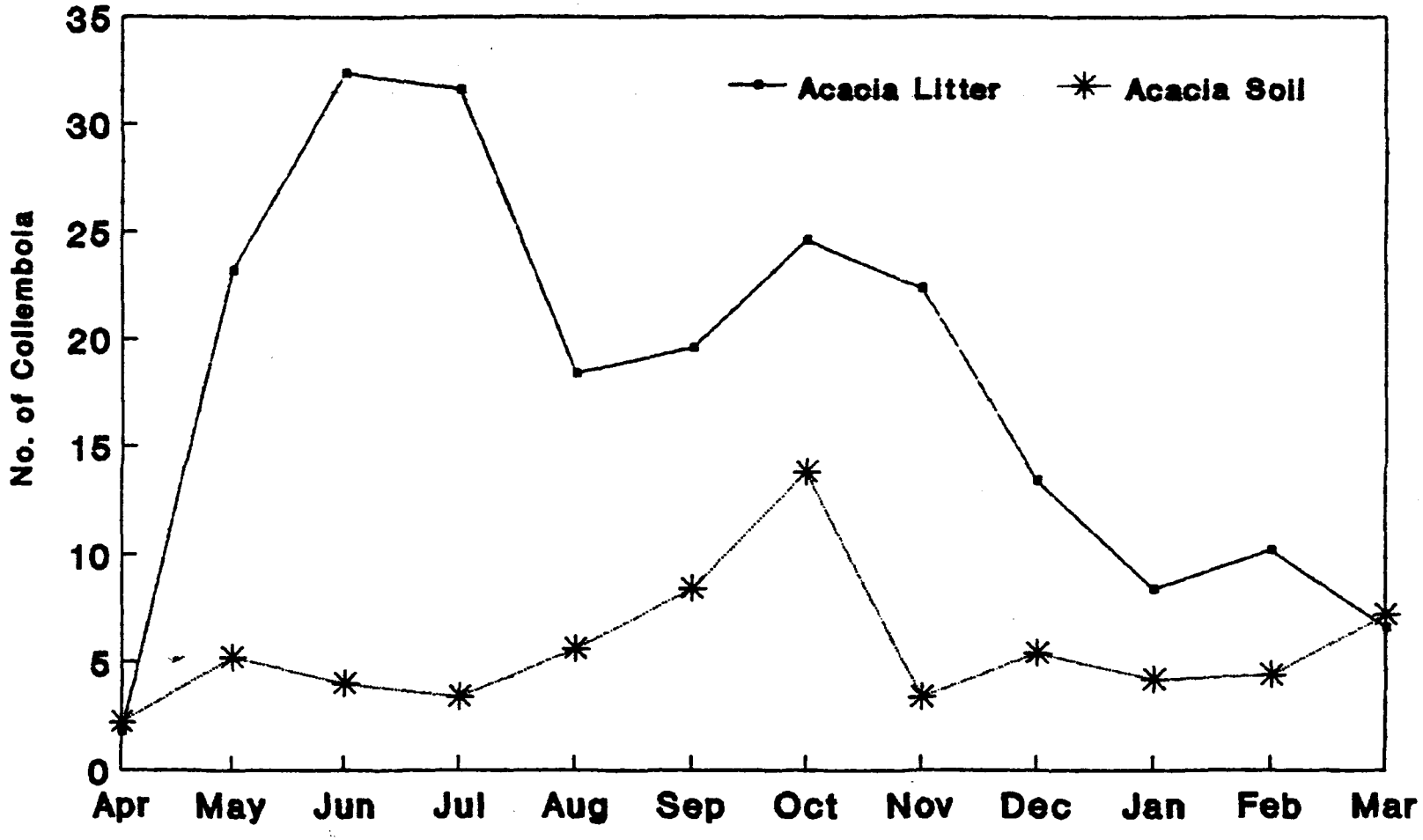

Fig.36:Distribution of Collembola in Acacia plantation

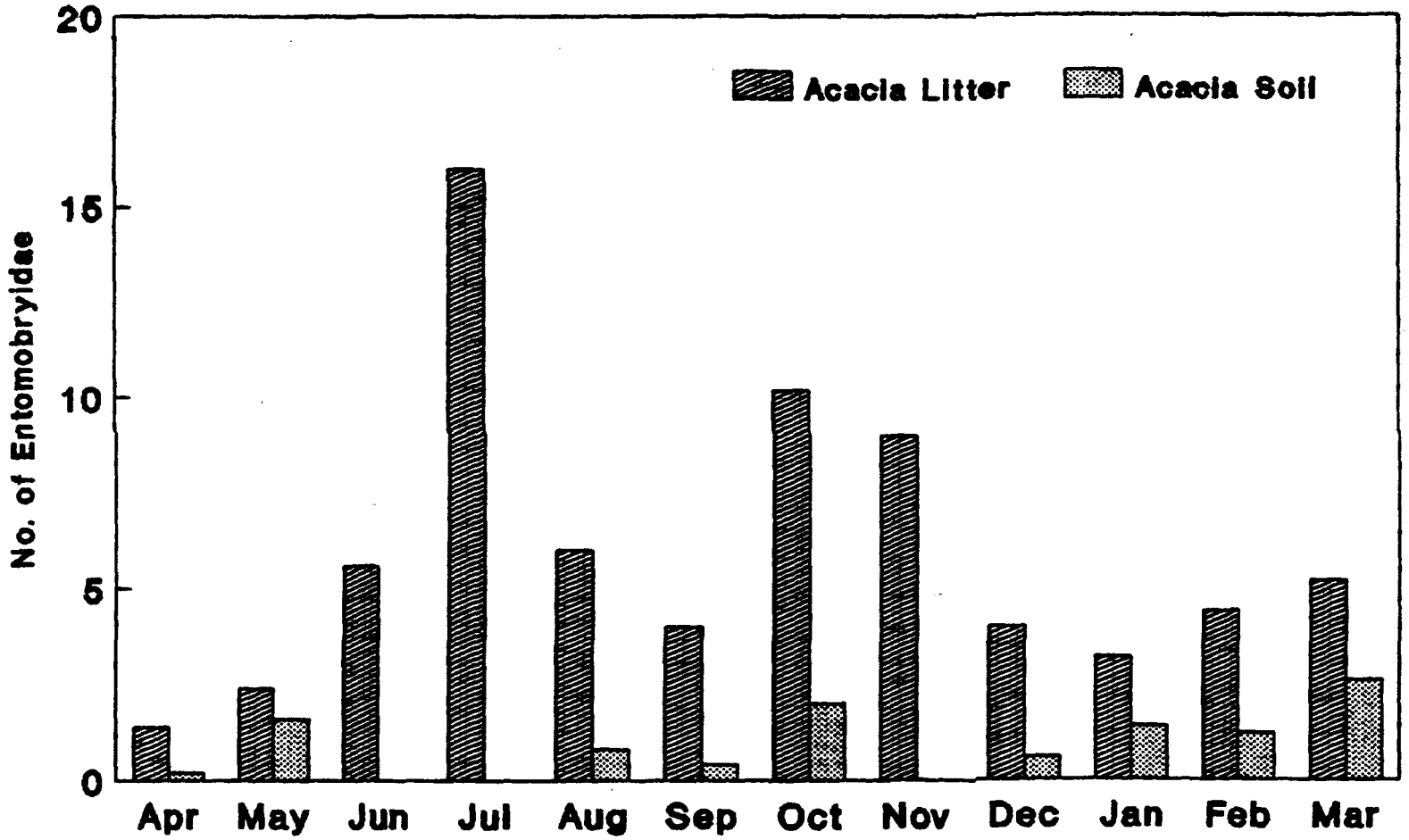

Fig.37:Population fluctuation of Entomobryidae in Acacia plantation

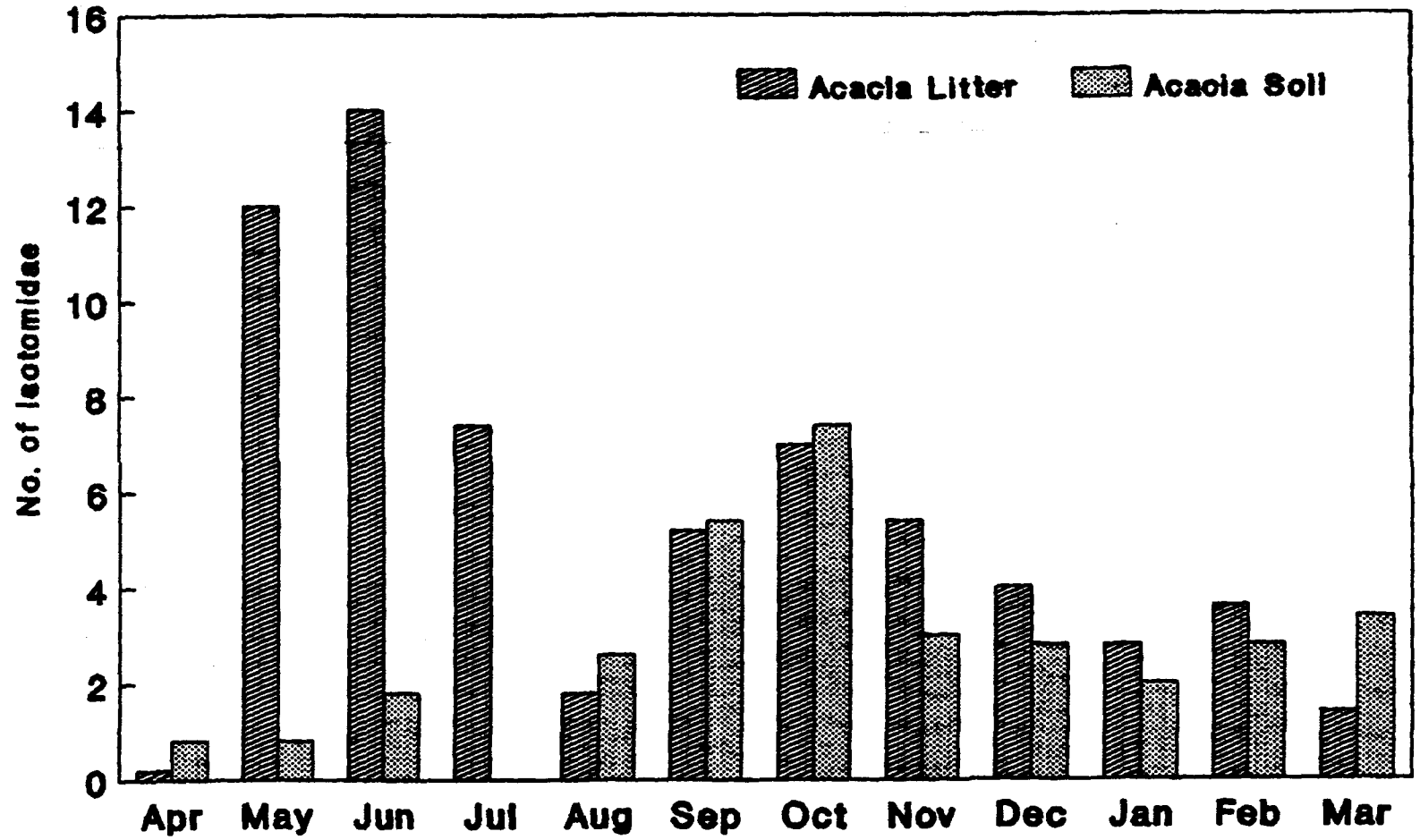

Fig.38:Population fluctuation of Isotomidae in Acacia plantation

Pterygota contributed 0.076 per cent of the total soil fauna, maximum being during August (16.8) and minimum occurred in April (2.6) (Table 12). The other arachnids was found to be maximum during September (1.6) and showed less number in remaining period being absent during April (Table 12). Psocids recorded maximum and minimum during June (5.2) and January (0.2) respectively. Thrips recorded the highest in this habitat compared to other habitats (Table 16). They were occurred through out the year and ranged from 0.2 to 7.4 during April and January respectively. The other insect fauna such as hemipterans (0.2-3.0), ants (0.4-4.2), coleopteran adults and larvae were less in number (0.2-2.2), and lepidopteran larvae (13.6) were highest in this habitat compared to rest of the habitats (Table 17).

IV.C.4 Acacia soil

The abundance of soil fauna obtained from this study site recorded the maximum number during October (39.0) and minimum during September (4.4) (Table 11). Two peaks were observed during October (39.0) and May (35.8). The population increased from April (8.0) to May (35.8) then the trend was almost steady upto August (13.0-23.8) and suddenly decreased in September (4.4).

The population increased abruptly to reach its peak during October (39.0) and there after became constant from November to March (15.6-29.6) (Fig.33). Only one isopod was recorded in January during the entire study period. Myriapods population obtained from this habitat was quantitatively (6.2) similar to eucalyptus soil and acacia litter. Pauropods ranged from 0.2-2.2 and Chilopoda 0.2-0.4. However they were not found regularly in this habitat (Table 13).

Population of Acarina was maximum during September (31.0) and minimum during April (2.4) (Fig.34). Though the population was less, three peaks were observed in May (19.2), September (31.0) and December (23.6). During rest of the period, they were distributed more or less constant. Similarly the occurrence of Oribatei showed three peaks during May (12.8), September (7.2) and December (7.6). They were more or less steady (0.6-5.8) (Fig.35) during rest of the period.

Other arachnids were considerably less (2.0) in this habitat compared to other habitats (Table 12).

The peak population of Collembola was observed during October (13.8) followed by September (8.4) and March (7.2) (Fig.36). Population remained constant

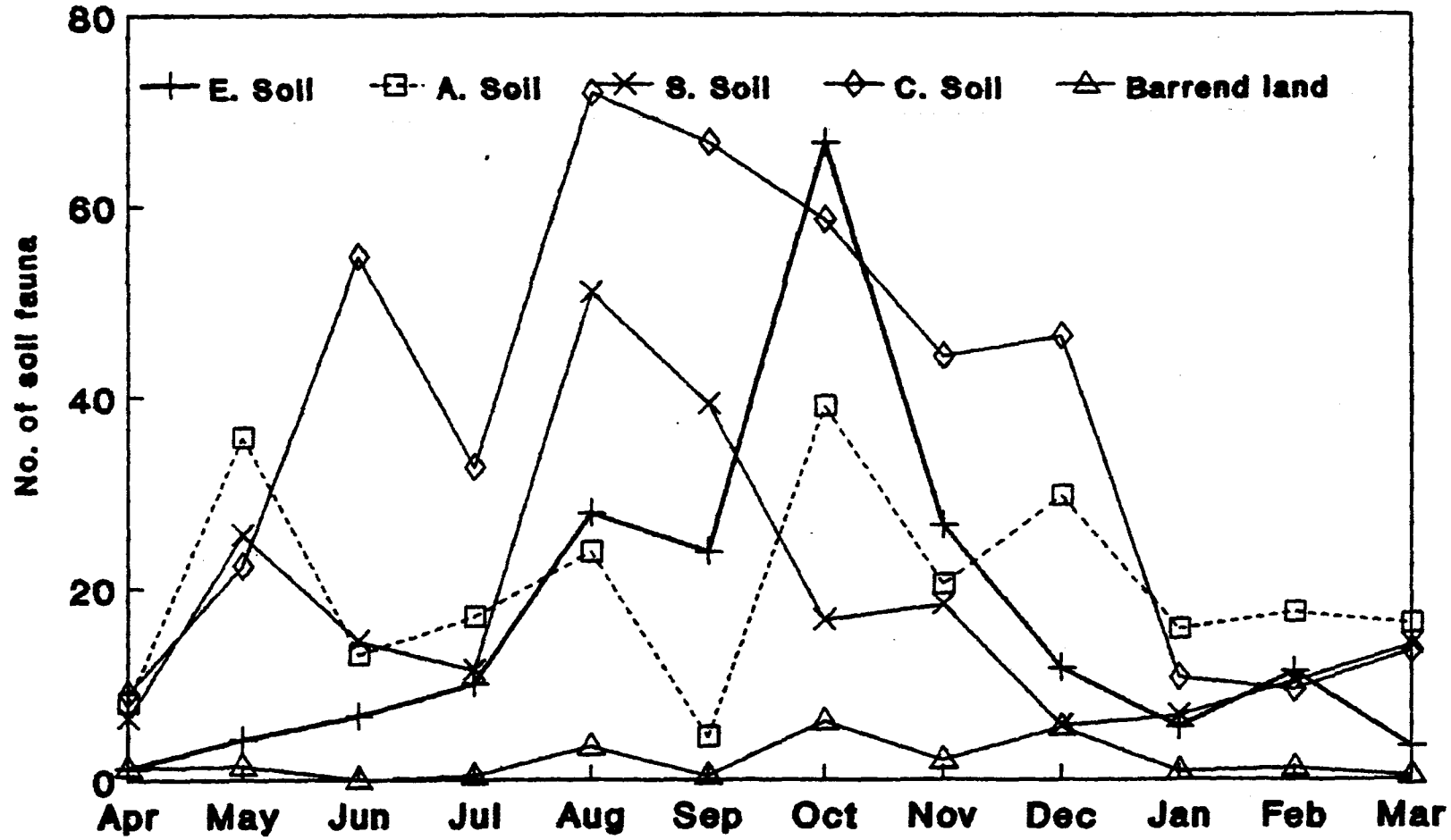

Fig.33: Distribution of soil fauna in different soil habitats

during rest of the period (2.2-5.6) (Table 12). A maximum of 2.6 entomobryids were noticed during March (Fig.37). However their population declined during September (0.4) and December (0.6) and was constant during the remaining period (Table 15). Isotomids were less abundant (32.8) when compared to eucalyptus habitats. However, the maximum peak was recorded in October (7.4) followed by September (5.4). Minimum occurred in April and May (0.8) (Table 15 and Fig.38). The mean number of Hypogastruridae ranged from 0.2-3.0 and Brachystomellidae were not noticed regularly in acacia soil. However the maximum number was found in July (2.6). Population varied between 0.4-1.4 during other period. Sminthurids were least abundant in the acacia soil (1.4) compared to other habitats. They were noticed only during May (1.2) and February (0.2) in this study site. Diplura and Protura were found during October (0.4) and May (0.4) repectively (Table 15).

Mean number of Pterygota ranged from 0.4 in January to 10.6 in May. Population varied from 0.6-2.6 during remaining period except in June where they were absent (Table 12). The other soil insects include psocids (0.2-0.6), thrips (0.2-0.4), hemipterans (0.2-0.6). Ants population was maximum (8.8) in May and absent in June-July and December, they remained constant (0.2-2.4)

during other period. Coleopteran adults and larvae recorded 0.4 and 1.4 respectively. Lepidopteran larvae (0.4) and dipteran larvae (0.4-1.6) were also noticed in this habitat (Table 17).

IV.C.5 Silver oak litter

The total soil fauna was minimum (6.4) and maximum (82.2) during April and September respectively (Table 11). The population exhibited the same trend during April-May. The population increased during May (31.8) then declined during July (27.8). There was a gradual increase of population which reached a peak in September (82.2) (Fig.27) and again declined slightly in October (46.2). The second peak was attained during November (59.0) later there was a sudden decline in December (19.0) and then the population became almost constant during the remaining period.

Total population of Acari followed a fluctuating trend of total soil fauna which exhibited only one peak during September (65.0) (Table 12 and Fig.39). Oribatei showed maximum number during November (11.4) (Fig.40). However the number was constant (10.8) in August-September. During April it was least abundant similar to all other habitats (0.4) (Table 14).

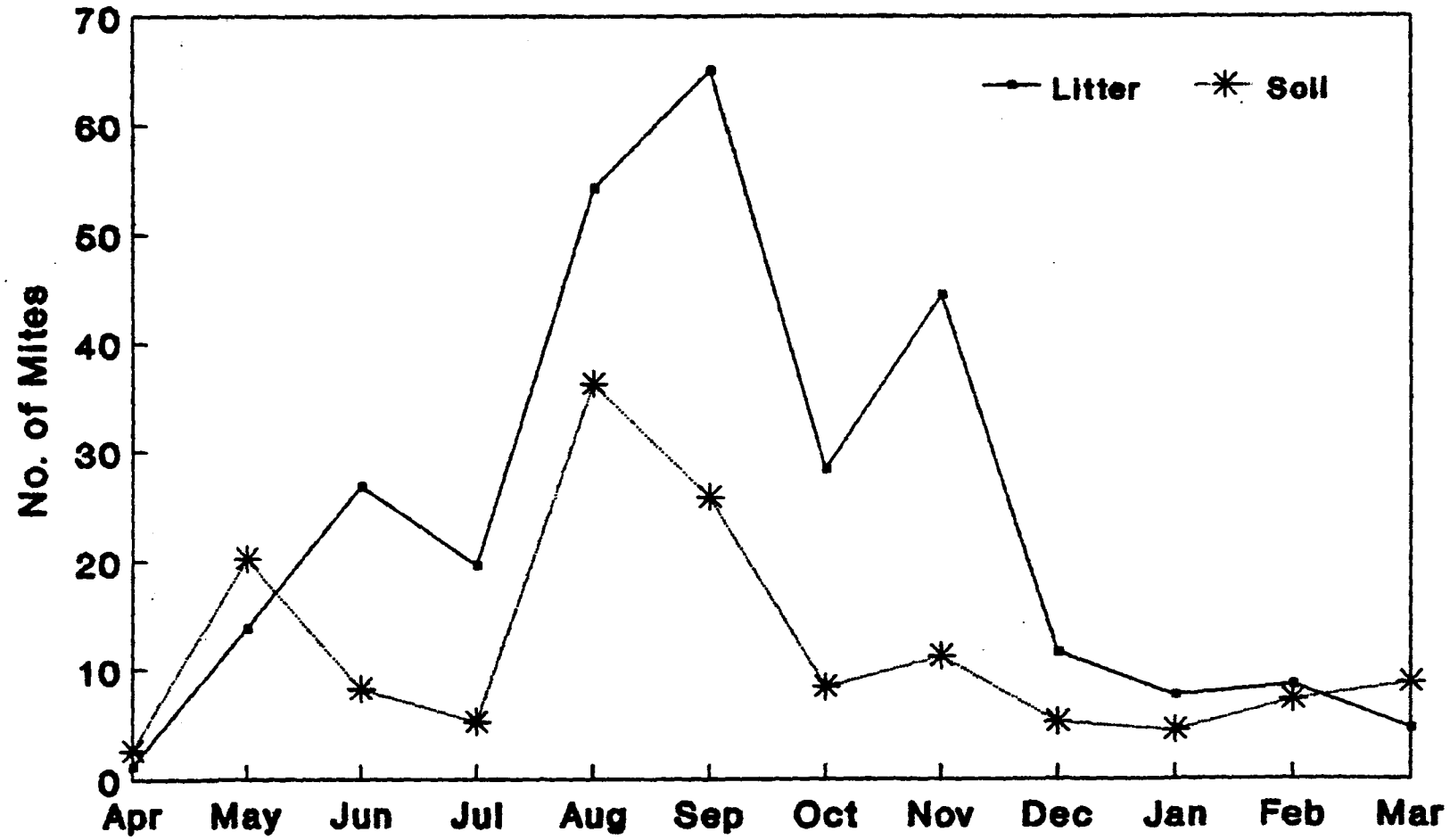

Fig.39:Distribution of Acari in silver oak plantation

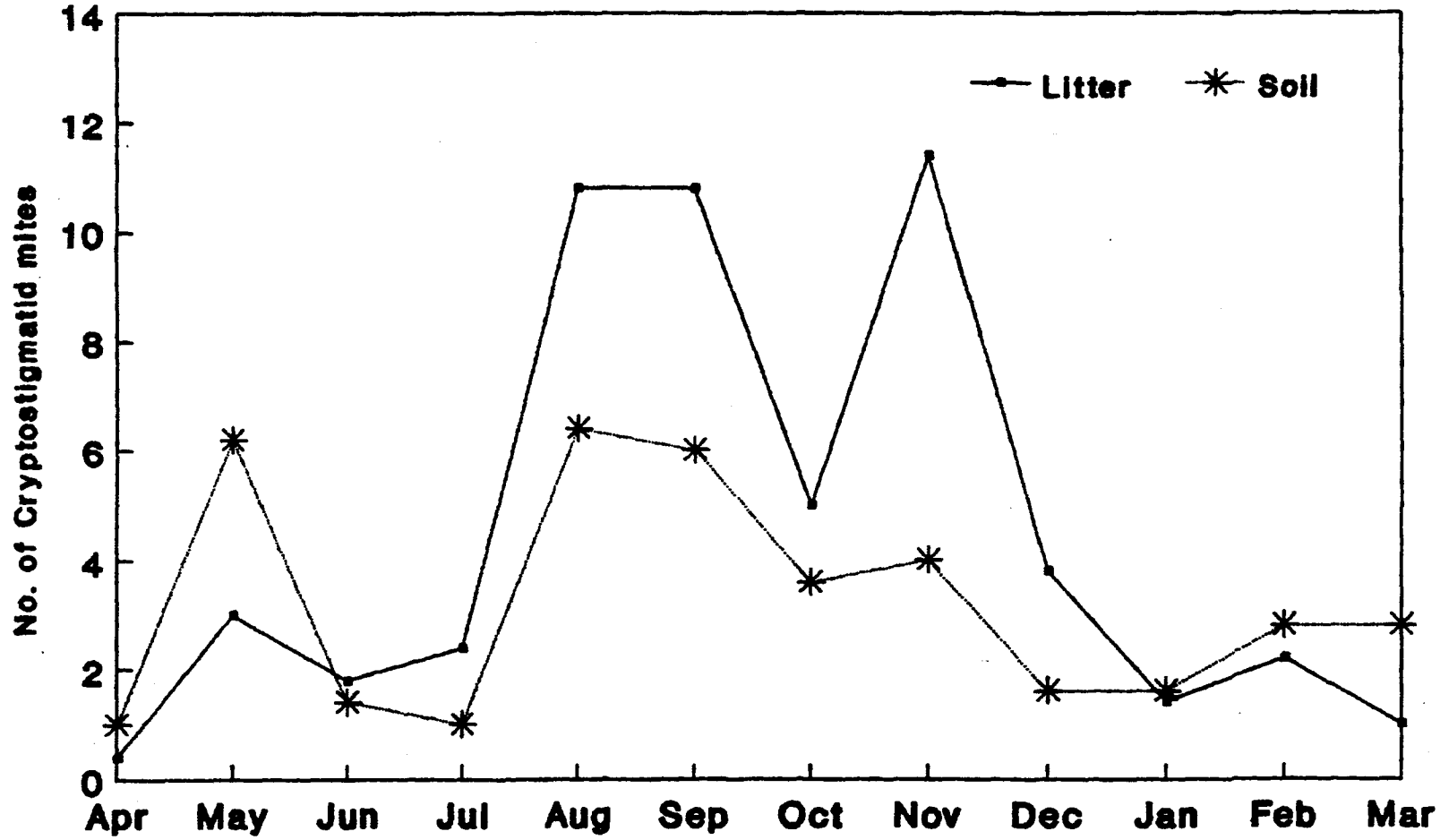

Fig.40:Distribution of Cryptostigmatid mites in silver oak plantation

During August and November isopods were encountered (0.4-1.0). Diplopods were more (1.4) compared to Chilopoda (0.4). This was the only habitat which recorded the least number of myriapods during the study period compared to other forest habitats. Other arachnids were maximum in August (2.0) and minimum in May and July (0.4) (Table 12).

The collembolan fauna observed from this habitat was (70.4) comparatively less than the eucalyptus (172.0) and acacia litter (212.8) (Table 12 and Fig.41) showed that the population in April-May (3.4) had almost remained constant. Then population increased gradually in June (6.2) with a slight decline during July (3.4). The fauna gradually increased and their number almost remained same the maximum was during August (9.6), September (10.6) and October (9.2) compared to other period. Further it gradually decreased and became more or less constant. Maximum Entomobryidae was recorded during October (3.8) and minimum in September (1.0) (Table 15 and Fig.42). However, the population was constant in November and March (2.2-3.2). Isotomidae fluctuated from 0.20 (May) to 3.0 (November). The two peaks (Fig.43) were noticed, the prominent being in November and other during September (2.2) and October

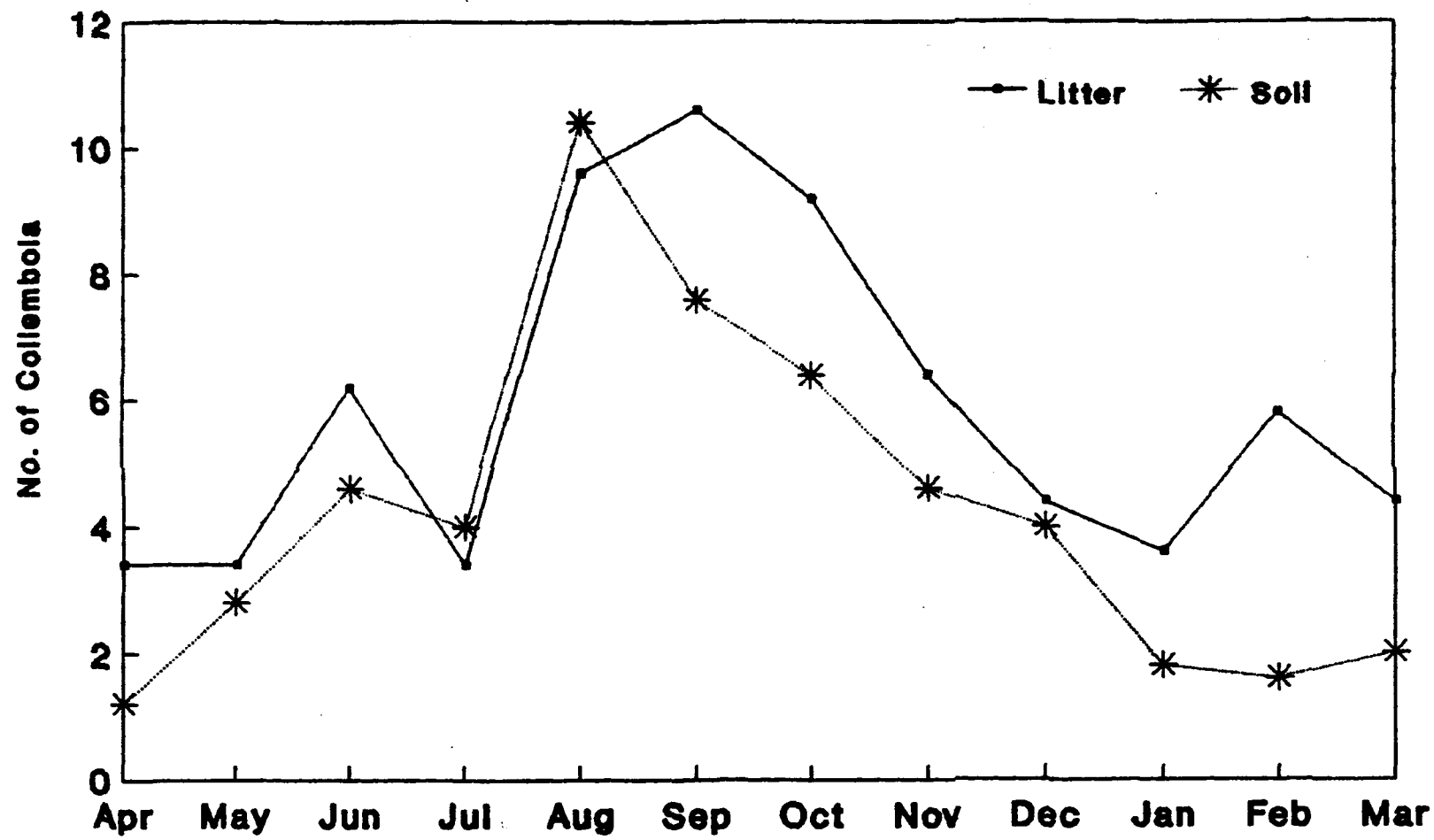

Fig.41:Distribution of Collembola in silver oak plantation

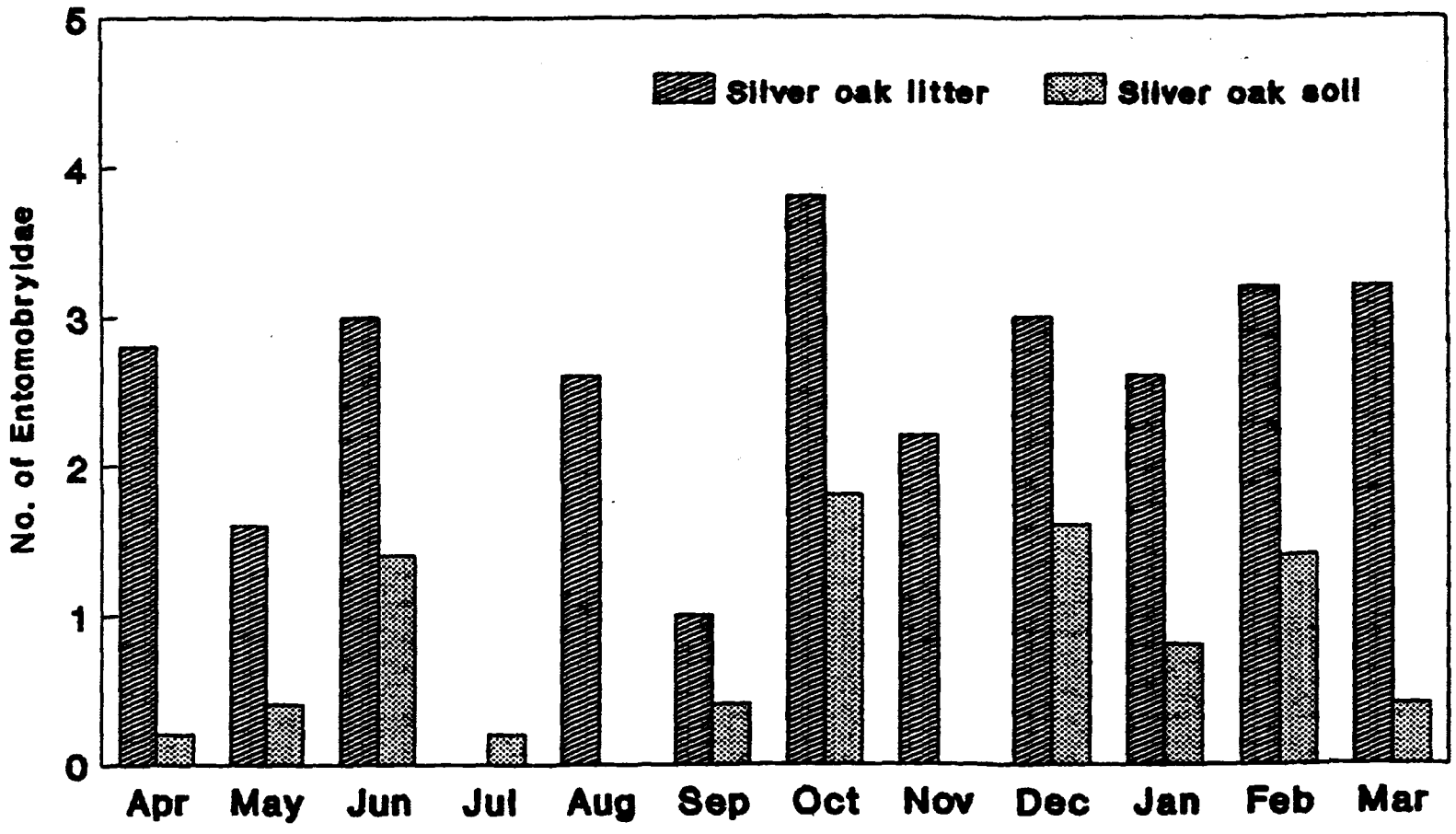

Fig.42:Population fluctuation of Entomobryidae in Silver oak plantation

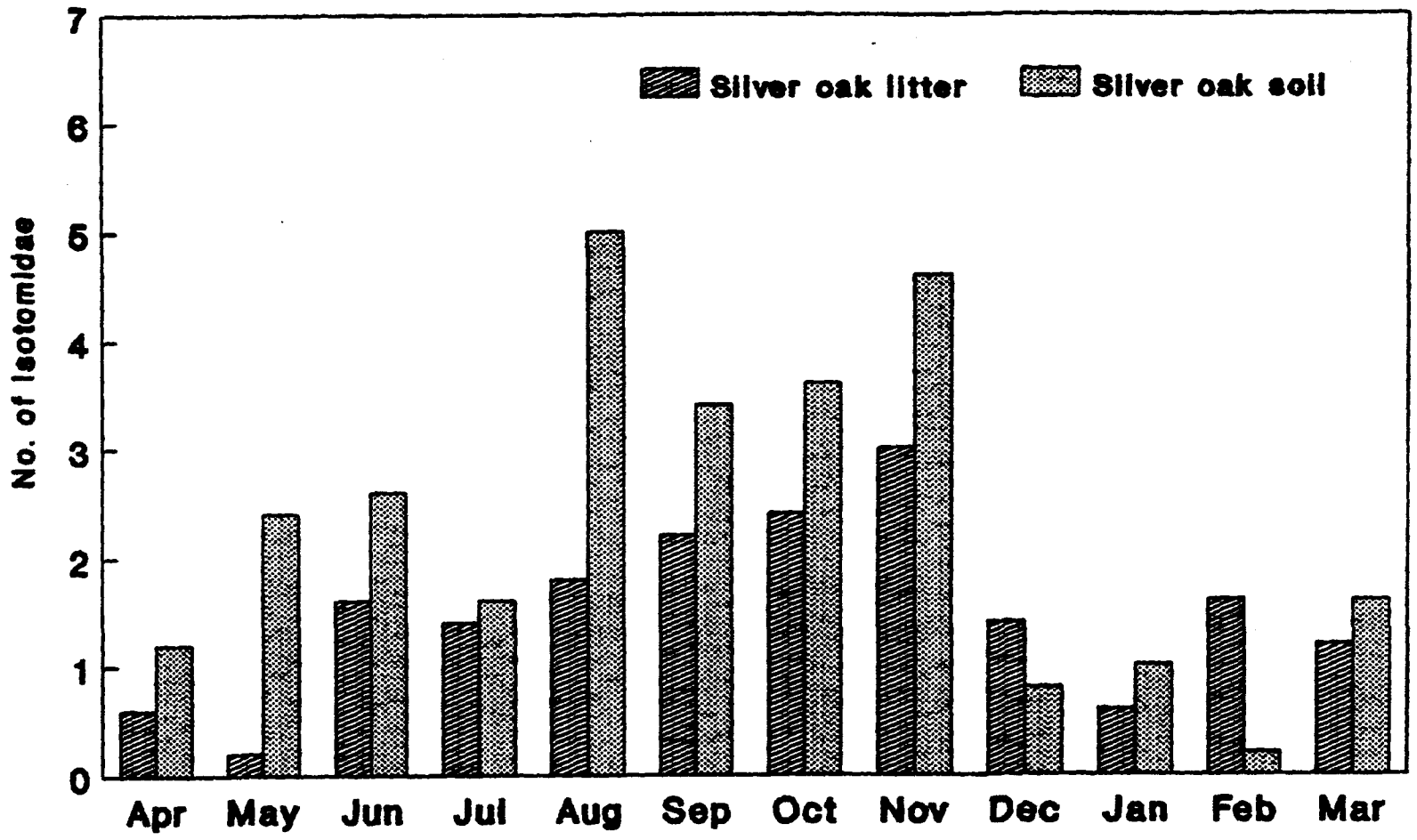

Fig.43:Population fluctuation of Isotomidae in Silver oak plantation

(2.4). The population was constant (0.6-1.8) during the rest of the period (Table 15) Members of Hypogastruridae were not found regularly. However they varied between 0.2-3.8 (January-August respectively). Brachystomellidae encountered only during August, November and January (0.2-1.4). Similarly sminthurids were recorded during October, November and February (0.4-1.0). Diplurans recorded during January and March was 0.2 to 0.4 (Table 15).

The pterygota fauna exhibited two peaks in June (10.2) and May (8.2). Population remained constant during October and February (7.6). During rest of the period the pterygota population varied from 1.8-6.4 (Table 12). Psocids and thrips varied from 0.2 (April, February and March) to 1.6 (June) and 0.8 (August) to 3.8 (October) respectively (Table 16). The other fauna such as hemipterans (0.2-0.4), ants (0.4-1.2), coleopteran adults (0.2-0.8), coleopteran larvae (0.2-5.4), lepidopteran larvae (0.2-1.2) and dipteran larvae (7.0) were also recorded (Table 17).

IV.C.6 Silver oak soil

The soil fauna attained its peak during August (51.0). As in the previous habitats, the population increased from April (6.4) to May (25.6) and it declined

in July (11.4) and from July onwards, a sudden increase in population was observed and reached its maximum peak in August (51.0), later it gradually decline till December (5.6) (Table 11 and Fig.33).

Isopods were recorded during April (0.8) and August (0.2). Myriapods population ranged from 0.4-1.0, maximum symphylans were encountered from this habitat (0.2-0.6). Pauropods were found only in August and September (0.2-1.0). However, there was only one chilopod noticed during August (Table 13).

Distribution of Acari in this habitat followed the fluctation pattern of total soil fauna where the peak population was observed during August (36.2) (Table 12 and Fig.39). As seen in most of the habitats minimum number of Acari were noticed during April (2.6). Oribatei exhibited the maximum number in May (6.2), August (6.4) and September (6.0). As could be seen from Fig. 40 there was a decline of population from June-July (1.0-1.4) and was more or less constant from December to March (1.6-2.8). Other arachnids were very few (0.2-0.8) compared to remaining habitats.

Collembolan fauna was maximum during August (10.4) (Fig.41). Entomobryids in this habitat were less (8.6)

abundant compared to other habitats (Fig.42). Isotomids recorded throughout the study period and August showed maximum number (5.0) (Fig.43) and minimum (0.2) in February. Members of Hypogastruridae were less in their abundance (8.2) compared to all other habitats studied. Brachystomellidae were found during July (0.6) and September to October (0.6-1.0). Sminthurids was noticed only during June (0.6), August (3.2) and September (0.4). Diplura occurred during August-September (0.2) (Table 15).

The mean number of Pterygota were fluctuated between 0.4 and 4.4 during December and September respectively (Table 12). Thrips (2.6), Hemiptera (0.2), ants (0.4-2.8), coleopteran adult (0.2-0.6), coleopteran larvae (0.2-0.8), lepidopteran larvae (0.6) and dipteran larvae (0.2) occurred in this habitat (Table 17).

IV.C.7 Casuarina litter

The maximum total soil fauna was contributed by this habitat. Soil fauna was maximum during August (245.20) and minimum in April (18.40) (Table 11).

There were two prominent peaks during August (245.20) and November (225.60). The population gradually

increased from April (18.40) to July (66.60) and suddenly raised from July-August (66.6-245.20) to reach its peak in August. Then the population decreased during September (154.0) and October (123.0) and once again increased in November (225.6). Further it was decreased in February (22.2) and again increased during March (41.0) (Fig.27).

The maximum number of isopods were encountered from this habitat (2.2) (Table 12). Similarly the highest number of myriapods were recorded (0.2-2.6) from this habitat compared to remaining habitats (Table 12). Symphyla and pauropods were noticed during March (0.8) and August-November (0.6-1.4) respectively. Chilopoda fluctuated from 0.2-1.0. Diplopods recorded the highest number (10.2) in this habitat compared to other forest habitats. Other arachnids were also maximum (38.6) in casuarina litter compared to rest of the habitats (Table 12).

The population of Acari gradually increased from April (6.0) to July (39.0). It increased suddenly from July and reached its maximum peak during (August (164.8) and declined to 72.4 during October and again increased, to reach its second peak during November (102.0). Further the population suddenly declined in February

(6.4) and a slight increase of population was seen in March (22.80) (Table 12 and Fig.44).

The population of Oribatei exhibited two prominent peaks during August (51.80) and November (39.60). Population did not fluctuate during May to July but the population declined in October (10.8) and December (6.80). (Table 14 and Fig.45).

The total number of Collembola obtained from casuarina litter was the maximum (313.8) compared to all other habitats studied. They fluctuated from 3.20 (April) to 105.4 (November). There were two peaks (Fig.46) the prominent being in November (105.4) and a less pronounced in August (52.8). However, the population became constant during June-July (13.8-14.4) (Table 12). This habitat contributed the maximum number of Entomobryidae (31.40) (Fig.47) during November. In addition, a small peak was noticed during December (6.2). During the remaining period their population ranged from 1.8 to 5.6. In case of Isotomidae three peaks occurred in November (20.60) October (17.0) and August (15.80) (Table 15) and Fig.48). Their population declined twice during April (0.8) and February (1.2). However, they showed a narrow range of fluctuation (1.8-4.4) during remaining period. Hypogastruridae were

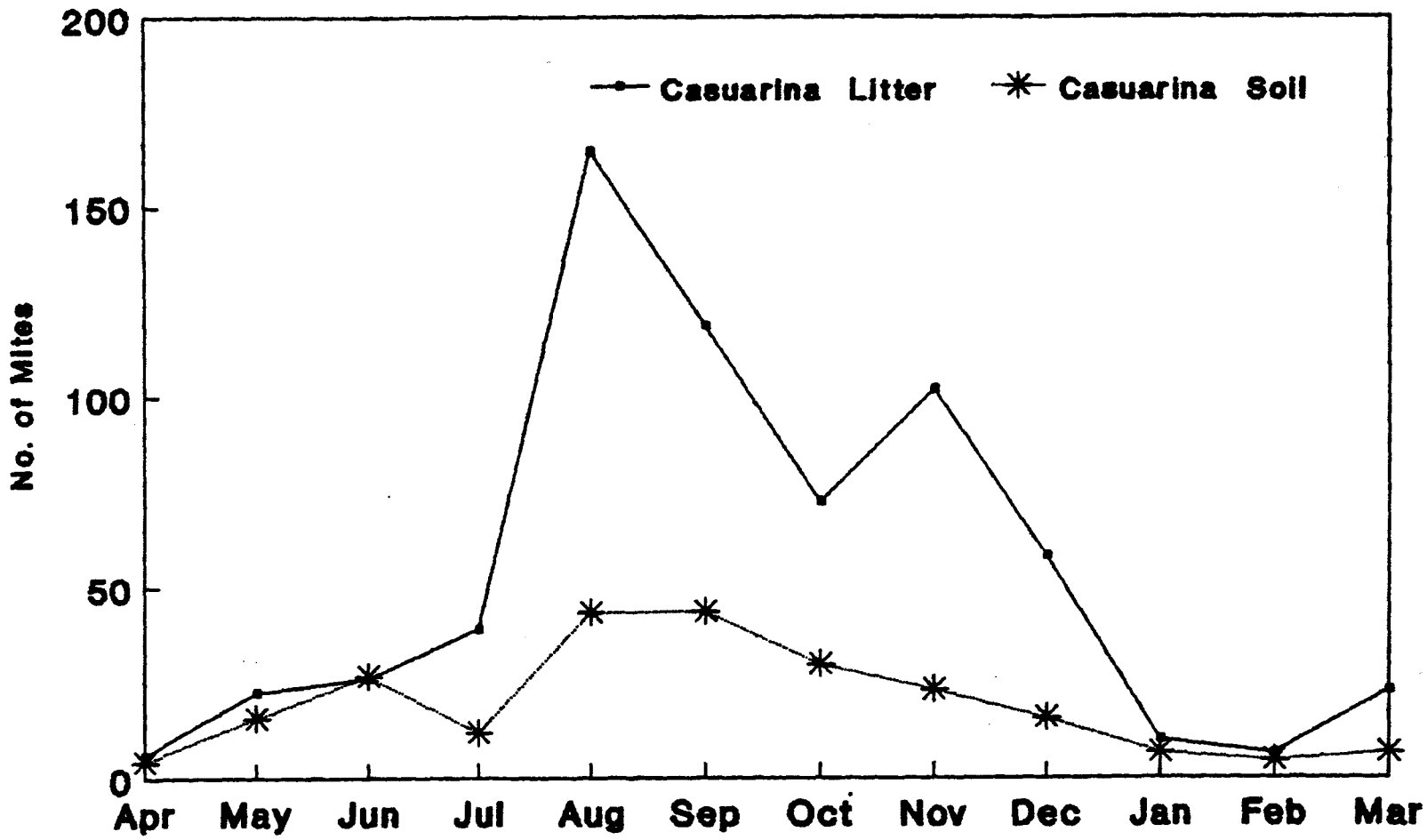

Fig.44:Distribution of Acari in Casuarina plantation

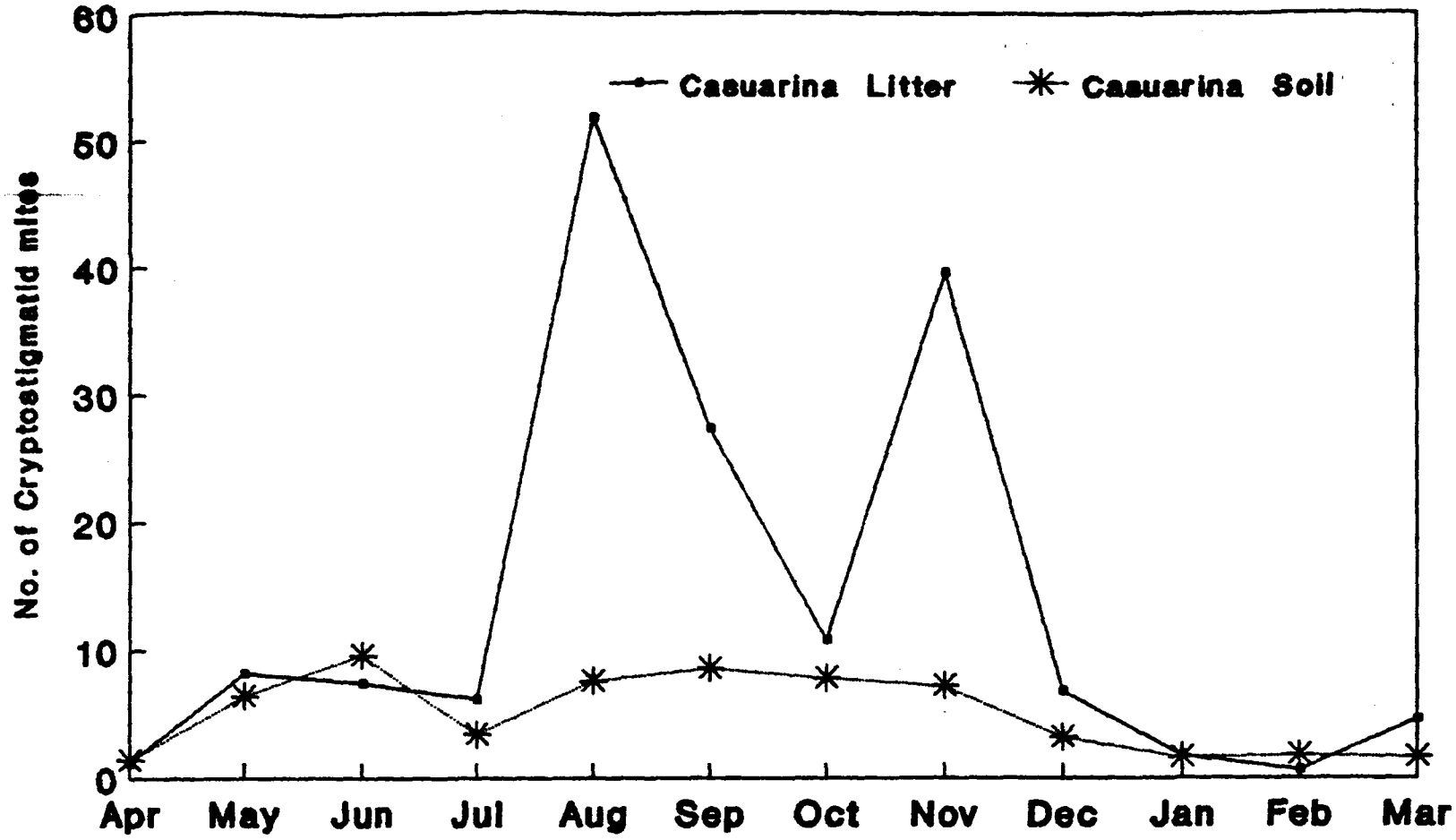

Fig.45:Distribution o6 Cryptostigmatid mites in Casuarina plantation

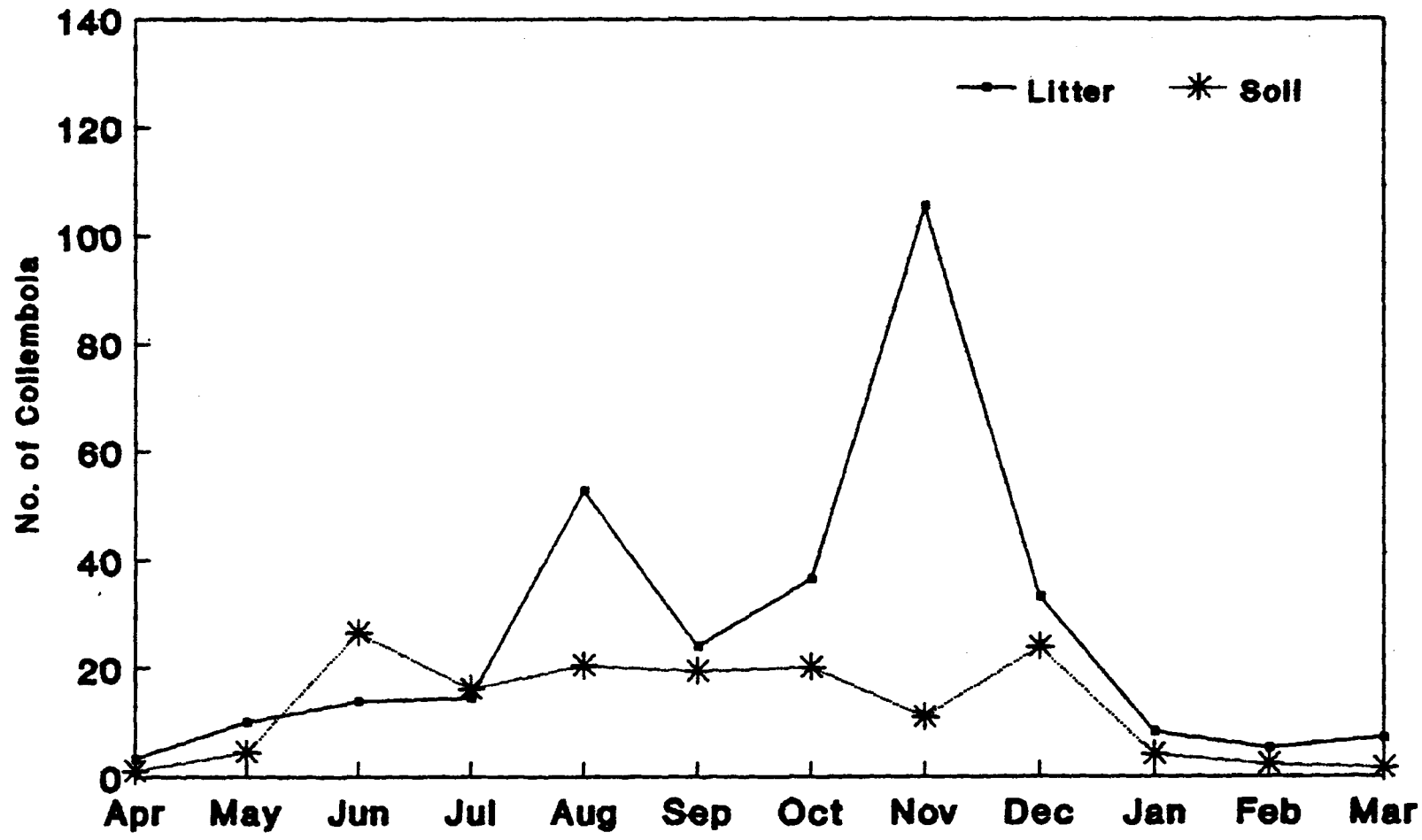

Fig.46:Distribution of Collembola in Casuarina plantation

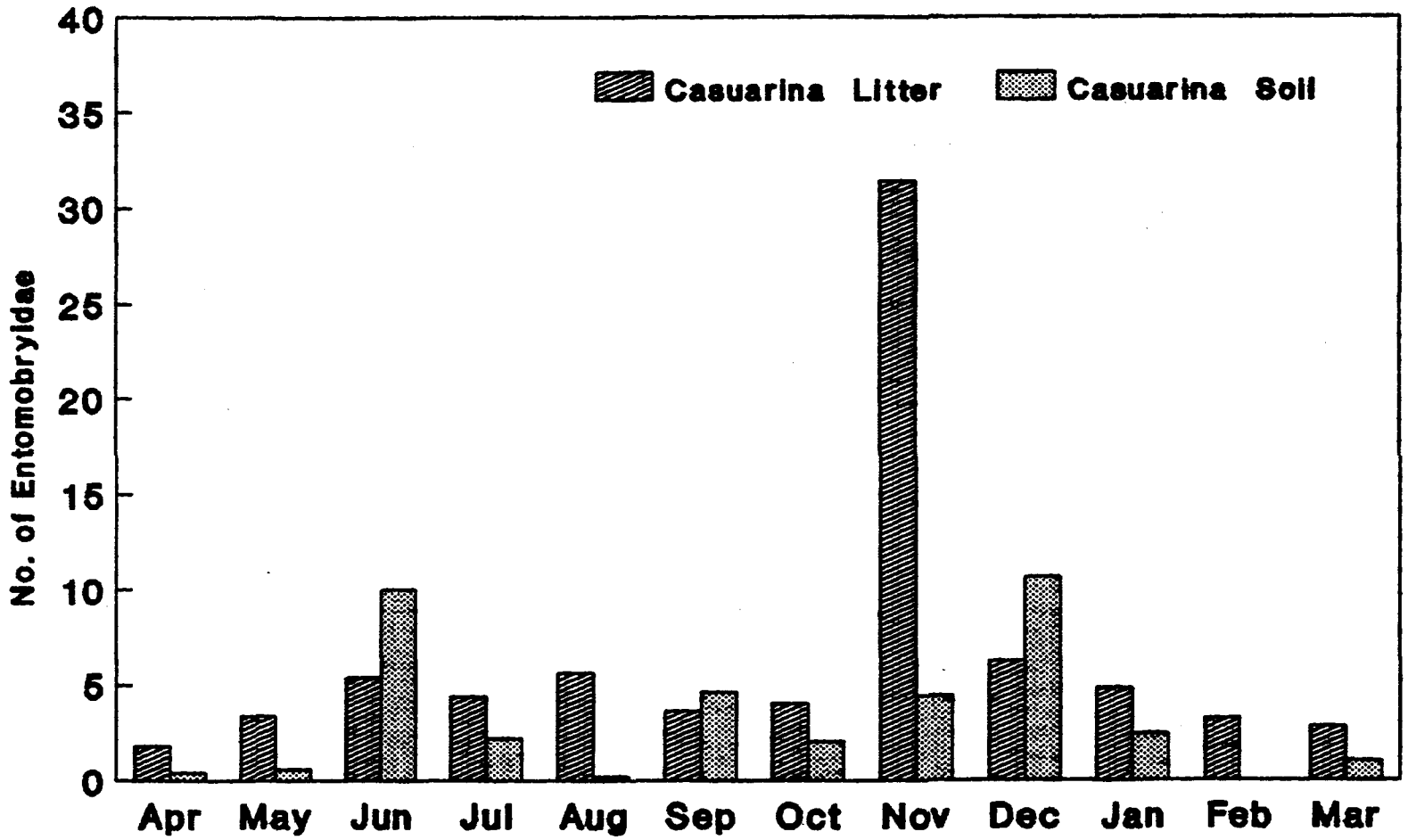

Fig.47 Population fluctuation of Entomobryidae in Casuarina plantation

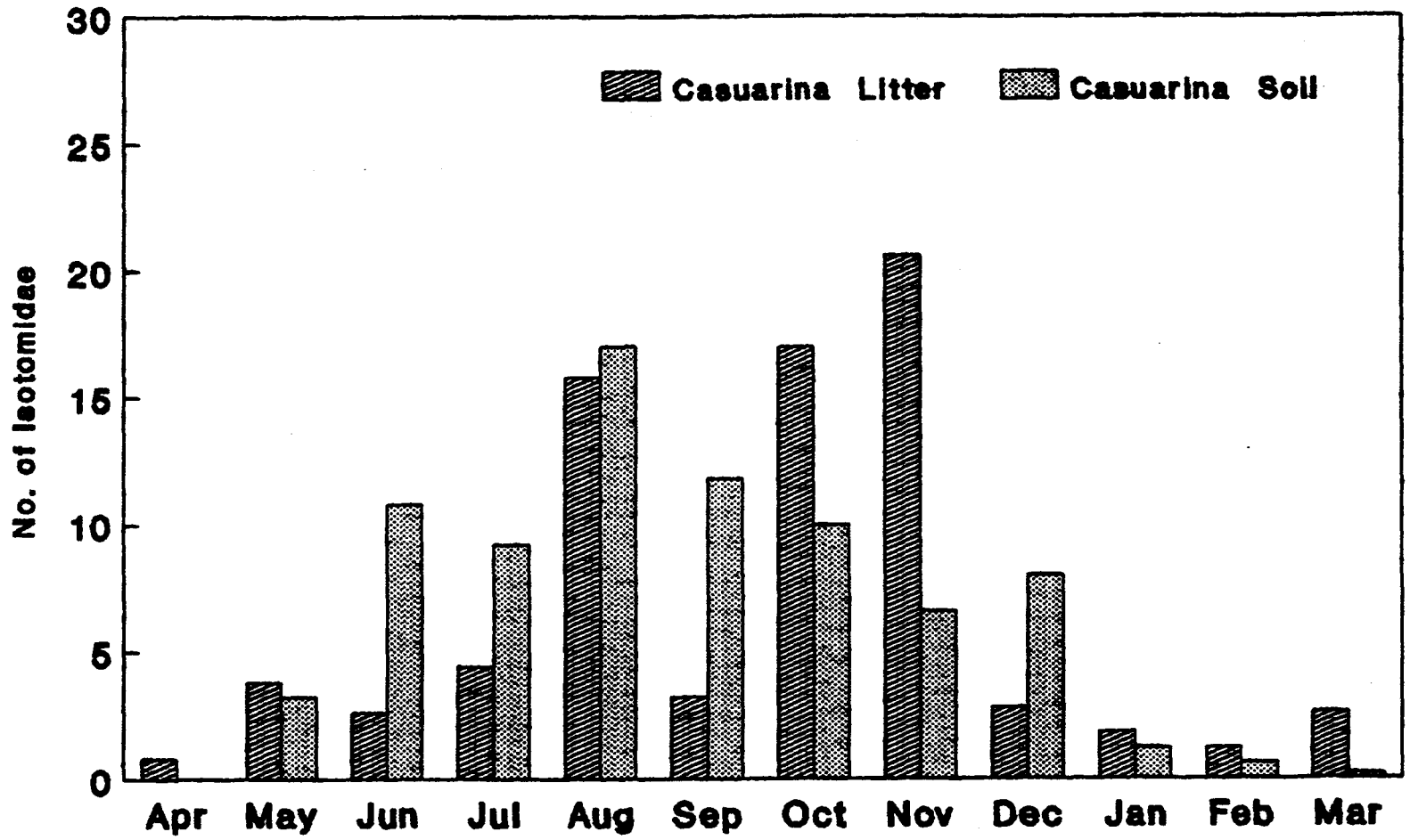

Fig.48 Population fluctuation of Isotomidae in Casuarina plantation

considerably more (86.8) compared to Entomobryidae and Isotomidae (76.6). Similarly they were highest in this habitat compared to all other habitats. However, maximum population was recorded in November (21.20) and August (21.60). Brachystomellidae (21.2) and Sminthuridae (8.6) was found maximum during November (Table 15). Diplurans were recorded during April (0.2) and March (1.4).

Pterygota reached a maximum population (18.60) during August and minimum (3.4) in May. Mean number of population ranged from 4.0 (June) to 13.0 (November) during other period (Table 12). Psocids observed maximum (7.0) in August, they were absent in April, January and March. Thrips (0.4-6.4), Hempitera (4.0) (Table 16) ants (0.6-2.8), coleopteran larvae and adults (0.2-1.6), lepidopteran larvae (7.0) and dipteran larvae (0.2-2.6) were also recorded in this habitat (Table 17).

IV.C.8 Casuarina soil

In this habitat, the total soil fauna was maximum (71.8) during August and lowest (9.0) in April (Table 11). The population increased (22.4-54.8) during May-June, then decreased during July (32.6) and suddenly reached its peak in August (71.8). Population declined slowly in October (58.6) and became constant till

December (44.2-46.4), again the population decreased during January, February and March (9.4-13.4) (Fig.33).

Isopods occurred during October (0.8), February (0.2) and March (0.4). Myriapods recorded highest in August (4.6). Pauropods were more (9.2) compared to remaining habitats throughout the study period. Symphylans was represented by 5 numbers. Chilopoda observed only during April (0.2) and in March (0.2). Diplopods population varied from 0.2-0.4 (Table 13).

The highest Acari population was recorded in August (43.40) and September (43.60). The lowest population was found in April (4.2) and February (4.4). The population increased from April slowly upto June (26.6) and again decreased during July (11.8) and they increaed slowly to reach the maximum in August (43.40) and September (43.60) (Table 12 and Fig.44). There was a fall in the population from September (43.6) to February (4.4).

Oribatei encountered from this habitat was maximum abundant in June (9.6) and was lowest during April (1.4). The population was more or less steady from August to September (7.2-8.6) (Table 14 and Fig.45).

The total collembolan population showed two peaks during June (26.40) and December (23.80) (Fig.46). The

fall in population was found in January to March (4.0-20.4). Similarly entomobryids were maximum during June (10.0) and December (10.6) (Fig.47). Population declined during April (0.4), May (0.6) and August (0.2) and during other period the population varied between 1.0-4.6, being absent in February. Isotomidae recorded highest (79.2) from this habitat compared to all other habitats. Majority of the collembolan fauna was formed by istomids (Table 15 and Fig.48). However there were two peaks prominent being August (17.0) and September (11.8). Members of Hypogastruridae and Brachystomellidae was found maximum in October (3.4) and June (3.4) respectively. However, sminthurid population was meagre (2.8). The highest number of Diplura and Protura were recorded from this habitat (1.6 and 1.0 respectively) (Table 15).

Maximum and minimum number of Pterygota was noticed in November (7.4) June (1.4) and September (1.4) respectively (Table 16). Other soil fauna such as psocids and thrips were 1.6 and 4.0 respectively. Hemipterans (0.2-1.0), ants (0.2-0.4), coleopteran larvae (0.2-1.2), lepidopteran larvae (0.6) and dipteran larvae (1.8) were also present (Table 17).

IV.C.9 Barren land

Soil faunal abundance in this habitat was very poor compared to forest habitats. However, the highest number of soil fauna were encountered during October (6.0) and December (5.4). Their number was least during July (0.4) and September (0.4) (Table 11). Acarina formed bulk of the fauna in barren land. However three peaks were observed during August (3.4), October (6.0) and December (4.8) (Table 12 and Fig.49).

IV.D The effect of Eucalyptus plant parts on soil fauna

A preliminary observations were made to find out the effect of eucalyptus on soil fauna under pot culture experiment. The changes in the chemical properties as influenced by addition of eucalyptus plant parts over a period of six months are presented in Table 18.

a. pH

There was a significant decrease in the soil pH content with incorporation of eucalyptus plant parts compared to control. The maximum pH was 5.64 recorded in soil treated with eucalyptus floral parts (15g/kg soil) and the minimum was 5.51 due to addition of eucalyptus bark (15g/kg soil).

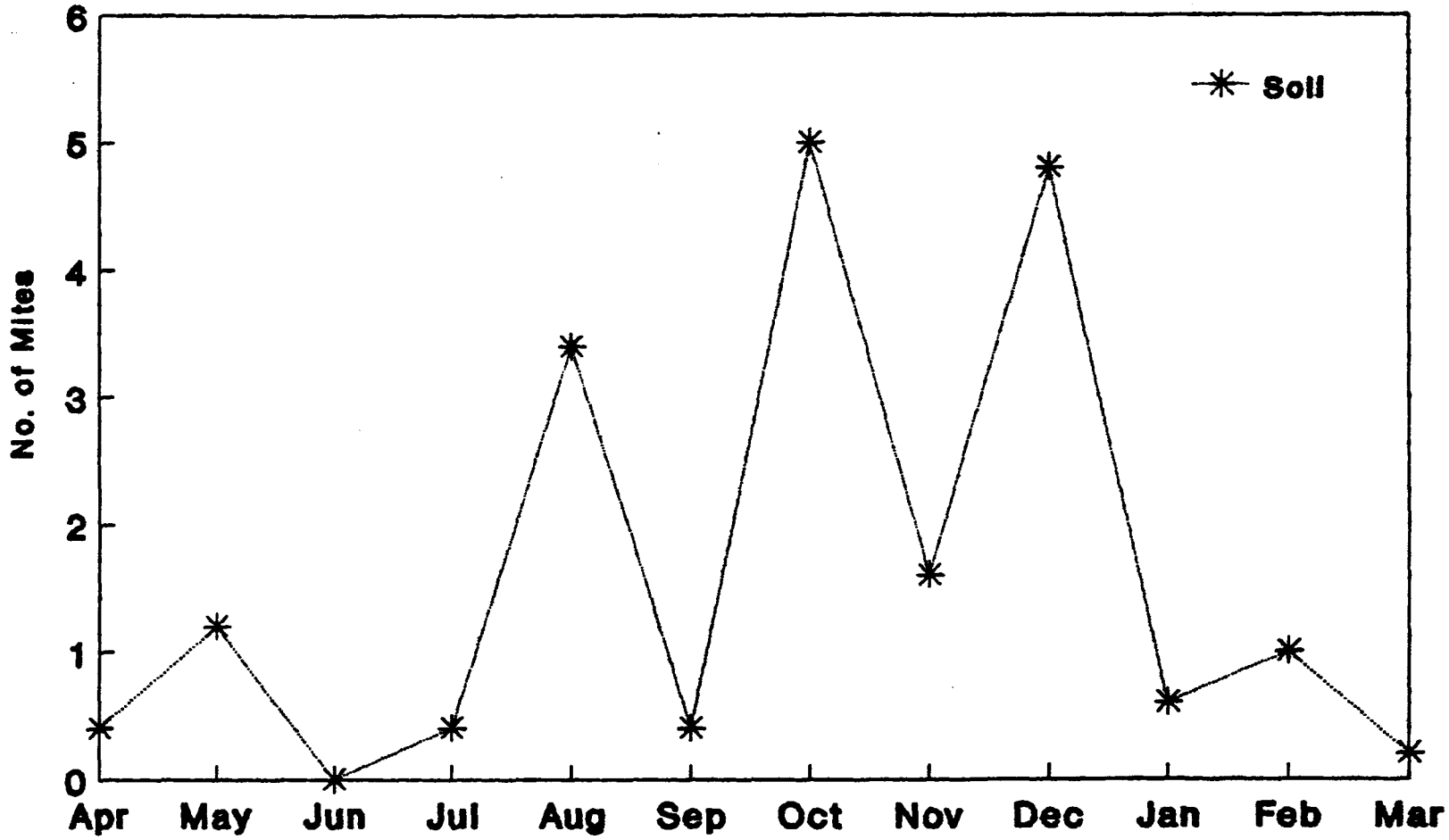

Fig.49 : Distribution of Acari in barren land

Table 18. Changes in the chemical properties of soil as influenced by incorporation of Eucalyptus plant parts at different levels over a period of six months

Eucalyptus plant parts	Treatments	EC (dsm^{-1})	PH	OC %	Av.P_2O_5 (Kg/ha)	Av.K_2O (kg/ha)	Ca [C.mol(p+) Kg^{-1}]	Mg [C.mol(p+) Kg^{-1}]	Micronutrients Zn	Cu	Mn	Fe
									<---------- ppm --------->			
Leaves	T_1=5g/kg soil	0.20	5.58	0.38	25.46	70.03	2.62	0.76	3.73	1.63	31.63	10.50
	T_2=10g/kg soil	0.19	5.58	0.37	25.59	70.17	2.69	0.76	3.70	1.64	31.64	10.51
	T_3=15g/kg soil	0.20	5.56	0.37	25.65	70.50	2.78	0.77	3.70	1.66	31.64	10.52
Bark	T_4=5g/kg soil	0.20	5.54	0.36	25.35	69.73	2.55	0.76	3.69	1.63	31.56	10.49
	T_5=10g/kg soil	0.19	5.53	0.36	25.38	69.83	2.55	0.76	3.69	1.64	31.58	10.49
	T_6=15g/kg soil	0.20	5.51	0.37	25.39	69.95	2.62	0.76	3.67	1.64	31.62	10.50
Floral parts	T_7=5g/kg soil	0.20	5.60	0.36	25.28	69.33	2.51	0.75	3.65	1.61	31.50	10.49
	T_8=10g/kg soil	0.21	5.58	0.36	25.19	69.68	2.52	0.76	3.66	1.62	31.52	10.47
	T_9=15g/kg soil	0.20	5.64	0.36	25.34	69.58	2.52	0.77	3.66	1.61	31.53	10.48
Check	T_{10}=untreated check (soil alone)	0.20	5.60	0.36	25.34	69.67	2.53	0.76	3.67	1.63	31.50	10.48
	F - test	NS	*	*	NS	NS	*	NS	NS	NS	NS	NS
	SEm±	0.004	0.023	0.002	0.795	0.718	0.032	0.008	0.055	0.038	0.498	0.659
	CD at 5%	-	0.069	0.006	-	-	0.094	-	-	-	-	-

b. Electrical conductivity (EC)

Electrical conductivity which indicates soluble salt content showed no variation irrespective of the addition of eucalyptus leaves, bark and floral parts. It ranged from 0.19 to 0.21 dsm^{-1}.

c. Organic carbon

The organic carbon content of soil treated with eucalyptus leaves showed a significant change compared to untreated check.

d. Phosphorus

The available phosphorus did not vary with treatments irrespective of addition of eucalyptus leaves, bark or floral parts. There was no appreciable change in phosphorus content of soil. However, the data revealed that addition of eucalyptus leaves had marginally increase the phosphorus content.

e. Potassium

There was no significant difference in respect of available K content in the soils treated with eucalyptus leaves, bark or floral parts and untreated check.

f. Calcium and Magnesium

The calcium content differ significantly among the treatments. The calcium content in soils treated with eucalyptus leaves was found to increase over a period of 180 days, ranged from 2.54 C.mol (P+) Kg^{-1} to 2.61 C.mol (P+) kg^{-1}. However its content in soils treated with floral parts was almost similar to control.

The magnesium content did not vary irrespective of the addition of different levels of leaves, bark and floral parts of eucalyptus, there was no appreciable change in magnesium content of the soil over a period of 6 months.

g. Micronutrients

Even in case of micronutrients viz., Zn, Cu, Mn and Fe there was no significant difference among the treatments during the study period.

IV.D.1 Soil faunal status

The soil faunal status before the addition of eucalyptus plant parts and six months after are presented in Table 19.

Table 19. Soil faunal status due to the treatment of Eucalyptus plant parts

	Initial soil faunal population					Soil faunal population after 6 months				
	Collembola	Acari	Diplura	Psocid	Diptera larva	Collembola	Acari	Diplura	Psocid	Diptera larva
T_1	+	+	-	+	-	-	+	-	+	-
T_2	+	+	+	+	+	-	-	-	-	-
T_3	-	+	-	+	+	-	+	-	-	-
T_4	+	+	+	+	+	-	+	-	-	-
T_5	-	-	+	+	-	-	-	-	+	-
T_6	+	+	+	-	-	-	+	-	-	-
T_7	-	+	-	+	+	-	+	-	-	+
T_8	+	-	-	-	+	-	-	-	-	+
T_9	+	+	+	-	+	-	+	-	-	-
T_{10} (Control)	-	+	+	+	+	-	+	+	-	+

+ : Present ; - : Absent

Five groups of soil fauna viz., Collembola, Acari, Diplura, psocids and dipteran larvae were encountered initially in the soils used for pot culture experiment.

Six months after the addition of eucalyptus leaves, bark and floral parts, these fauna considerably reduced in most treatments, except Acari which did not vary much. The collembolan fauna completely disappeared in all the treatments compared to initial faunal status. Similarly Diplura was completely absent in all the treatments treated with eucalyptus plant parts compared to initial faunal status. Psocids were present in soils treated with 5g leaves/kg soil and 10g bark/kg soil and was absent in the remaining treatments. Dipteran was also not found in soils treated with eucalyptus plant parts except in 5g floral parts/kg soil and 10g floral parts/kg soil treatments and untreated check.

DISCUSSION

V. DISCUSSION

Eucalyptus is being planted in various parts of India to meet the ever increasing demands of fuel, timber and forest based industries on account of their rapid growth and high yield within stipulated time and ability to survive under wide edaphic and climatic conditions besides excellent soil binding properties which makes it useful in soil conservation. Inspite of the tremendous economical uses of the tree, in india or elsewhere in the world, a lot of controversy has been raised regarding the high water consumption, drying of perrenial streams, depletion of soil fertility and reduced ground flora due to allelopathic effect resulting in environmental problems. Hence it has attracted a great deal of attention of environmentalists. However, detailed studies on soil faunal diversity in eucalyptus have not been carried out so far. Therefore, for the first time an attempt has been made to investigate the distribution and diversity pattern of soil fauna in eucalyptus plantation in comparison with other similar forest plantations in semi arid tropics.

The results of the investigations conducted during 1993 to 1994 on the soil faunal diversity of eucalyptus

plantation in comparison with the acacia, silver oak and casuarina and also barren land are discussed.

The organic carbon content of these habitats (Appendix-II) indicated that casuarina soil recorded the highest with 1.58 per cent compared to soils of acacia (1.14%), silver oak (1.05%), eucalyptus (0.96%) and barren land (0.18%).

V.A.I Distribution of soil fauna

The distribution of soil fauna was maximum in tree litters compared to soil in all the forest plantations studied. A maximum of 5615 soil arthropods/core sample/ year was recorded in casuarina litter followed by that of acacia litter (5229), eucalyptus litter (4658) and silver oak litter (2214). These results have clearly indicated that the casuarina litter had harboured more fauna compared to other plantation litters. Generally it was observed that the soil fauna was maximum in litter compared to the soil and obviously that the litter could provide required microclimatic conditions for the faunal development such as space, aeration and availability of food in terms of decaying organic matter, fungi, algae, etc. Similarly Holt (1985) reported that the litter fauna were higher than soil fauna in the natural rain forests of northern Queensland, Australia.

In case of soil habitats, the casuarina soil had harboured the maximum soil fauna (2199) followed by acacia (1388), silver oak (1118), eucalyptus (982) and barren land (112).

It was observed that the faunal distribution were found to be more in soils with higher organic carbon content. As the organic matter content decreased the faunal number also decreased and the values recorded were 21.99 in casuarina, 13.88 in acacia, 11.18 in silver oak 9.82 in eucalyptus soils and 1.12 in barren land soil. Similalry many workers have reported that the organic carbon was found to have a significant direct effect on Acari and Collembola population under forest ecosystem (Banerjee and Sanyal, 1991; Banerjee, 1993; Chattopadhyay and Subrata Roy, 1993).

The higher population due to increase of soil organic carbon was reported by earlier workers such Choudhuri et al. (1978), Choudhuri and Pande (1979, 1981) Joy and Bhattacharya (1981), Sanyal (1981a, 1981b, 1991).

However, in contrary to the present findings Bhattacharya and Roychoudhuri (1979) found that organic carbon had very little effect on the fluctuation of soil

microarthropods at Shantiniketan in West Bengal. Similarly Mukharji and Singh (1970) from Varanasi and Choudhuri and Roy (1971) of Burdwan had not reported positive correlation between organic carbon and higher population.

In the present investigation Collembola and Acarina constituted 79.91 to 88.46 per cent of total fauna in different habitats. The eucalyptus litter recorded 79.91 per cent, acacia litter 84.93 per cent, silver oak litter 81.55 per cent and casuarina litter 85.68 per cent. Similarly in soils of eucalyptus, acacia, silver oak and casuarina the percentage was 88.46, 86.87, 87.01 and 86.75 per cent respectively. These results are in broader agreement with the findings of Singh and Pillai (1981) who reported that the Acari and Collembola constituted 77.88 to 88.04 per cent of the total fauna in banana, citrus, fodder and fallow land. Similarly Singh and Mukharji (1973) earlier concluded that Acari and Collembola comprised from 72 to 97 per cent of the total fauna of Indian soils.

Adis et al. (1987) recorded that Acari and Collembola represented more than 75 per cent of the total fauna extracted in a secondary dry land forest at Manaus, Brazil. However, Reddy (1989) recorded that the

population of Collembola and Acari together constituted 97.5 per cent of the total microarthropods in a pine plantation in Northern India during 1983-84.

In eucalyptus litter, the Acari and Collembola were 61.54 and 18.37 per cent of the total fauna respectively. Similarly Acarina and Collembola comprised 64.59 and 20.34, 65.66 and 15.89, 57.74 and 27.94 per cent of the total fauna in acacia, silver oak and casuarina litters respectively.

Similarly in the soils of eucalyptus, Acari and Collembola were 57.0 and 31.46 per cent respectively. Whereas in silver oak, acacia and casuarina soils Acari and Collembola were 64.21 and 22.80, 62.67 and 24.20 and 52.56 and 34.19 per cent respectively. Some of the present findings corroborate the findings of Adams (1971) from his study of microarthropods of NewZealand pasture soil found that total Acari always exceeded Collembola. Similarly several workers from different parts of the world concluded that Acari were more abundant than Collembola in different forest ecosystem (Sarkar, 1990; Haq and Ramani, 1991; Schowalter and Sabin, 1991 and Paul et al., 1993).

Contrary to these findings Crossley et al. (1960) obtained maximum of 82.9 per cent of mites and only 12.2 per cent of Collembola in pine forest litter. Similarly Wallwork (1972a) also recorded that Acari constituted nearly 90 per cent of all microarthropod fauna collected from litter and mineral soils. However, Acari and Collembola constituted 32 and 67 per cent respectively at Matador in Canada (Willard, 1973). According to Vats and Handa (1983) Collembola were the most dominant group in all seasons constituting 73.5 per cent of total fauna followed by Acari.

The distribution of oribatid mites in eucalyptus litter was 18.52 per cent followed by casuarina litter (14.81%), acacia litter (14.59%) and silver oak litter (12.19%). However in eucalyptus soil the Oribatei was represented by 12.21 per cent and in acacia soil it was 19.52 per cent. This may be due to the presence of more organic matter and its rapid decomposition in acacia plantation. Whereas silver oak and casuarina soils constituted 17.17 and 13.68 per cent respectively. Though the organic matter was maximum in casuarina soil the Oribatei did not outnumbered their population. However in barren land Oribatei accounted for 17.85 per cent of the total fauna.

Contrary to these findings, Singh and Singh (1975) reported that among the soil Acari Oribatei constituted 34.25 and 42.51 per cent of the total population of the soil and litter respectively in tropical dry deciduous forest dominanted by Shorea robusta, Butea monosperma and Terminalia tomentosa. Similarly Joy and Bhattacharya (1981) found that Oribatei in dominant in banana plantation which constituted 43.2 per cent of the total acarine fauna at Shantiniketan, West Bengal.

Apart from Acari and Collembola the other soil fauna encountered in different habitats included Isopoda, Symphyla, Pauropoda, Chilopoda, Diplopoda, spiders, Pseudoscorpiones, Protura, Diplura, Thysanura, Orthoptera, Embioptera, Dictyoptera, Isoptera, Psocoptera, Hemiptera, Thysanoptera, Neuroptera, Hymenoptera, Larvae of Lepidoptera, Diptera and Coleoptera. Similar to these observations Annaduari (1988) while working on the structural composition and trophic diversity of the entamofauna of the litter samples of eucalyptus, coffee, tea and natural forest habitats observed the distribution of Collembola, Thysanoptera, Dictyoptera, Psocoptera, Dermaptera and Coleoptera.

V.A.2 Soil fauna diversity

Diversity of soil faunal communities was higher in litter compared to soil in all the forest plantations studied. Shannon-Weaner diversity index, total number of fauna and number of faunal groups collected for each habitat during present study are given (Table 4).

Diversity of soil fauna in eucalyptus plantation was more in litter than soil, maximum faunal diversity in litter was 2.010 when compared to soil (1.444). Faunal diversity was found maximum during January both in litter and soil. The average faunal diversity was 1.700 for litter and 1.113 for soil. Diversity fluctuated through out the year. The litter harboured a maximum of 15 groups during May and 8 groups in soil recorded during November, minimum number of 8 groups was recorded in litter during April and December and 3 groups in soil during April and March. Maximum number of fauna collected was 548 and 167 in litter and soil respectively during october. Similarly minimum number of fauna with 19 and 3 were found in litter and soil respectively during April.

In Acacia, maximum diversity was 1.827 (January) in litter whereas it was 1.634 (May) in soil. Minimum diversity in litter was 1.059 where as in soil it was

1.072 recorded during November and December respectively. The average faunal diversity was 1.553 in litter and 1.295 in soil. A maximum of 14 and 11 groups were encountered in litter and soil during June and May respectively. A minimum of 7 and 4 groups were found in Litter and soil during April and June respectively. Total number of arthropod population collected was 529 and 110 during November and September in litter and soil respectively. During April, a minimum of 21 and 20 total fauna were recorded in litter and soil respectively.

In silver oak, the maximum diversity value was 2.119 (February) in litter when compared to 1.546 (April) in soil. Similarly minimum diversity value recorded were 1.057 in litter and 1.061 in soil which was noticed during September and July respectively. Average faunal diversity was 1.508 in litter and 1.300 in soil. Maximum of 13 groups in litter and 9 groups in soil was recorded during November and August respectively. A minimum of 5 groups during April in litter and 4 groups in soil was recorded during June, December and January. A maximum of 228 fauna in litter and 128 in soil was recorded during October. The minimum total fauna encountered was 16 and 17 in litter and soil during April and April and January respectively.

In casuarina, highest diversity value was 2.158 in litter and 2.003 in soil which was recorded during April. Average faunal group diversity was 1.637 and 1.451 in litter and soil respectively. During August and December, a maximum of 15 groups were recorded in litter. Whereas 12 groups were recorded in soil during November. A minimum of 9 groups were observed during June and October in litter. However, three groups were found during January in soil. The total number of individuals collected was maximum 565 and 180 from litter and soil during November and August respectively. The minimum total number of individuals recorded in litter and soil was 47 and 23 respectively during April.

In barren land, the distribution of soil fauna and its diversity was poor. However the peak diversity of 0.851 was observed during December and minimum diversity was 0.318 during October. Similarly the average faunal diversity was 0.312. A maximum of only four groups were recorded during December and minimum of only one group (Acari) was found during April, July, August, September and February.

The results obtained in this study regarding the soil faunal diversity in litter and soil in different forest habitats varied from habitat to habitat and

season to season. This variation may be due to the differences in the deposition of organic matter between the habitats which would appear to be the significant factor contributing to the distribution, abundance and diversity of soil faunal communities.

Anderson and Hall (1977) showed that the positive correlation between orbatid species diversity and the habitat structural diversity. In the present investigation, the diversity of soil faunal communities was higher in a particular season as seen in eucalyptus litter which recorded 14 groups with a total number of fauna recorded being 91 with diversity index was 2.010 during January. However the same number of 14 groups were recorded with a total of 272 fauna during August and the diversity value was 1.663. This has clearly indicated that some groups were dominant during August (272) resulting in lower diversity eventhough the number of faunal groups were same during January and August. This suggests that the population density, number of groups and group diversity do not go hand in hand.

Lower abundance of soil fauna in barren land may be accounted for the low amount of organic matter, open area without vegetation and also less soil moisture. However, there is no information available to compare

the soil faunal diversity from forest habitats to barren land.

A significant positive correlation was obtained between eucalyptus litter and soil faunal population in respect of relative humidity, rainfall, litter and soil moisture (Table 5). Similarly Bhattacharya and Roy-Choudhuri (1979) found significant positive correlation between total soil microarthropods and relative humidity, rainfall and soil moisture.

Maximum, minimum, mean temperature and soil temperature at 5,10 and 15cm depth of soil showed a non significant correlation between eucalyptus litter and soil fauna. Insignificant correlation was observed between orbatid population and Temperature (Sanyal, 1991).

The litter faunal population in acacia was positively correlated with relative humidity, litter moisture and rainfall. According to Reddy (1992) rainfall and neem litter moisture showed significant positive linear correlations with the densities of micro arthropods taxa. Maximum, minimum, mean temperature and soil temperature at 5,10 and 15 cm depth of soil non significantly correlated with acacia litter fauna.

The soil faunal population in acacia showed a significant positive correlation with rainfall and soil moisture. Soil moisture positively correlated with the number of Collembola and Acari in the subtropical forest ecosystems (Jam et al., 1986; Chattopadhyay and Subrata Roy, 1993). Whereas non significant correlation was observed with relative humidity, maximum, minimum and mean temperature, soil temperature at 5,10,and 15cm depth of soil.

The litter faunal population in silver oak showed a positive significant correlation with relative humidity, rainfall and litter moisture. However, maximum, minimum and mean temperature, soil temperature at 5,10, and 15 cm depth of soil were non significantly correlated with litter fauna. Similarly the soil faunal population showed non significant relationship with all the variables.

There was a significant positive correlation between the fauna of casuarina litter relative humidity and litter moisture. However, non significant correlation was observed in respect of rainfall, maximum, minimum mean temperature and soil temperature at 5,10 and 15cm depth of soil. The soil faunal

population had a positive significant correlation with relative humidity, rainfall and soil moisture.

Influence of soil moisture favouring increase of oribatid population has been recorded by a number of workers (Choudhuri and Banerjee, 1977; Sanyal, 1981a; Sarkar, 1990 and Banerjee, 1993).

Similarly Choudhuri and Roy (1972) and Hazra and Choudhuri (1983) have reported an increased population of Collembola due to soil moisture condition.

The faunal population in Barren land soil showed non significant correlation with all the variables studied.

V.B Relative soil faunal abundance

Relative abundance of soil fauna in the five habitats, revealed that Acari contributed for more than 50 per cent of the total fauna and the next highest group was Collembola (except in barren land) which varied from 15.94 to 34.32 per cent. Acari and Collembola combination constituted 79.91 to 88.46 percent of the total fauna in different forest habitats.

Acari constituted 68.75 per cent in eucalyptus litter and it was less compared to acacia litter fauna

(72.58%) and slightly higher than silver oak (65.85%) and casuarina litter (57.03%). However, the maximum oribatids were obtained from eucalyptus litter (30.10%) followed by casuarina (25.65%), acacia (23.06%) and silver oak litters (18.56%).

Relative abundance of acarine fauna in eucalyptus soil was 59.44 per cent which was less compared to acacia (65.41%) and silver oak soils (64.39%) and slightly more than casuarina soil (52.76%). But casurina soil had numerically maximum acarine fauna compared to other habitats. Among acarine fauna, oribatid mites were least abundant in eucalyputs soil (21.42%) compared to acacia (31.14%) silver oak (26.74%) and casuarina soils (26.03%). Maximum oribatids in acacia and least in eucalyptus soil may be attributed to the higher organic matter content in acacia soil and lower content in eucalyptus soil. These findings are in broader agreement with the observations made by Sanyal (1981b), Sanyal (1991), Banerjee and Sanyal (1991) and Banerjee (1993).

Similar to the present findings oribatid mites accounted for 29 per cent of the total fauna in litter bags under 10 year old Douglas fir, Pseudotsuga menziessi in Western Oregon (Schowalter and Sabin, 1991). However Singh and Pillai (1975) observed that

Cryptostigmata accounted for 16.99 to 41.21 per cent of the total acari in different fields of Varanasi in Uttar Pradesh, being minimal in citrus orchard and maximum in banana field.

Contrary to the present findings, Singh and Singh (1975) reported that among the Acari, Oribatei constitute 34.25 and 42.51 per cent of the total population of the soil and litter respectively in tropical dry deciduous forests. Though the organic matter was higher in casuarina soil, the oribaids were relatively lower (26.03%) compared to acacia soil (31.14%). But numerically their population was maximum only in casuarina soil.

Taxonomic observation made on the Acari fauna of the four habitats studied showed that oribatids represented in the present study belonged to 6 families (Table 3). Eucalyptus and Casuarina litters had all five families except Epilohmanniidae and in acacia soil except Ceratozetidae all other families were recorded. However, Epilohmanniidae and Eremulidae were not encountered in the acacia litter. Casuarina soil had represented by Phthiracaridae, Galumnidae and Scheloribatidae and silver oak soil by Galumnidae and Scheloribatidae. However, only Galumnidae and

Pthiracaridae were encountered from eucalyptus soil and silver oak litter respectively. Perhaps this might be due to the influence of organic carbon content.

Collembolan fauna was recorded at 20.52 per cent in eucalyptus litter, which was relatively more than silver oak litter fauna (15.94%) and less than the casuarina (27.98%) and acacia litters (22.79%). Among the different families recorded under Collembola, Entomobryidae and Isotomidae dominated all the habitats except casuarina litter where Hypogastruridae dominated. Among Collembola, entomobryids were maximum in eucalyptus litter (44.97%) compared to silver oak litter (41.19%), acacia litter (33.64%) and casuarina litter (24.36%), Isotomidae contributed 29.90, 30.53, 25.56 and 24.36 percent respectively in eucalyptus, acacia, silver oak and casuarina litters.

In eucalyptus soil, the collembolan fauna was 32.90 per cent which is comparatively more than the acacia (24.81%) and silver oak soils (22.86%) and relatively less than the casuarina soil (34.32%). Among collembolan fauna, Entomobryidae constituted 24.51 per cent in eucalyptus soil. Whereas 26.05 per cent in casuarina soil. In acacia and silver oak soils 16.36 and 16.79 per cent respectively. Eucalyptus soil recorded the

least abundance of isotomids (38.38%) compared to silver oak (54.68%), casuarina (53.73%) and acacia (49.69%).

In this study, Collembola was abundant in casuarina litter may perhaps be due to the influence of litter moisture conservation in the casuarina plantation due to more litter fall compared to other forest plantations.

Taxonomic observation made on the collembolan fauna of the forest plantations revealed that collembolan fauna encountered in the present study belonging to 6 families included 9 species from different habitats.

Isopods were least in eucalyptus litter (0.11%) compared to silver oak (0.31%) and casuarina litters (0.16%). Myriapod population was 0.50, 1.55, 0.60 and 0.40 per cent in eucalyptus, casuarina, silver oak and acacia litters respectively. Among Myriapoda, symphylans were 7.14 and 4.59 per cent in acacia and casuarina litters respectively. Pauropods were abundant in eucalyptus litter (71.42%) followed by casuarina (25.28%) and acacia litter (25.0%). Similarly the abundance of chilopods were more in eucalyptus litter (28.57%) than silver oak (22.22%) and casuarina litter (11.49%) and less than the acacia litter (67.85%). Polyxenidae (Diplopoda) were recorded at 77.77 and 58.62 per cent respectively in silver oak and casuarina

litter. However the members of Polyxenidae were more in casuarina litter. Pseudoscorpiones and spiders were respectively abundant in eucalyptus litter (8.05%) than. casuarina (3.44%), silver oak (2.76%) and acacia (0.85%). Psocids were relatively higher in eucalyptus litter (29.69%) compared to casuarina (19.64%), acacia (14.90%) and silver oak litter (12.80%). The abundance of thrips was 16.72, 35.32, 34.94 and 34.15 per cent in eucalyptus acacia, silver oak and casuarina litter respectively. Bugs were highest in eucalyptus litter (10.52%) followed by acacia (8.04%), casuarina (4.46%) and silver oak litters (2.42%). Similarly the ants recorded was 8.27 per cent in eucalyptus litter which is more or less similar to the distribution in casuarina litter (8.48%) but slightly more than the silver oak litter (6.57%) and much lower than the acacia litter (14.75%). In eucalyptus litter, termites accounted to 3.75 and 4.84 per cent in silver oak litter. Whereas casuarina litter recorded only 2.45 per cent. Similarly the roaches were found maximum of 3.75 per cent in eucalyptus litter followed by casuarina (0.89%), acacia (0.59%) and silver oak litter (0.34%). Silverfishes represented by 2.81, 3.12 and 1.03 per cent in eucalyptus, acacia and silver oak litter respectively. Eucalyptus litter formed 7.14 per cent of coleopteran

adults and casuarina, silver oak and acacia constituted 5.58, 3.46 and 3.42 per cent respectively. Coleopteran larvae were 8.45 per cent in eucalyptus litter and 16.59, 7.14 and 6.25 per cent in silver oak, casuarina and acacia litter respectively. Larvae of Lepidoptera recorded 6.95 percent in eucalyptus litter and higher in acacia (10.13%). Casuarina (7.8%) and least in silver oak litter (3.46%). Eucalyptus litter recorded minimum dipteran larvae (1.31%) compared to silver oak, casuarina and acacia litter recorded 12.11, 7.58 and 2.83 percent respectively.

The Acari fauna in eucalyptus soil was 59.44 per cent which was less than acacia (65.41%) and silver oak soil (64.39%) and slightly more than casuarina soil (52.76%). However total number of acarine fauna was maximum in casuarina soil compared to other habitats. Among Acari, Oribatei was least in soils of eucalyptus (21.42%) compared to acacia (31.14%) silver oak (26.74%) and casuarina soils (26.03%).

Eucalyptus soil constituted 32.90 per cent of Collembola which is comparatively more than the acacia (24.81%) and silver oak soils (22.86%) and lower than the casuarina soil (34.32%). Among collembolan fauna entomobryids accounted for 24.51, 26.05, 16.79 and 16.36

per cent in eucalyptus, casuarina, silver oak and acacia soils respectively. Eucalyptus soil recorded 38.38 per cent of isotomids which was least compared to silver oak (54.68%) casuarina (53.73%) and acacia soils (49.69%).

Isopods was distributed to an extent of 0.07, 0.44 and 0.31 per cent respectively in acacia, silver oak and casuarina soils. Myriapod represented by 2.86 per cent in eucalyptus soil was followed by casuarina (2.73%), acacia (2.33%) and silver oak soils (1.34%). Among myriapods, symphylans were less in eucalyptus soil (3.70%) compared to silver oak and casuarina soils with 53.33 and 8.33 per cent respectively. The abundance of pauropods was maximum in eucalyptus soil (96.29%) followed by casuarina (76.66%) acacia (64.51%) and silver oak soils (40.0%). Chilopods were observed maximum in acacia soil (35.48%) and least in casuarina (3.33%) and 6.66 per cent in silver oak soil. Diplopods were encountered only in casuarina soil (11.66%). Other arachnids included, Pseudoscorpiones and spiders which were relatively more in eucalyptus soil (2.01%) followed by casuarina (1.18%), acacia (0.75%) and silver oak soils (0.62%).

Maximum abundance of psocids were noticed in eucalyptus soil (27.41%) and were 4.83 and 4.84 percent in acacia and casuarina soils respectively. Thrips recorded 6.45 per cent in eucalyptus soil which was less than the casuarina, (12.12%), silver oak (11.71%) and acacia soil (8.06%). However, the bugs constituted a maximum of 8.06 per cent in eucalyptus soil compared to casuarina (6.66%) acacia (4.83%) and silver oak soils (1.80%). Abundance of ants were 33.87, 58.06, 38.73 and 30.90 per cent in eucalyptus, acacia, silver oak and casuarina soils respectively. Termites recorded 16.36 and 6.30 per cent in casuarina and silver oak soils respectively. In all the soil habitats, roaches were not noticed. Silverfish was observed only in acacia soil (1.61%). Adult Coleoptera contributed 4.83, 14.41, 3.63 and 1.61 per cent respectively in eucalyptus, silver oak, casuarina and acacia soils. Eucalyptus soil recorded 3.22 per cent of Coleoptera larvae which is least compared to casuarina (10.30%), silver oak (9.90%) and acacia soils (5/64%). Similarly eucalyptus soil recorded minimum dipteran larvae (1.61%) and maximum in silver oak soil (12.61%) followed by acacia (10.48%) and casuarina soils (5.45%).

V.C Seasonal variation of soil fauna

An account of the total number of soil fauna extracted for each month is presented. In all the habitats studied, the population tend to decrease during April being a dry season with low litter fall, soil moisture and higher temperature.

The monthly total faunal fluctuation in eucalyptus litter showed two peaks during May and October. This may be due to an ideal moisture condition with good precipitation during this period and also the availability of food in the form of decaying organic matter, fungi and algae. Litter fauna was recorded low during April, January, February and March mainly because of moisture stress and high atmospheric temperature. The eucalyptus litter harboured more fauna inspite of containing oil which is volatile and water solubility would not have any adverse effect on fauna in litter rather than soil. However in eucalyptus soil, the soil faunal distribution and abundance was very low compared to litter. This may be a fact in case of eucalyptus with well developed root systems which are specifically adopted for absorbing more moisture from the upper soil profile rather than from the ground water table at a considerable depth. This is also evident from the point

of soil faunal distribution mostly from the top soil. Therefore the faunal population might have very much reduced under dry conditions, apart from this toxic substances might have been added to the soil through the eucalyptus leaf litter which may have an inhibitory effect on the existence of soil fauna. However, the peak population was recorded during October which coincided with more soil moisture conditions during rainy season.

The present findings are more or less in close conformity with the observations of Bhattacharya and Roy Choudhuri (1979) who reported that the soil fauna occurred in two peaks during the postmonsoon period (September - October) and premonsoon period (May-June) at Shantiniketan, West Bengal. Collembola and Acarina were minimum in abundance during summer (April to mid June) and maximum during rainy season (mid June to September) in tree planted (mostly Eucalyptus sp) and grass land area of semi arid tropical savanna in Telengana region of Andhra pradesh (Reddy and Venkataiah, 1990).

Contrary to the present findings, Vats and Handa (1983) reported that soil arthropod populations were highest during summer and lowest during the rainy season in a forest dominated by Dalbergia sissoo in Haryana.

The total acacia litter fauna showed three peaks during May, August and November, during these months the litter moisture was in optimum condition with required rainfall and it was in advanced degree of decomposition. The thick litter layer, may have also provided food and shelter for fauna which may be attributed to the faunal maxima during these months.

Results obtained in this study are in full agreement with that of Gupta and Mukharji (1978) who recorded maximum soil arthropod population during July and August. Similarly Jam et al (1986) recorded the maximum soil faunal population densities during August and July in the sub tropical forest ecosystem at Manipur. Sinha et al. (1988) observed the maximum Collembola and Acarina populations in monsoon period and populations were constant and high in the winter in a deciduous forest at Ranchi, Bihar (Chattopadhyay and Subrata Roy, 1993).

In Acacia soil, the highest soil fauna was recorded during October and least during September. Two peaks were observed during October and May. The population increased from April to May during the onset of monsoon and this might be due to optimum soil moisture

conditions which prevailed during this period. These results are in agreement with the earlier works (Bhattacharya and Roychoudhuri, 1979; Haq and Ramani, 1991; Chattopadhyay and Subrata Roy, 1993).

The total soil fauna was maximum and minimum during September and April respectively in silver oak litter. The peak population of litter fauna observed in this study are comparable with the findings of Bhattacharya and Roychoudhuri (1977, 1979). Silver oak soil fauna exhibited its peak during August and the population tended to increase from April to May.

Casuarina litter contributed the highest total fauna compared to other habitats. However, peak was noticed during August and the lowest population in April. Two prominent peaks were found during August and November. Similarly in casuarina soil, the maximum soil fauna was recorded in August and minimum in April. Similar observations were made by Choudhuri and Banerjee (1975), Gupta and Mukharji (1978) Hazra and Choudhuri (1983) and Jam et al. (1986).

In barren land, maximum number of soil fauna were found during post monsoon period viz; October and December and minimum during July and September (monsoon

period) which might not be optimum for faunal distribution.

Acari had a peak population during October and least number occurred in April in eucalyptus litter and soil. This might be attributed to the precipitation received in the previous months (September) and absence of precipitation during March and April. The present investigations are in full agreement with Joy and Bhattacharya (1981) who reported that Cryptostigmata showed a pronounced population peak during post monsoon period (October) in banana plantation at Shantiniketan. Further these results are also partly conformed to the observations made by Bhattacharya and Roychoudhuri (1977) who observed peak population of oribatid mites during September and October.

In acacia litter the prominent Acari fauna was recorded during November followed by August and May. Similarly Oribatei showed three peaks in May, August and October - November. This might be attributed to the well decomposed litter layer along with optimum moisture during this period. However, Sanyal (1981) noticed two peaks of Oribatei in May and November in Paraganas, West Bengal.

Contrary to the present observations Choudhuri and Banerjee (1975) reported a peak population only during July-August.

Population of Acari in acacia soil was found maximum during September and minimum during April. Whereas Oribatei recorded a maximum during May. These results are more or less conformed with the findings of Bhattacharya and Roychoudhuri (1979) and Sanyal (1981a). Total acarifauna and oribatid mites showed their peak during September and November respectively in Silver oak litter. This may be due to good microclimatic conditions which prevailed during this period by sufficient litter moisture and also the influence of weed growth which covered the litter surface.

Both were least abundant in April as recorded in rest of the habitats. However Acari population in silver oak soil was highest during August. These observations are in broader agreement with the observations of Banerjee (1991). Similarly Oribatei recorded maximum during May, August and September. These findings are however more or less in close conformity with the observations of Banerjee (1974a) Choudhuri and Banerjee (1975) and Sanyal (1981a).

In casuarina litter, total acari and oribatid population showed a maximum in August. The frequent rains during May-August seemed to have favoured the increased population. The present findings broadly corroborate the findings of Banerjee (1974a, 1991) and Choudhuri and Banerjee (1975) where they observed maximum Oribatei population during August. Similarly, the highest Acari population was observed during August in casuarina soil with maximum abundance of oribatids during June. This may be due to influence of sufficient soil moisture.

Eucalyptus litter had a peak collembolan fauna during May and October. This may be attributed to the prevalence of more favourable moisture condition due to the rainfall. This finding is corroborate, with that of many investigators who recorded that moisture was significantly positively correlated with different species of Collembola (Christiansen, 1964; Hazra and Choudhuri, 1983; Santos and whitford, 1983; Reddy, 1984a and 1984b). Similarly in eucalyptus soil also, collembolan population recorded highest during October. This might be due to leaf fall which coincided with rainfall resulting in sufficient moisture during this period. (Kim and Hyun, 1989).

The peak population of Collembola was recorded during June-July in acacia litter. This may be due to the fact that Collembola tends to concentrate in the upper layer of litter during the rainy season. The results of the present investigations fairly agree with similar conclusion made by Hazra (1991). In case of acacia soil it was maximum during October, September and March. Guru et al. (1988) reported that Collembola showed a distinct peak during October in uncultivated site in Orissa. However, Mukharji and Singh (1970) recorded maximum population of Collembola during March. The collembolan fauna recorded was highest during August, September and October in silver oak litter. Similarly the population was highest during August in silver oak soil (Choudhuri and Roy, 1967; Bhattacharya and Roychoudhuri, 1979; Kim and Hyun, 1989). However casuarina litter had recorded the highest collembolan fauna compared to rest of the habitats with prominent peak in November (Fig 46). This may be attributed to more litter fall, compact spacing and more litter moisture. Casuarina soil showed a peak population during June and December.

V.D Effect of eucalyptus on soil fauna

With a view to find out the influence on the application of different parts of eucalyptus on the soil

faunal status, a preliminary pot culture experiment was conducted.

The application of different parts of eucalyptus to soil over a period of six months showed that the treatments had a significant influence on soil reaction organic carbon and calcium content, however there was no drastic changes in these properties.

The treatments did not influence significantly other soil properties such as electrical conductivity, macronutrients including phosphorus and potash, magnesium and micronutrients.

Data showed the existence of all the five faunal groups including Collembola, Acari dipteran larvae, psocids and Diplura in all the treatments at the beginning of the experiment. Later it was observed that only Acari> dipteran larvae >psocid> Diplura were present in that order six months after imposition of the treatments. Contrast to the initial faunal status that collembolans were completely absent.

SUMMARY

VI. SUMMARY

Investigations on distribution, abundance, diversity, comparative faunal diversity of soil fauna of four forest habitats and a barren land located at Gandhi Krishi Vignana Kendra, Campus of the University of Agricultural Sciences, Bangalore were carried out during 1993-94.

The faunal distribution was more in litter compared to soil in all the forest plantations studied. The maximum fauna were recorded/core/year in casuarina litter (5615) followed by acacia litter (5229), eucalyptus litter (4658) and silver oak litter (2214). In soil habitats, casuarina had recorded the highest soil fauna (2199) compared to acacia (1388), silver oak (1118) eucalyptus (982) and barren land (112). The abundance of soil fauna was found to be more in soils rich in organic carbon content.

The Acarina and Collembola constituted 79.91 to 88.46 per cent of the total fauna in different habitats studied.

The other common soil fauna encountered in all the five habitats included Isopoda, Symphyla, Pauropoda,

Chilopoda, Diplopoda, spiders, Pseudoscorpiones, Protura, Diplura, Thysanura, Orthoptera, Embioptera, Dictyoptera, Isoptera, Psocoptera, Hemiptera, Thysanoptera, Neuroptera, Hymenoptera, lepidopteran larvae, dipteran larvae, coleopteran larvae and adults.

The faunal diversity was higher in tree litters compared to soil in all the forest habitats. Maximum faunal diversity was 2.010, 2.158, 2.119 and 1.827 in litter of eucalyptus, casuarina, silver oak and acacia. However minimum faunal diversity in eucalyptus, casuarina, acacia and silver oak litter was 1.311, 1.191, 1.059 and 1.057 respectively.

The maximum soil faunal diversity in eucalyptus, casuarina, acacia and silver oak soils were 1.444, 2.003, 1.634 and 1.546 respectively. Minimum soil faunal diversity was 0.706 in eucalyptus soil, 1.072 in acacia, 1.061 in silver oak and 1.009 in casuarina soils. However the maximum and minimum soil faunal diversity was 0.851 and 0.318 in barren land.

A significant positive correlation was obtained between eucalyptus litter and soil faunal population with relative humidity, rainfall and litter and soil moisture. Relative humidity, litter and soil moisture were positively correlated with acacia litter fauna.

Soil faunal population in acacia showed significant positive correlation with rainfall, litter and soil moisture. Relative humidity, rainfall, litter and soil moisture had significant positive correlation with silver oak litter fauna. Casuarina litter fauna had significant positive correlation with relative humidity, litter and soil moisture. Whereas casuarina soil faunal population showed positive significant correlation with relative humidity, rainfall, litter and soil moisture.

Relative abundance of soil fauna in the eucalyptus plantation and other tree forest plantations showed that Acari contributed for more than 50 per cent of the total soil fauna. Collembola was next highest group with 15.94 to 34.32 per cent. Acari and Collembola together constituted 79.91 to 88.46 per cent of the total fauna in these forest habitats. Among Acari, Oribatei recorded numerically highest in eucalyptus litter (863) followed by casuarina (832), acacia (779) and silver oak litters (270). But eucalyptus soil had least number (120) compared to casuarina (301), acacia (271) and silveroak soils (122). The number of Oribatei collected was only 20 in the barren land.

Relative abundance of Acari in eucalyptus litter was 68.75 per cent, acacia, silver oak and casuarina

litter recorded 72.58, 65.85 and 57.03 per cent respectively. Maximum oribatids were obtained from eucalyptus litter (30.10%) followed by casuarina (25.65%) acacia (23.06%) and silver oak litter (18.56%).

In soil habitats, Acari fauna was least in eucalyptus (59.44%) compared to acacia (65.41%) and silver oak soils (64.39%) and slightly more than casuarina soil (52.76%). The Oribatei was least abundant in eucalyptus soil (21.42%) compared to acacia (31.14%), silver oak (26.74%) and casuarina soils (26.03%).

Oribatids were represented by six families viz., Phthiracaridae,Galumnidae,Ceratozetidae,Scheloribatidae, Epilohmanniidae and Eremulidae in different habitats studied.

Collembola abundance was 20.52 per cent in eucalyptus litter and 27.98, 22.79 and 15.94 per cent in casuarina, acacia and silver oak soils respectively. In eucalyptus soil, the Collembola fauna was 32.90 per cent followed by casuarina (34.32%), acacia (24.81%) and silver oak soil (22.86%).

The major species of Collembola recorded in these habitats are Brachystomella sp. (Brachystomellidae),

Xenylla sp. and X. reducta (Hypogastruridae) Folsomides sp and Proisotoma sp. (Isotomidae). Lepidocyrtus sp. Cyphoderus sp. and Salina sp. (Entomobryidae) and Sminthurides sp. (Sminthuridae).

Pseudoscorpiones and spiders were relatively abundant in eucalyptus litter (8.05%) compared to casuarina (3.44%), silver oak (2.76%) and acacia (0.85%). Similarly Psocids were relatively higher in eucalyptus litter (29.69%) compared to casuarina (19.64%), acacia (14.90%) and silver oak litter (12.80%). The abundance of thrips was 16.72, 35.32, 34.94 and 34.15 per cent in eucalyptus, acacia, silver oak and casuarina litters respectively. Ants were 8.27 per cent in eucalyptus litter and 14.75, 8.48 and 6.57 per cent in acacia, casuarina and silver oak litters respectively.

Pseudoscorpiones and spiders were relatively more in eucalyptus soil (2.01%) and 1.18, 0.75 and 0.62 per cent in casuarina, acacia and silver oak soils respectively. Maximum psocids found in eucalyptus soil (27.41%) and in acacia 4.83 per cent and 4.84 per cent in casuarina soils. Thrips were less abundant in eucalyptus soil (6.45%) compared to casuarina (12.12%) silver oak (11.71%) and acacia soils (8.06%). Abundance

of ants were 33.87, 58.06, 38.73 and 30.90 per cent in eucalyptus, acacia, silver oak and casuarina soils respectively.

The total soil fauna in all the five habitats revealed that the population tended to increase from May onwards and reduced very much during dry period. The soil fauna including Acari and Collembola showed their peak during May, August, September, October and November when the optimum litter and soil moisture were prevailed followed by rainfall. Least number of fauna were encountered during dry months from January-April due to low soil moisture and higher atmospheric temperature.

The effect of eucalyptus plant parts on soil fauna in a pot culture experiment revealed that Collembola, Diplura, psocid and dipteran larvae considerably reduced due to these treatments. But Acari fauna did not vary much. Collembola completely disappeared in all the treatments with the application of eucalyptus plant parts compared to initial faunal status.

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VII. REFERENCES

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Original not seen

APPENDICES

APPENDIX - I

Data on mechanical analyses of soils of different habitats

Site	Sand (%)		Silt (%)	Clay (%)	Textural class
	Coarse	Fine			
Eucalyptus plantation	42.00	30.50	6.20	21.20	Sandy clay loam
Acacia plantation	42.00	30.60	6.20	21.20	Sandy clay loam
Silver oak plantation	39.80	31.80	6.20	21.10	Sandy clay loam
Casuarina plantation	38.70	30.60	5.10	22.70	Sandy clay loam
Barren land	40.10	30.70	5.70	20.80	Sandy clay loam

Organic carbon status of soils of different habitats over a period of time

Month	Eucalyptus soil	Acacia soil	Silver-oak soil	Casuarina soil	Barren land
May	1.57	1.24	0.72	1.53	0.92
July	1.56	1.17	1.47	1.59	1.11
September	1.20	1.62	1.60	0.86	0.35
November	1.50	1.59	1.17	1.32	0.54
January	0.96	1.11	0.70	0.54	0.54
March	0.98	1.00	0.58	0.36	0.18

APPENDIX - II

Mean values of physico chemical properties of soils of different habitats

	EP	AP	SP	CP	BL
PH (1:2.5)	5.40	5.60	6.00	5.70	5.20
EC (1:2.5) dsm^{-1} at 25^{o}	0.19	0.20	0.16	0.18	0.15
Organic Carbon (%)	0.96	1.14	1.05	1.58	0.18
Available Nitrogen (Kg/ha^{-1})	201.60	299.60	328.60	260.00	173.60
Available Phosphorus (Kg/ha^{-1})	23.08	23.00	25.65	23.08	69.00
Available Potassium (Kg/ha^{-1})	94.00	79.00	54.00	62.00	18.13
Exchangeable calcium [$C.mol(p+)\ Kg^{-1}$]	4.00	4.05	4.15	4.30	4.60
Exchangeable Magnesium [$C.mol\ (p+)\ Kg^{-1}$]	1.30	1.55	1.50	0.85	0.75
DTPA Extractable micronutrients (ppm)					
Fe	13.56	15.85	14.60	11.70	52.00
Cu	0.83	0.40	0.43	0.70	0.80
Zn	7.10	5.35	6.40	6.60	1.57
Mn	37.44	39.33	30.80	35.08	16.88

EP = Eucalyptus plantation ; AP = Acacia plantation
SP = Silver oak plantation ; CP = Casuarina plantation
BL = Barren land