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The interrelation between living things and their environment on the earth attracted the human attention with the dawn of civilization.

The earliest attempt to study on soil fauna was made by Diem (1903) who surveyed the occurrence of soil fauna in the region of Alps Switzerland. McAtee (1907) successfully counted the soil fauna collected from forest floor and grass meadow. This work was followed by some useful observation in Pedobiology by Shelford (1913), Adams (1915), Thompson (1924), Jorjanson (1934) and Ford (1935). Cameron (1913) enlisted 163 different species from the soil at Manchester. Subsequently this author in 1917 extended his investigations on two types of grassland. He observed a marked variation in the faunal composition of the two areas and according to him; the variation was due to the prevalence of different environmental conditions.

Buckle (1921) was of the opinion that the distribution and density of soil fauna were more stable on grassland than on arable land and he observed that the soil fauna increased in both the areas with the growth of vegetation. Morris (1922) observed that there was an increase in the invertebrate population of an arable land when the farm manure was added to this piece of land. Edwards (1929) compared the invertebrate fauna comprising of Collembola, Symphyla, Diplopoda, Coleoptera and Diptera in the pasture areas as well as the area having an alluvial soil. Symphyla were found at a depth of 6-9 inches and several species of Collembola namely Tullbergia were also found at the same depth. He observed a striking difference in the qualitative and quantitative faunal composition from both the patches of land. According to him, the horizontal and vertical distributions were probably associated with: (I) situation and mechanical composition of soil which in turn determines the degree of moisture, aeration and temperature, (II) with the nature of flora which affected the density of surface turf means of shelter above ground as well influencing evaporation and (III) with the depth, particular food occurred specially for the carnivorous forms. He also observed the occurrence of injurious insects such as larvae of Elateridae and Curculionidae in all the four pasture area. These larvae were scarce in alluvial soil which was under partial cultivation.

Blacke (1931) studied the litter and soil inhabiting animal community of a deciduous forest. He took samples at three levels of forest; these were 0.6 metres
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(shrub level) and 11 meters (tree level) above forest floor and 10 cm (top soil below it). This work was a continuation of his earlier work published in the form of a monograph in 1926. He found *Tomocerus Onychiurus* and *Tipula* larvae along with some beetles belonging to family Cantheridae. He opined that during most of the period, the leaf stratum animals were the most numerous and determined the total population curve. He found lesser number of animals in the soil on the patch of land where herbs and shrubs were in abundance. He postulated his results as follows, “Population changes accompanied meteorological changes of the effects of such changes on the substratum, the numbers rose with high temperature and increased moisture and fall with the reverse”. MacLagan (1932) made a comprehensive ecological study on the “Lucerne Flea” (*Sminthurus virdis* lin). He studied the effect of biotic environmental factors in detail upon the survival of this Collembola. The biotic factors that influenced the survival of *S. virdis* were insect predators in the form of two species of *Coccinella*, two species of *Philonthes*, and four species of family Staphylinidae were also the predators of Collembola. Carabidea like *Bembidon* sps. was also predating upon this Collembola besides beetles *S. virdis* was prone to the attack of Hemipterans like *Anthiscoris lygus* and the *Dermptera forficula. S. virdis* also faced a threat on its survival from a number of species of spiders. The edaphic factors like temperature, moisture, hydrogen ion concentration, had a pronounced effect on the growth rate, development and fecundity. Besides these, the type of soil also had an effect on these vital processes. He concluded that the actual facts appeared to be the population increases in natural environment is seriously handicapped on account of diverse physiological assemblage of the individual and the fact that organisms flourish to the extent they do, is not due to much to their adaptation to the environment as to their increase in-spite of it, on account of enormous reproductive potential with which every creature is endowed. Ford (1935) compared the animal population of the soil and vegetation of ridge traversing a meadow at certain periods of the year and was able to collect the soil organisms upto the level of 263.8 million individuals per acre in the surface vegetation. He observed a rising population in December and declining population from January to May. According to him, the fluctuations were entirely due to variations in the population of collembolans. Frenzel (1936) made a comparative study of soil fauna of different habitats situated at elevations ranging from 110-2000 meters in Germany and inferred that soil moisture depending upon the structure mainly influenced the
population fluctuation. The ecological plasticity of some of the soil organisms' maximum population in October and early spring and minimum population on mid winter and mid summer were the focal points of his observations.

Ford (1937) extracted collembolans, Acarina, Staphylinides and spiders from grass tussocks with the aid of an improvised Tullgren funnel. In his opinion, moisture was of great importance for the existence of these fauna and the drying up and wetting of different regions of tussocks caused migration of certain species within them. A fluctuation of the population with an increase in November and December, early February and late February with the intervening minimum was shown to characterize the Collembola and Acarina. He elucidated that the February minima was in correspondence with the period of high evaporation rate which destroyed the tussocks structure, so, in his opinion the period of cold dry weather created a very adverse condition for the survival of collembolans and Acarina. Campwell (1937) studied the temperature and moisture preference of wireworm larvae. Most of them were located in a temperate zone of 8-140°F temperature. With an increase in temperature the wireworm migrated out of the hot end and became active at the cold end. Similarly, he found that the soil containing 3-4% moisture was too dry and it caused migration of the wireworm larvae towards the moistured soil. Migrations were also caused by the presence or absence of the food.

Melinchenko (1938) observed the periodic appearance of *Isotoma palustris, I. virdis* during winter months, he found that their numbers increase in the early hours of the day (8 am) and gradually decrease until 6.30 pm in his opinion, the temperature of the air reflected in the layer of snow apparently regulated the movements of the animals under phototropism. If the temperature of air was below requisite minimum, the individuals returned to the ground, if that of the air and strata of snow was favorable (probably about ± 0.1 to ± 0.2°C), the collembolans rose to the surface of snow. The optimal humidity according to him varied between 96-100%. Baweja (1939) studied the population dynamics of soil insects belonging to the orders Collembola, Coleoptera, Hemiptera, Hymenoptera and Diptera. He studied the phenomenon of recolonization of these insects after sterilization of plots under study. In controlled plots, the mean population varied from 61.2-67.6 million and in the sterilized plots, the population was from 98.2-111.8 million per acre. The proportion of insects to other invertebrates such as Myriapoda, Arachnids and Oligochaetes was
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raised from 2% in the control to 20% in certain sterilized plots. The peak of the population was observed in late autumn which was caused by a sudden increase in the numbers of collembolans. The decrease in the number of collembolans brought down the population of soil insects. Decreasing temperature between 55°F and 45°F was found to be optimum for the collembolans. According to him, the insects require seven months to recolonize sterilized plots. Glasgow (1939) made a comprehensive study of subterranean soil fauna. He observed that below the earth surface there is a region of perpetual darkness inhabited by a community of sluggish white blind animals whose modification recalled those of the cave forms. Some are infact recorded as cave forms (Onychiurus armatus, O. ambulans, Tulibergia krausbauri, T. quadrispina). The other truly subterranean fauna consists of Symphyla, four species of Onychiuridae, Pauropoda and Protura. Under wet conditions, the distribution of O. armatus is positively correlated with soil and moisture under dry conditions while O ambulans is positively correlated with moisture and negatively with the ignition loss of the soil. The correlation did not account for the uneven distribution of the animals. He extracted the animals by Ladell's Floatation Method. He concluded his studies that the vertical distribution of each species was different with the note that each species exhibited positive partial correlation with soil moisture and temperature, except in the case of Onychiurus ambulans which is independent of temperature and Tulibergia quadrispina which is not significantly correlated with moisture and temperature. As these factors were themselves negatively correlated, moreover, their effects cancelled each other out. Population fluctuation cannot be with certainty attributed to either. The population of both species of Onychiurus had a winter maxima. The population was prone to the effects of freezing and flooding.

Jacot (1940) observed that the seasonal and daily movements of the soil animals were due chiefly to the variation to light and moisture. He strongly advocated that animals should not be classified primarily on the basis of dominants, subdominants etc. but rather according to food habits, life cycles and interrelations. Agrall (1941) while working on the temperature preference of different species of Collembola, found that the collembolans are endowed with a great plasticity of thermic tolerance as they could withstand a considerable range of temperature ranging from -4°C to -10°C as lower limit and the 35°C to 38°C as upper limit. He further observed that the collembolan population is dependent upon water content of
the soil. Gisin (1943) showed that the occurrence of some of the species of
collembolans which were sensitive to edaphological conditions could be used as
reliable index for determining the nature of soil.

Hammer (1944), a legend in the ecological study of microarthropods, through
her works on microflora in Greenland and Canada observed that the soil fauna were
to some extent negatively correlated to the soil moisture and they could be decided
into two communities.
   a) Moisturephilic
   b) Moisturephobic

Dowdy (1944) studied the influence of temperature on the vertical migration
of soil invertebrates inhabiting different types of soil. He observed that in areas which
had been greatly disturbed by man the reaction of the invertebrates to the
temperature changes are different. The soil invertebrates moved deeper into the soil
during fall and winter and returned closer to the surface the following spring.
According to him, temperature was the main stimulus behind vertical movements.
The range that he observed lied between 38°C and 45°C. He observed that many of
these soil invertebrates were able to withstand freezing temperature without apparent
injury.

In 1947, Strickland used floatation method of extraction for the first time for
soil microarthropod from three undisturbed forest reserve and four Cacaco Estates.
He was able to extract mites, termites, Nemetoceran fly larvae. According to him, the
general soil fauna was considerably more abundant in the reserved forests than in
the estates. The vegetation had a greater influence on the size of soil inhabiting
insect population than the soil type. Although, the latter influenced the occurrence of
other arthropod groups. In all localities, he found that acarina were the predominant
animals in the soil and the litter. He observed a decrease in population of soil insects
along with the depth and he found that these insects did not migrate deeper than 7
inches.

Two years later, he extracted the soil microarthropods with the aid of Tullgren
funnel. This time he tried to compare the population of soil microarthropods of open
Savanna land with that of an open Cacaco field. In both the plots, he observed that
the Acarina and Collembola migrated downwardly as the moisture of the soil depleted
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during dry season. He further noticed that there was a considerable difference in the qualitative population, present in the plots in spite of the fact that the nature of the soil being the same. He attributed this difference due to the difference in vegetation in the two plots that he studied. Weisfogh (1948) observed a population maximum in autumn and population minima in the summer in cases of Mites and Collembola. He has also observed that the different life forms of Collembola were strictly limited to certain biostrata especially to certain range of moisture. Representative of rare species were important indicators. According to him, the number of Collembola changed very little within a year. Kunnelt (1950) layed stress on the possibility of effects of the concentration of electrolytes in the soil size and the pore space on the population of soil microarthropods.

Mac Fadyen (1952) made a comprehensive study on the study occurrence of soil arthropods at Cothil near Oxford. He observed that microscopic vegetation had a great influence on the fauna but little effect on its species composition. The majority of species did not exhibit greater variation in the samples taken from near and distant parts of the area indicating a very uniform distribution within each plant type. The population of the fauna was largely confined to the upper 5 cm of the soil but in the winter some species penetrated further into the soil. The author observed a regular seasonal difference in population size as shown by most species, they involved an August minima and a February maxima, there were also lesser maxima for some species in December to May. There was relatively little variation in the species composition throughout the year. During his studies the author was able to collect large number of Oribatid, collembolans, Thysanoptera, Coleoptera adult and larvae and dipteran larvae. The population of microarthropod was prone to the effect of accidental fire. Salt (1952) made a useful observation on the arthropod population of the soil in some East African pastures. He used floatation methods developed by him and Hollick (Salt and Hollick 1944). He was able to extract collembolans, thysanopteran, Isoperta, coleopteran larvae, lepidopteran larvae, Symphyla, Chilopoda etc. He summarized his work as follows:

i) 11 soil samples from pastures yielded a population of 5456.2 arthropods per square meter in the top 6 inches of the soil.

ii) 9 soil samples from Coffee and Cassava and fallow land gave collections representing population of 24423 arthropods per square meter in the 8 inches
of the soil. In his opinion, the populations of these arthropods in soil were meager as compared to that of an English soil. The author opined that the paucity of humus in the tropics was the main factor resulting in a smaller population of arthropod in the soil of East African countries.

Birch and Clerk (1953) observed that diversity of characterized soil fauna was attributed to-

(a) the density of different sorts of spaces in the soil
(b) heterogeneity of solid soil.

Bellinger (1954) emphasized that the most important factors determining habitat preference of many species of Collembola were soil moisture, amount and kind of organic matter present and nature of micro and macro flora. A species differed to an extent to which they penetrated through soil as opposed to superficial litter and humus. The author noted population maxima in spring and late summer, but at the same time he observed that each species had its own pattern of annual fluctuation which may differ in different areas. Causes of this fluctuation appeared to be complex, with temperature and rainfall.

In 1955, at Nottingham a symposium was held under Easter School and a galaxy of Pedobiologists participated. The proceeding of the symposium was compiled in the form of a book "Soil Zoology". This was a great thrust to the ecological studies of soil inhabiting insects like termites, collembolans and mites. The symposium covered a wide spectrum dealing with the distribution of soil fauna along with the influence of the soil types. The new aspects of pedobiology such as effects of agricultural practices on soil fauna, the effect of DDT and BHC on the soil Collembola and Acarina were discussed. The book also deals with various methods of sampling and estimation and in the last pages of the book an attempt has been made to present a practical key to the orders and suborders of soil inhabiting insects. This was a great incentive to the workers in the field of Pedobiology.

In the same year, Haarlov (1955) made a study on the vertical distribution on collembolan and mites in relation to soil structure and found that vertical distribution of collembolan fauna was probably related to size and shape of soil cavities and scarcity of food materials. Raw (1956) was probably the first worker who succeeded in extracting the most agile and fragile group of insects the proturans with an aid of
floatation method. He observed that the degree of aggregation appeared to be independent of population density. The distribution of these small insects according to him was associated with the condition induced by lining. Further, the abundance of proturans were correlated with exchangeable Ca\textsuperscript{2+} and soil pH. We observed that the horizontal distribution of the collembolans and Acarina was not random. The fluctuation in the population of the collembolans may be attributed to the climatic conditions but the changes in the population of Oribatei were due to in part to the movements associated with their reproductive cycle. He further postulated that density of population of these microarthropods was significantly greater in the epigeal layer (0-3 inch) than in the deeper layer (3-9 inches). Wallwork (1959) investigated into the general biology of the forest soil mites in relation to selective decomposition of litter and formation of humus at Implake Michigan. He observed that the onset of the winter brought about numerical structural changes in the Mite population of litter and humus layer. The greater part of the fauna was found in the 7-10 cm of profile which was made up of distinct layer of litter and humus. During the summer, the number of mites was apparently four times as great as that of collembolans and at this time, slightly more than 50\% of soil population occurred in litter. In winter a decrease in the number was observed in litter but the humus population was more than that of the summer. In litter, the largest population of adults occurred in the summer, while the peaks of juvenile were in winter. In humus, the population of adults continued to increase slowly through summer and later at the late winter.

Further he discussed the population changes of several commonly occurring oribatid mites to the following factors.

1) death
2) emergence of new forms
3) movements through the profile

Poole (1959) through an examination of the visible gut content of the Collembola showed that the largest species feed mainly on soil fungi whereas smaller forms appeared to feed directly on humus. He was of the opinion that the larger species of *Tomocerus longicornis* probably play an important role in the dispersal of soil fungi.
Granes (1960) was able to extract with the aid of Berlese funnel technique, soil arthropods representing five classes, fourteen orders and some seventy families among which ninety genera and seventy species were identified. Acarina, Collembola and Coleoptera were the dominant orders; this clearly indicated that fungal flora created a conducive habitat for soil organisms. Choudhury (1963) observation on the role of different ecological factors influencing the reproduction and development of different species of Collembola is an extension of his earlier work (1961, 62a, 62b). This comprehensive study is an important milestone in the pedobiological studies in India. Trehan (1945) laid stress on the role of various edaphological factors in conditioning the make up of collembolan population both qualitatively and quantitatively while ascertaining the effect of temperature on three species of Onychiurus, he found that the low temperature retarded the rate of development as some species of Onychiurus over winter either in the egg form or in nymphal stage. He observed that these collembolans are capable of withstanding the adverse atmospheric conditions created by cold and dry spells. Under favourable conditions, with the increase of temperature, there was rapid acceleration in the rate of growth and with this, the duration of each instar, total life span and preoviposition period shortened in duration.

Davis (1963) made a comparative study of Acarina and collembolan population of eight sites and he observed a seasonal variation in the population of microarthropods from a total of 114 species. According to him, the factors which made impact on the population of soil microarthropods, were the amount of organic content of the soil, but the most important factor which affected the seasonal variations was the moisture. Watenova (1964) observed that there is decrease in the population of springtails and mites with the depth of the soil. This decrease was attributed to the factors like the decrease of porosity, CO₂ evolution, carbon contents of the soil and amount of root in each horizon. Dowdy (1965) studied the population of microarthropod in an Oak-Hickort Community in Missouri. The number of mites average 296 per square feet of soil to a depth of 10 inches. Peaks in the mites population appeared in December and January with a temperature below freezing. The population was also high in March at a temperature of 8°C. The lowest peak appeared in November. The highest peak of Collembola appeared in January and February when 84% of the total number were collected. Only a small number of Collembola was collected in March.
In a Pine Community, 256 Mites and 197 Collembola were collected per square feet. Highest peak of population appeared in September with an air temperature 20° C and rainfall 6 inches. Peaks also appeared in July-December with low temperature and normal rainfall. In this community 69% of the mites were taken from litter and 29% from 0-2 inches level. 57% of the collembolans were taken from litter and 41% from 0-2 inches level. In the blue grass community the author observed a meagre population of mites and Collembola.

Ghilarov (1965) highlighted the role of soil fauna in Agro forestry. The activity of soil dwelling animals is very significant for the fertility of soil. In his opinion, destruction of plant debris, their penetration into soil, decay and humification and mixing with mineral particles proceeds due to the participation of the soil dwelling animals. He further stated activity of the soil organisms depends on environmental conditions and vice-versa. It leads to the changes in the environment. Hale (1966) observation on the population of Collembola in moorland is a clear reflection of Dowdy's work which lays stress on the fact that habitat has a pronounced effect on the life forms of Collembola. Hale, too, collected monthly soil samples from four vegetation type (lime stone grassland, alluvial grassland, Juncus grassland and Heather litter). In the low land area collembolans were found to be distributed non randomly and aggregation was found in all soil types study. Inter-specific aggregation occurred probably in the areas of food concentration. He observed that an adverse weather conditions caused a vertical migration as there was higher proportion of Collembola in a lower of the two layers in early summer and winter. The population diminished in the upper layer of the soil because of vertical migration but possibly as a result of differential morality or both. Seasonal variation in number, showed that in early summer and in early winter peak in total numbers of Collembola on lime stone grassland. Early summer peaks were also present in alluvial grassland and Heather litter. The four habitats had different population densities; lime stone grassland supported a higher average population density (52,920 per square meter) than alluvial grassland (48,920 per square meter). Heather litter (35,175 per square meter) and 20,930 per square meter in Juncus grassland.

Jenson and Corbin (1966) performed experiments to evaluate the microclimatic factors causing aggregation in animals and he selected *Isotoma viridis*, a Collembola and *Arion fasciatus*, a Pulmonate. They did not support the hypothesis
that the temperature and relative humidity had any effect on the number of *l. virdis* and *Arion fasciatus*. However, they agree with the previous author like Glassgow (1939), that collembolans are sensitive to moisture and temperature. They postulated that a multiple factor system in which time of day passed, whether effects the formation of aggregation. Wood (1967) studied that the vertical distribution of Acari and Collembola from the four grassland soil from Yorkshire. He summarized his observation as follows: In a mil like Rendzine under Sesleria under *Festuca Agrostis* and two glycepofosolic earth under Nardus greatest density of Acarii and Collembola were found in upper 4 cm. The surface concentration of fauna was greater in podosolic brown earth (87% - 90%) of the total which had distinct LF and H layers over lying mineral horizons than in brown earth and the mil like Rendzine (76% - 79%) of the total there was no surface accumulation of litter and where the horizon consisted of mixed mineral and organic matter the vertical distribution of individual was closely related to their life forms.

Luxton (1966) studied the variation in the densities of Mite population in landward and seaward areas. In his opinion, both the areas were basically homogenous with some evidence of microgradient in the density from sea to land. It was found that Mite numbers reached their peak in August and the fluctuations were attributed to the effect of soil moisture originating from precipitation and total effect. Moisture levels had a more significant effect in seaward plot. Kapetium (1968) studied the influence of several mechanical disturbances on the population of some epigeal forms inhabiting soil. Rosenzweig (1968) studied on the net primary productivity of terrestrial communities: prediction from climatological data. According to them, precipitation is related to primary productivity and has a strong effect on population dynamics of vertebrate populations. A thin, chitinous exoskeleton limits springtail distribution within ecosystems to sites with adequate moisture. Gill (1969) investigated whether litter determines the abundances of soil microarthropods. He observed that an increase or decrease in the amount of litter in the field produced a significant increase or decrease on the abundance of microarthropods during summer and winter and not during spring. The nutritional properties of litter were far less important. The litter had its effect on the microarthropods of soil and in turn affecting the soil faunal population.

Mc Millan (1969) studied the Acarine and collembolan population in two New Zealand pastures. He compared the seasonal variation in the density of collembolan
and Acarine population of the two pastures. Through his analysis of total and partial coefficient correlation, he found that in majority of instances soil moisture and temperature did significantly influence population numbers. He found that, Acarii and collembolan population attained greatest number generally during autumn and winter, when temperature was decreasing. The pattern of seasonal periodicity was not uniform for all the constituent group of Collembola and Acarina. A comparative study of frequency and dominance of collembolan and Acarine species. revealed that *Isotomina thermophila* was the most dominant collembolan in plot A and ranking second in dominance in plot 3. *Oppia* spp. was the most dominant Acarine in both the plots. He concluded that in both the plots a significant association existed. Usher (1969) worked on some properties of the aggregations of soil arthropods: Collembola and explained that Collembola behaviour in presence of a predator generally considered individual reactions but no data are available on the reactions at the population level. Collembola populations are known to aggregate in space.

According to Kaptin and Groen (1970), *Tomocerus minor*, *Orchesella cincta* and *Isotoma virdis* reacted differently to the same saturation deficit. The different species reacted differently to the same saturation deficit value with the humidity preference of the species in their natural habitats. In their opinion, desiccation stimulated Collembola to higher locomotory activity and finally let them to aggregate in optimal humidity condition. Christiansen (1970b) while making behavioural studies in Collembola, especially pertaining to general aggregation, selection of substrate, aggregation around food dispersal under different conditions observed that in the Entomobryoidae, the epigeic and trogolophilic forms showed larger aggregation than the trogolobitic forms. In reference to the substrate selection the species showed preference for wet or drier substrate. According to Belfield (1970) the population density of soil arthropod was greater in the shaded plots than in the unshaded plots. Choudhury and Roy (1970) studied the effects of soil condition on the collembolan population in the district of Jalpaiguri, West Bengal (India) and observed lack of identity among the collembolan population of the two plots though having more or less similar soil conditions. Mukherji and Singh (1970) studied the seasonal variation in the densities of Collembola, Acarina, Diplura, Symphyla, Pauropoda, Palpigradi and Pseudoscorpions in a rose garden at Varanasi. They found that there existed a certain correlation between the moisture content, temperature and the population.
dynamics of soil microarthropods, when both, the temperature and soil moisture contents are reasonably high. They observed a narrow range of variation in the case of pH and organic matter of the soil. According to them, it was difficult to interpret any correlation with these soil factors and population of soil arthropods. Erasmus and Ryke (1970) worked on the soil mesofauna associate with Eragrostis curvula (Schrad) ness and reported an increase in the density of microarthropods as soil moisture conditions increased. However, the fact that correlation between moisture content and mite numbers at the cassava plot was not significant implies that the disturbances at the cassava plot as a result of cultivation probably introduced other factors which influenced mite populations. These factors must have been superimposed on the existing factors under forest conditions.

After 1953 in 1970 was another major breakthrough in Pedobiology a book entitled "The Ecology of Soil Animals" by publication of Wallwork. This book is a comprehensive and systematic account which deals in detail, the soil environment, soil forming processes and the soil type, classification of the soil fauna, regulation of population size, character of the soil community and the functioning of the soil community. This was a great thrust towards the ecological study of soil fauna and was a source of inspiration for new entrants in the arena of Pedobiology.

Choudhury and Roy (1971a) observed that the population of collemboans reached the maxima in Nov-Jan in an uncultivated plot of West Bengal. These maxima had a positive correlation with organic carbon, CaCO₃ average particle size, but negatively correlated with moisture. In a separate attempt Choudhury and Roy (1971b) studied the vertical distribution and seasonal fluctuation of the Lepidocyrtus sp. They observed a monsoon peak in July and winter peak in December in West Bengal. It has also been shown that soil inhabiting acarina could tolerate a minimum temperature upto 18°C and during this period there was an increase in the population; Oswald (1971). Wood (1971) worked on The distribution and abundance of Folsomides deserticola Wood (Collembola: Isotomidae) and other microarthropods in arid and semi-arid soils in southern Australia, with a note on nematode populations and has found to be widespread in Australian desert soils; the remainder comprised, to a very large extent, individuals identified with the genus Xenylla. Lee and Wood (1971a) studied on physical and chemical effects on soils of some Australian termites and their pedological significance and stated that for Australian mound-building and subterranean termites there was a lowering of the pH compared with
surrounding soil, but the differences were small. They also found in a few mounds that the pH was higher than the surrounding soil but, as before, not by a great margin. A decrease in pH is associated with the incorporation of organic-rich excreta while an increase is often correlated with an increase in calcium. Butcher et al (1971) studied on Bioecology of edaphic Collembola and Acarina and found that soil temperature accounts for 76 percent and 61 percent of the variation in mite numbers at the forest and cassava plots, respectively, and soil temperature was not as affected as moisture content by the new factors imposed upon the cassava plot because the negative correlations between this factor and mite numbers at both plots were significant. High soil temperatures have been reported to reduce or prevent egg-laying and cause mortality of the sperm of mites thereby leading to a decrease in the size of mite populations. Solhoy (1972) studied the invertebrate fauna of mountains in South Norway. He found that the fauna of the vegetation layer on the three sites namely – the dry meadow, wet meadow and lichen heath was dominated by Collembola and Acarii. During the draught period, in July/August a pronounced drop in population occurred on the dry meadow and lichen heath, while the population on the wet meadow was positively affected. The trends in the total number during the seasons were chiefly governed by the variations in these two groups. In the wet meadow the groups Hemiptera, Coleoptera, and on the dry Lepidoptera and Coleoptera. Thysanoptera showed an early summer peak in the dry meadow but a late summer peak in wet meadow. The number of other groups Hemiptera, Coleoptera was quite similar in July and September. It was interesting to note that the number of Hymenoptera and Opilina decreased from early summer towards the autumn and the trends were almost identical on both dry and wet meadow. In the dry and wet meadow, the number of Hemiptera and Diptera showed a decreasing trend towards autumn.

Choudhury and Roy (1972) in their comprehensive studies on the quantitative and qualitative composition of collembolan fauna of West Bengal in India gave a detailed account of their seasonal variations and distributional pattern of Collembola (both horizontal and vertical) in relation to various soil factors namely, moisture, organic carbon, nitrate, phosphate, calcium carbonate, hydrogen ion concentration, particle size and soil cover. According to them, the spectrum of Collembola was not very large and the collembolan fauna extracted, belonged to 25 genera of the families Entomobryoidae, Onychiuridae, Hypogastruridae, Nenuridae, Poduridae,
Isotomidae and Sminthuridae. *Lepidocyrthus, Proisotima, Cyphoderus, Lobella* and *Isotomurus* were the dominant genera. The general form of population curve which they obtained seems to be determined by aforesaid three genera, members of which attained peak in July and August. The winter maxima were also obtained in some cases. They postulated that the rise in the population density was correlated with the soil factors like moisture, organic carbon, nitrate and phosphate. The particle size was also found to be significantly correlated with the population, at least, in some cases. They found majority of the individuals in the upper layers of the soil. Fujikawa (1972) compared the population of mites thriving on leaves without insecticides with that of the leaves with insecticides. In all 781 adult Oribatid mites representing 40 species were collected. 9 of the 40 sps were common to both with or without insecticide. Of the 9 species *Oppia* sp. was dominant. He further stressed that the fresh leaves taken from the trees were not conducive to the growth of the population of Oribatid mites in comparison with that of the litter in various stage of decomposition.

Ghilrov (1973) elucidated, "Soil tillage an agricultural utilization affects soil animals in various ways and are to a different degree dangerous to various taxa and various soil invertebrates accompanied by change in predominant species". He observed that many ecological groups/taxa were completely eliminated after tillage and other agricultural operations. Edward and Lofty (1973) while working on the influence of cultivation on the soil microarthropod population, observed that affects of ploughing more or less stimulated the conditions that normally prevailed in an arable land. Vlug and Borden (1973) observed the population density in water logged and burnt forest area was moderate indicating that neither of the two cause induced mortality. There was no seasonal fluctuation and no correlation of the density of population with soil moisture, hydrogen ion concentration and temperature. Zheleva's (1973) observations were in the line of above quoted works, according to the author, the deep cultivation of the soil was favorable for the species inhabiting deep soil layer. The cultivation of soil influenced the seasonal variations of Oribatid population of different spp. The use of fertilizers however, did not make any difference in the total number of Oribatids. Athias (1974) observed numerous fluctuations in the population of soil mites related to three environmental factors namely soil temperature, soil moisture and amount of litter. A dry warm soil supported highest mite densities. The increase in soil moisture
did not affect the abundance. He found a positive correlation between the number of Oribatids and dry weight of the litter. Other important factors that influenced the population density of mites were soil erosion and amount of the roots of the grass plant. Edward and Lofty (1974) while ascertaining the effects of organic manures and other factors on the invertebrate fauna of a grassland in a park observed that the total collembolan population remained little affected by the level of nitrogen. A slight increase in response to single dose of nitrogen was noticed, but the number of soil dwelling collembolan decreased much more than those living near the surface of the soil. In their opinion Collembola as a whole was influenced by the hydrogen ion concentration of the soil more than the mites.

Choudhury and Banerjee (1975) in their ecological investigation on the soil meso and micro fauna of uncultivated plots of West Bengal, India brought to light the following information:

1) Crystostigmate mites predominates in monsoon months (July – August) over other groups of mites such as Mesostigmata, Prostigmata and Astigmata as well as Collembola in the scale of population – abundance next come Collembola followed by Mesostigmata, Population of both Prostigmata and Astigmata mites were significantly low to both qualitative and quantitative composition.

2) Population size of both Acari and Collembola appeared to be dependent on the organic matter – microbes complex operating in soil.

In the same year Choudhury and Bhattacharya experimentally investigated the effects of temperature and humidity on the development and hatching of eggs of Lobella mxillaris Yosii (1966) under laboratory conditions. The results that obtained are summarized as follows:

1. There existed a direct relationship between development index and temperature – humidity complex.
2. Though the minimum incubation period was noted at 30°C and 100% RH at this temperature / humidity complex the egg mortality was high because of fungus infestation.
3. The rate of hatching was relatively low at 25°C with 90% RH.
4. Favourable range of humidity for development at all temperature gradient was between 95% and 100% RH.
5. Rate of mortality of developing embryo increased in low temperature combined with desiccation.
6. Decrease of humidity retarded the rate of development.

Singh and Pillai (1975) compared the population of soil microarthropod of banana field, a citrus orchard, fodder field and fallow land. They found that population density of microarthropod ranged from 1697 to 20,376 per square meter. Acarii was the most dominant group of all the habitats ranging from 45.5-71.7% of the total fauna. Maximum number of Collembola was obtained from banana field where the soil moisture, organic content and calcium carbonate were high. Population density of Collembola in different habitats ranged from 11.9%-41.7%. A positive association was observed between the collemobolan and oribatei and negative association between collemobolan and Prostigmata. Quantitative composition of collemobolan showed that some species were specific to particular habitats in their population build up. Collembola and Oribatei were dominant in soil with high organic matter content and Prostigmata predominated in the soil with lower organic matter. Tadros (1976) made an attempt to test the role of micro fauna in the decomposition of fresh organic matter, it was found that the organisms responsible for the process belongs to two phylum Arthropoda and Annelida, and three classes Arachnida Insecta and Oligochaeta. Arachnides reached a rate of (65.19%) followed by Insecta (33.36%) while the Annelida was the least infesting organism (0.68%). He observed that mesofauna preferred to live on leaves followed by roots and lastly stems. He concluded that the period needed for the decomposition of fresh healthy plant part into consideration, it appeared that the first period was more suitable for the soil fauna to work than the second one. Oribatei was a group of high infestation followed closely by Insecta. Knight (1976) compared the seasonal and microstratal dietary habits of two species of *Tomocerus*, that is *T. lamelliferus* and *T. falvescens* occurring in pine and mixed deciduous community. Three random samples of upper soil profile were taken from each ecosystem. In the case of *T. lamelliferus* it was found that in the litter, the micro-stratum of the pine community organic detritus material was consumed in significantly greater quantity than fungal material. But no statistically significant results were obtained from the data collected from deciduous area. Though, the deciduous humus population was larger than those recovered from the upper litter microstrata. There was a tendency for older members of *T. lamelliferu*
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with greater frequency in microstrata and each system investigated. In his opinion, feeding activity occurred more frequently in the litter microstrata, soil profile. The humus microstrata may serve as a convenient refuge for moulting activity when the organism would be more vulnerable for predation. Hiroshi (1976) studied the population density of *Folsomia octoculata* in a sub-alpine coniferous forest. The body size of the individual population ranged between 0.3mm - 0.6mm in length and the population is always composed of 2-3 generations. Breading period appeared to begin in mid July and cease in mid October. Population structure was seasonally different, but, stable year by year. The peak of growth rate was observed in August every year. The species was chosen by the author as it was a dominant Collembola in Shiga heights. The annual mean temperature of the area was 3.7°C with soil type was wet podosal.

Dean et al (1976) studied the effects of carbaryl on Mites, Collembola and Calosoma in an Oak type forest. The carbaryl was spread serially for the control of gypsy moth at the rate of one pound per acre. This treatment did not have a lasting significant effect on total mite population. The collembolan population was reduced in about six week and three months after treatment. This reduction was not apparent by the following spring. In their opinion, the insecticide had a short term effect on the mite and collembolan population. Wong et al (1977) observed that Collembola and Acarina were abundant in the soil which had higher contents of organic matter. Anderson (1977) studied on the organization of soil animal communities. According to him, a serious difficulty for understanding the diversity-ecosystem functioning relationship in decomposer invertebrates is that knowledge on the driving forces for the evolution of soil-animal diversity is poor. The packing of animal species in soil is exceptionally dense. In forest soil, hundreds of species and thousands of individuals are concentrated in the litter layer and the uppermost mineral-soil layer the size of a footprint. Both the diversity within and the diversity between trophic groups are high. Food relationships between soil-animal species are not well studied, but some evidence shows that most taxa are food generalists rather than specialists. Nosek (1977) studied the adaptations in Protura related to their soil life. According to him, the evolutionary adaptations in Protura are of not only physiological, ecological and morphological nature but genetic and geographical isolation as well as population genetics are of importance. Protura are well adapted to different life conditions existing in edaphic environment. Price and Benhan (1977)
are of the opinion that population densities of microarthropods (Acarina, Collembola, Pscoptera, Pauropoda, Protura, Symphyla, coleopteran and dipteran larvae and Diplura) decreased gradually with the increasing depth. According to them, the sampling depth in the study area perhaps in all agricultural cultivation sites should extend at least to the bottom of the tillage zone. As they found some of the taxa of microarthropod were abundant below the tillage zone. Hutson (1978) studied on Influence of pH, temperature and salinity on the fecundity and longevity of four species of Collembola. According to him long-term reduction in environmental pH may disrupt soil fauna. Changes in the structure of collembolan communities due to soil acidification have been observed in alpine grassland, where an alkalophilic species decreased and was replaced by an acidophilic species. This change not only involved mortality but also other factors such as fecundity and longevity. Muraleedharan and Prabhoo (1978) Collembola capable of selecting food, Collembola feed on fungi. Food relation between soil animal species is not well studied, but some evidence show that most taxa are food generalists rather than specialists.

Bhattacharya and Roy Choudhury (1979) studied the population fluctuation of the soil microarthropod in a stretch of arable land of Shantiniketan in relation to some climatic and edaphic factors for two years. Soil microarthropods including two major groups, Cryptostigmata and Collembola, showed two peaks, a pronounced peak during post-monsoon period (September and October) and less pronounced peak in pre-monsoon period (May and June). Collembolan population have been found to have a significant positive correlation with a mean monthly RH, air temperature and with the moisture content of the soil, whereas mean monthly RH and moisture content of the soil had a significant positive correlation with Cryptostigmatid mites. Contrary to these, pH showed significant negative correlation with Cryptostigmatid, Collembola and with microarthropod population in general. Moisture content of the soil was considered to be the most important single factor responsible for the population fluctuation of microarthropod inhabiting soil. Bath (1980) found that the soil when treated with \( \text{H}_2\text{SO}_4 \) influenced different soil biological properties significantly. It caused a decrease in the rate of decomposition, the microorganism population. The composition of soil fauna population consists of Collembola, Hypogastrura, Isotoma, Mesostigmata, Astigmata, Prostigmata and Cryptostigmata changed. Hence, the total decrease of the activity remains prevalent ultimately
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decreased the soil fertility. The authors observed, that, “from our results it was not possible to conclude that changes in soil biological properties were entirely due to hydrogen ion (H) the acid was distributed as H$_2$SO$_4$. It can be excluded that the added SO$_4$ could have negative effect on soil organism. Qualitative and quantitative changes in the input of plant litter could also be the major factor. The ground and field vegetation were almost killed in acid treatment. It appears, however, that one cannot preclude that acidification may have marked influence on the processes in the below ground ecosystem and consequently, in a longer time perspective, on the whole terrestrial ecosystem”.

Hole (1981) studied on the effect of animals on soil and summarized the activities of soil fauna which include: mounding, mixing, forming voids, forming and destroying peds; regulating soil erosion, plant and animals litter; assisting the movement of air and water in soil, and regulating nutrient cycling. These activities have long been recognized as having a significant role in soil formation. Josse (1981) studied the population dynamics of Collembola based upon the study of surface dwelling species like orchesella and Tomocerus minor in light of their life history, availability of moisture, physiological efficiency and behavioural methods to combat with desiccation. In this connection, their locomotory behavior and jumping mechanism were also taken into account. The author elucidated that reproduction and feeding were linked and starvation brought a cessation of reproduction and development. The author was of the view that the role in regulating the population size apparently depends on the nature of the environment. An unstable environment clearly less favourable for T. minor mainly because of density independent factor such as RH, in this case affects population number. The same habitat was found to be favourable for O. cineta. Humidity is important but acts indirectly on the number via mobility. In a more stable and favourable environment, biotic factors play a more direct role, a higher predation risk for O. cineta and specially stronger competition between two species. Josse (1981) while working on the ecological strategies and population regulation of Collembola in heterogeneous environments found that springtails are parthenogenetic; sexual maturity generally occurs at the sixth instar and oviposition generally occurs within 12–48 h after moulting at 21°C. Takeda (1981) studied on effects of shifting cultivation on the soil mesofauna with special reference to collembolan populations in the north-east Thailand. He documented the seasonal changes in abundance of Collembola in north-east Thailand. The population of Collembola abundances increased in the wet season and decreased in
the dry season. William (1981) studied low temperature effects on microarthropods. Badejo (1982) has pointed that, there was an increase in the density of microarthropods as soil moisture content increases and more mites (acarina) are generally supported in the upper layers of fermentation and litter. A difference in arthropod population structure in the soils of forest and Jhum sites of North Eastern states was observed by Darlong and Alfred (1982). They further observed that firstly the population density was maximum in May and minimum in December from the upper soil layers. Secondly the population tended to decrease during dry and cold season. According to them, temperature and precipitation are of vital importance for soil fauna. The occurrence of high population during rainy season was due to the excessive moisture content in the soil and winter minima was due to desiccation of soil combined with low temperature. The Jhuming practice increase the pH of soil decreased its moisture holding capacity, which in turn caused loss of vegetation and increase soil temperature. It also reduced the soil organic matter and consequently the availability of food to the soil fauna.

Parker et al (1982) studied on the effects of subterranean termite removal on desert soil nitrogen and ephemeral flora (Gnathham-termes tubiformans, Amitermes wheeleri) and measured an increase in soil nitrogen at the 0-2.5 and the 10-20 cm depths in the absence of termites. Hubta and Mikkonen (1982) were able to extract 7 sps. of Entomobryoidae. The most abundant of these was Lepidocystus, which amounted to 10,000 sq.m. The authors classified the 7 sps. into three groups according to their population cycle. All 5 sps. belonging to genus Entomobroya and Orchesella. The over wintered adult gave rise to the generation that started hatching in June or to some extent at the end of May. In Lepidocytus, hatching took place early and small juvenile were always abundant in first half of May. Probably, the eggs laid in previous year continued to hatch after melting of the snow. Over wintered adults were also present in May and probably produced the second wave of juvenile. Finally Tomocerus reproduced continuously in several ways during summer so that population consisted of many age classes. The oldest animals die during winter and half grown individual of different sizes were found in spring. Their offspring started hatching in July. This study revealed that temperature regulated the reproduction of springtails. The other important factor was moisture. According to the authors, Entomobryoidae are highly capable of searching suitable microhabitats. Petersen and Luxton (1982) studied on a comparative analysis of soil fauna populations and their role in
decomposition processes and reported that Collembola generally subjected to a heavy predation pressure because of their aggregative behaviour; nevertheless, they are found in very large number in soil and this puts the question if springtails have developed defence strategies against predators. Huther (1983) studied the impact of human interference on the collembolan population. The author selected three habitats to evaluate the effects on ground fauna by burning and cultivation. On the soil surface, collembolans were dominant as were the mites in the soil. The dominant collembolan group on surface was *Hypogastrura*, in the soil the blind Isotomides. One month after clearing the burn, the population density on the surface was higher than in the primeval forest but mites were now dominant and collembolans were completely absent from the soil. One year after the burning, the total arthropod population was similar to that of the primeval forest but the respective collembolan population showed distinct differences. In an orange plantation, the arthropods on the surface were much more abundant then in the forest including the Collembola but the mites were dominant. Rajagopal (1983) reviewed the earlier works on various aspects of the life of termites. His comprehensive review covers a wide spectrum including:

1. Classification
2. Distribution
3. Biology
4. Nest system
5. Architecture
6. Temperature and humidity relation
7. Population density

The population density and fluctuation in the cast composition within seasons vary with species to species. The optimum temperature requirements for *Heterotermis indicola* (Wasmann) was between 30-32°C. Mitra et al (1983) studied the effect of organic and inorganic fertilizers on a collembolan population. The authors are of the opinion that organic and inorganic fertilizers affect the number of Collembola favorably. Former exerting direct influence by providing food and later indirectly through the effect on the growth of plant and microorganism. The authors further stressed that rotation of crops with the application of fertilizers, increase the population of those species which were able to tolerate the rigor of cultivation. It was further observed that the effects of various dosages of NPK during jute, paddy
and wheat cultivations were reflected in their population dynamics. Long term use of chemical weedicides had a significant effect in reducing the population of Collembola as well as crop yield. During paddy cultivation, the effects of chemical weedicides, however, less pronounced presumably due to high degree of moisture and intermittent rains which diluted their effects.

Hagver (1984) performed experiments by adding calcium carbonate and dilute H$_2$SO$_4$ in the soil and observed the abundance of several species of Collembola in two out of three experiments. The total abundance of Collembola was significantly reduced. The abundance of Protura increased in one experiment. Reduced soil pH (mainly after application of water with pH 2-2.5) resulted a complex reaction pattern. Tamm (1984) work on the life of terrestrial arthropods living in flood prone areas, revealed that collembolans and Acarine undergo a stage of inactivity during submergence and their eggs hatch after the water recedes. Takeda (1984) showed that the birth and death rates of Folsomia octoculata are both temperature dependent in pine forests. In temperate forest soils, seasonal changes in population abundance reflect the birth and death processes of populations during the growth and reproductive period from spring to early winter and the mortality during the winter period. During the wet and dry seasons, recruitment occurred repeatedly and gave rise to an overlapping generation structure, and there was no evidence of aestivation during the dry seasons. Seastedt (1984) studied on the role of microarthropods in decomposition and mineralization processes. He found that abundances of soil arthropods were about 300,000 m$^{-2}$ in temperate forest soils compared with 50,000 m$^{-2}$ in tropical forest soils.

Mallow et al (1985) studied the effect of different management practices on the population dynamics of Acarina and Collembola in corn production system. His studies were directed towards the effect of ploughing and a weedicide Atrazine. He sampled the collembolans and mites from plots on which corn was grown. The soil was highly fertile with high moisture content. They compared their results with that of a grassland counter part. They found that Acarina and Collembola increased in June with maxima occurring in July for Acarina and in August for Collembola. The trends in the natural population level of these soil animals show a great deal of variation with respect to seasonal fluctuations. They observed an indirect effect of cultivation on the population dynamics in the form of a change in preexisting plant cover. Such an alteration of vegetation cover changed the structure of soil animal population within
one horizon and soil type. The change in the vegetation cover also changed the quality of soil organic matter which in turn, affected the faunal composition. The authors concluded that after seven month of the treatment, there was no recovery of the level comparable to grassland for total Acarina as Prostigmata, Cryptostigmata began to recover after few months while Mesostigmata recovered just after three months. The quick recovery in Mesostigmata in general may be attributed to their predatory behaviour. Population of Collembola with an exception Tullbergia granulata began to recover after four months. Tamm (1986) studied the post fire effects on the succession of surface dwelling Collembola in an unburned forest. He recorded 50,000 individuals distributed under 44 species. The fire brought a drastic change in the habitat as it resulted in the carbonization of ground vegetation to a large degree thus causing destruction of raw humus of the top soil. The fire mortality of epizooic springtail was very high. Seven months after the fire, the individual Collembola captured in burnt area were reduced to 20% in April. However, just two months, the burnt population level coincided the control level and their means remained greater than the control during entire study period. The first most striking effect on Collembola was the long term change in the dominance structure, although, species diversity did not change conspicuously. After the burn, 10 of the 25 more numerous species were clearly and consistently reduced by the fire. These species were mainly surface dwellers. Three of them probably became extinct. The long term effect causing reduction in the collembolan population was that the fire induced changes in the habitat structure. The most abundant species in this area were numerous in both burnt and unburnt areas. The remaining 13 species were for more numerous in burnt area than in the controlled area. Most of the species preferred either open habitat without a wood stratum or more xeric condition. With the reappearance of the vegetation, there was an outbreak of collembolan pioneer species. The collembolan fauna of burnt area gradually approached but not recovered its pre-burnt condition within the study period. After five years of succession some of the species which were typically abundant after the burn, but only occasionally found on the un-burnt area still dominated the community in contrast to many other arthropod group, the succession of Collembola is not characterized by a species which immigrated to burnt area.
Mola et al. (1987) studied the effects of weedicide atrazine on a species of Collembola under laboratory conditions. They compared the results of laboratory tests with those obtained in field studies and confirmed that the field herbicide effect may be direct. In fields, the atrazine causes cessation in the frequency of fecundity and thus affects reproduction. But this effect is a short-term effect as the collembolans under study restored the breeding capacity after a month.

Takeda (1987) studied on dynamics and maintenance of Collembolan community structure in a forest soil system; they supposed density-dependent regulation to be the cause for the consistency of temporal organization patterns of the studied Collembolan community, yet without testing this hypothesis by formal analysis. House et al. (1987) worked on herbicide effects on soil arthropod dynamics and wheat straw decomposition in North Carolina no-tillage agroecosystem. According to them, a decreased vegetation canopy can change the microclimate by affecting the temperature and moisture of soil. Anderson (1987) studied on interactions between invertebrates and microorganisms: noise or necessity for soil processes? According to him, the indirect effect of soil invertebrates on litter decomposition through litter fragmentation and modifications of the structure and activity of the microbial community considerably exceeds the direct effect via their own metabolism. Vance et al. (1987) worked on an extraction method for measuring soil microbial biomass and C contents and they have summarized that intact sub samples of the collected soils were used to characterize complementary biochemical and microbial parameters. Intact sub samples for biochemical analysis were immediately stored at 4°C until analysis. Triplicate 15 g aliquots of intact soil were used to determine N microbial biomass (N-MB) and C microbial biomass (C-MB). C-MB and N-MB were determined by the fumigation-extraction method using alcohol-free chloroform. In both cases, MB was calculated as the difference in total C and N extracted in the fumigated and non-fumigated soil. Didden (1987) critically evaluated the suggestion by Usher (1976) that aggregation of soil microarthropods in favourable microhabitats can be caused by two factors – the location of food sources and the physical environment. The author performed a number of experiments and opined that food as a factor could be ruled out so were the temperature and humidity. So the author further stressed that the pore structure remains the only factor that influences the nature of environment. The compost soil with 7.18% macropores by volume have sufficient space to harbour, the collembolan though, the macropore were not interconnected. Thus the author inferred, that the animals disappeared readily into compost.
soil even though they were placed on the surface compacted by the press. This indicates that they need more space to live in the soil.

Cannon and Block (1988) stated the cold tolerance of microarthropods. In their study, all microarthropods appear to be freez susceptible and they utilize varying levels of supercooling to avoid freezing, moulting may increase individual’s supercooling ability especially in Collembola and the activity of ice nucleating bacteria in cold hardy arthropods may be important. Vegter et al. (1988) studied on the community structure, distribution and population dynamics of Entomobryidae (Collembola), they argue that, in contrast to conventional theory, this hierarchical structure of collembolan communities does not characterise assemblages in an early successional state but that it is typical for developed communities where more and more species are forced into secondary roles. Anderson (1988) worked on spatiotemporal effects of invertebrates on soil processes. According to him, litter-feeding macrofauna have a tremendous impact on decomposition because they process large amounts of litter. Sinha et al (1988) were of the view that not a single factor but a cumulative action of a number of factors are responsible to control the seasonal periodicity of soil mesofauna. Sinclair (1989) studied on the population regulation of animals, his research was designed to investigate whether, and by what means, springtail and mite numbers are regulated. A regulatory factor is any density-dependent process that keeps populations within predictable density ranges by affecting population growth quantifiably. Villani and Wright (1990) studied the environmental influences on soil microarthropods behaviour in agricultural systems. Hagvar and Abrahamsen (1990) worked on the Microarthropod and Enchytraeidae (Oligochaeta) in a naturally lead-contaminated soil: a gradient study. According to them, anthropogenic activities may have persistent and long lasting effects on Collembola, although with long-term (centuries) exposure, springtails can become tolerant to metals. They have also found that species number decreased with increasing Pb concentration along a gradient. Aber et al (1990) studied on predicting long-term patterns of mass loss, nitrogen dynamics, and soil organic matter formation from initial fine litter chemistry in temperate forest ecosystems. According to them, on the basis of the close correlation between litter quality and decomposition, litter traits can be used as predictors for decay rates across species. Riechert and Bishop (1990) worked on Prey control by an assemblage of generalist predators: spiders in garden test systems. According to them, in agricultural systems, a clear positive correlation between the amount and composition of plant residues and the density and diversity of
decomposer and predator organisms has been observed. These relationships are of key importance for successful pest management, and therefore, a thorough understanding of trophic interactions and controls in food webs is necessary. Blair et al (1990) studied on decay rates, nitrogen fluxes, and decomposer ectomycorrhizal and a leaf-saprotrophic basidiomycete colonizing beech leaf litter. They have reported a significantly higher N release from mixtures did not detect a concomitant change in mass loss. Verhoef and Brussaard (1990) worked on decomposition and nitrogen mineralization in natural and agroecosystems: the contribution of soil animals. They have reported that the direct contribution of decomposer invertebrates to energy flow and carbon mineralization is low (about 10%), whereas the direct effect on nutrient mineralization is somewhat higher (~30%).

In an interesting study by Joy and Pratim (1991) it has been shown that chemicals like Aldrin and Endosulphan adversely affect the density of soil microarthropods and specially the Acari and Collembola. Andow (1991) worked on vegetational diversity and arthropod population response. According to him, in forest and agricultural ecosystems, plant-species diversity and composition may determine the susceptibility to insect outbreaks. Ponge (1991) worked on food resources and diets of soil animals in a small area of Scots pine litter. According to him, the factor which has been considered to have a high influence on the food preference is the microhabitat where they are living, but there are cases where the species share the microhabitat, but differ in the food they take. So, it has been observed that in soil and litter there is preference for fungal spores and mycelia, bacteria and fecal pellets, while the species which climb trees or always live in the canopy, ingest pollen grains and spores more often. Wolters (1991) worked on soil invertebrates: effects on nutrient turnover and soil structure. According to him, the indirect effect of soil invertebrates on litter decomposition through litter fragmentation and modifications of the structure and activity of the microbial community considerably exceeds the direct effect via their own metabolism. Myrold and Nason (1992) worked on the effect of acid rain on soil microbial processes. According to them, the impact of acid rain on soil fauna has been extensively investigated. However, the direct effects of acid precipitation on soil animals are poorly understood. Collembolans are important members of the soil mesofauna and play an important role in organic matter decomposition in soil. Lavelle et al (1992) worked on a hierarchical model for decomposition in terrestrial ecosystem: application to soils in the humid tropics. According to them, ecological studies of soil animals have been focused
on macro-soil animals such as termites and earthworms, which are important ecosystem engineers in tropical soils. However, there are rather few ecological studies of microarthropods such as Collembola and Acari. These arthropods have high abundances in boreal and temperate forests and have a significant function in decomposition processes in forest soils. Hobbie (1992) worked on the effects of plant species on nutrient cycling. According to them, plant-species composition, in turn, significantly affects ecosystem nutrient cycling through plant-nutrient uptake and use, rhizosphere interactions, production of litter of specific quality, and microenvironmental changes. Shaw (1992) worked on fungi, fungivores, and fungal food webs. According to him, laboratory experiments suggest that some fungivores (Collembola, Nematoda) prefer ectomycorrhizal over saprotrophic fungi, but this pattern varies according to specific features of animal and fungal species. In particular, collembolans avoid toxic species of mycorrhizal basidiomycetes. Lussenhop (1992) studied on mechanisms of microarthropod-microbial interactions in soil. According to him, selective grazing affects fungal biomass and activity, interrupts bidirectional nutrient transfer between decomposing litter and plant roots, regulates fungal succession in decaying litter, and can strongly reduce mycorrhizal mycelium. Crosseley et al (1992) stated that microarthropods participate in the complex food webs of soil. They have impact on organic debris, microbial decomposers, nematodes, roots and pathogenic fungi. Kaczmarek (1993) worked on Collembola and reported that more than 90% of Collembola inhabit the top 10 cm of soil. Thus, soil cores of 10 cm depth were considered to be sufficient to sample most of the springtails. Stork and Blackburn (1993) worked on Abundance, Body Size and Biomass of Arthropods in Tropical Forest. According to them, in the rain forests of Seram; Indonesia, Collembola comprise about 20% of the total number of arthropods on tree trunks and 50% and 60% of the total from soil and leaf litter, respectively (Stork and Blackburn). However, because of their small size the contribution of Collembola to total soil animal biomass and respiration is low, typically between 1% and 5% in temperate ecosystems, but up to about 10% in some arctic sites and as much as 33% of total soil fauna respiration in ecosystems in early stages of succession. Typical values for the dry weight of springtails in temperate ecosystems are 0.15 gm⁻² in deciduous woodland and 0.3 gm⁻² in limestone grassland. Perry et al (1993) studied on using response-surface methodology to detect chaos in ecological time series. According to them, most long-term census data on insect and vertebrate species have been analysed on a yearly time scale so that abundance in any given year is related to that in the previous year, yet dynamics of populations within years (e.g. seasonality) form the basis of many
insect population dynamics. Yuqing et al (1993) studied on Abundance of carabid beetles and other ground-dwelling arthropods in conventional versus low-input bean cropping systems and reported that the impact of cropping practices on the abundance of soil arthropods differs with species; many species were equally abundant in both conventional and low-input plots or had higher densities in the conventional or in the low-input plots. They also noted various carabid species that could spread from 1 to 49 ha in an active season and they claim that these movements between conventional and low-input plots may also indicate selections in resources, in which the carabids depend on, and in microclimatic conditions between the plots investigated. In another study, Vreeken-Buijs et al (1994) described microarthropods biomass C–dynamics in the below ground food webs of two arable farming systems. In their study, the most abundant functional groups were omnivorous Collembola, omnivorous – non – cryptostigmatic mites and predatory mites. He found no relation between the biomass of the microarthropods and their main food source.

Kuznetsova (1994) worked on Collembolan Guild Structure as an Indicator of Tree Plantation Conditions in Urban Areas and reported that the composition of fluctuating communities of mixed and ruderal types is even more variable. Due to the "insular effect," the urban soils under neighboring trees growing in the openings in pavement may be inhabited by different sets of springtail species with the local prevalence of any group of life forms, as well as with different dominant species. Jones et al (1994) studied on organisms as ecosystem engineers. According to them, the ecosystem consequences of the diversity of soil organisms are little understood, except for some keystone species or ecosystem engineers such as earthworms, termites, and ants. Hägvar (1994) Studies on springtails have shown that their natural communities (taxocenes) are multispecific groups organized on the basis of resource partitioning and competition between species, and their dynamics are generally predictable. Studies have shown that soil fauna improve agricultural productivity through their activities on soil (Tinzara and Tukahirwa 1995). An other important work done by Coulson et al (1995), who postulated the low temperature performance of soil microarthropods at Nyalesund Spitsbergen. He concluded that the supercolling activity of these animals decreased rapidly on regaining activity in spring starvation for 14 bands desiccation or a combination of both, resulted in little change in the means super cooling point of Collembola.

Chemova et al (1995) studied on the Changes in population growth rate of springtails (Collembola) under the influence of herbicides. According to them, tests on F.
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candida provide direct information only about the effects of chemicals on F. candida. How representative is this species of all Collembola? Most studies show that F. candida is among the most sensitive springtails to the majority of chemicals. Anderson (1995) worked on soil organisms as engineers: microsite modulation of macroscale processes. According to him, in natural ecosystems, and less so in agricultural ecosystems, the soil represents the habitat for a tremendous diversity of organisms. Moreover, soil itself is largely built through the action of animals, particularly primary and secondary decomposers. Laakso et al (1995) studied on The dominance of food generalists suggests high redundancy among soil animals, which supports evidence of a weak relationship between soil-animal diversity and ecosystem processes observed in various experiments. Filser et al (1995) worked on the effects of previous intensive agricultural management on microorganisms and the biodiversity of soil fauna. According to them species assemblages in polluted soils may change due to quantitative and qualitative changes in food, increased bioavailability of metals, avoidance of contamination by migration, and species-specific detoxification abilities. Some Collembola are specialist feeders and have preferences over which species of fungi they consume. The metal tolerant fungus, Paecilomyces farinosus, is protein rich. Therefore, there may be a trade-off between high quality food and metal toxicity to Collembola, suggested that Cu decreased or changed the microbial flora, which decreased the species number and abundance of Collembola when Cu was added to the soil. Dmowska (1995) studied on influence of stimulated acid rain on communities of soil nematodes. According to him, decades the impact of acid rain on soil fauna has been extensively investigated. However, the direct effects of acid precipitation on soil animals are poorly understood. Collembolans are important members of the soil mesofauna and play an important role in organic matter decomposition in soil. In this experiment, the potential impact of low environmental pH on the soil collembolan Onychiurus yaodai was studied under laboratory conditions. O. yaodai is widely distributed around Shanghai and easily cultivated in the laboratory. Dallai (1995) studied on the genus Isotomurus: where molecular markers help to evaluate the importance of morphological characters for the diagnosis of species. According to them, as taxonomical categories of Collembola are entirely based on morphology, molecular approaches to explore the evolution of the group are necessarily linked to morphological ones. Limits to morphological approaches are obvious at two main levels: in the process of disentangling species clusters, sibling species and color pattern forms, and in many aspects of phylogenetic reconstructions. Molecular tools are extremely useful in these critical situations. They help evaluating the interest of
tenuous morphological characters, such as in Isotomurus. Park and Cousins (1995) worked on soil biological health and agro-ecological change. According to them, soil macrofauna, invertebrates with a diameter larger than 2 mm, are diverse, abundant and multifunctional elements of most soils. They are considered useful indicators of soil health since they play diverse roles on the biological regulation system of soils, depending on their habits, distribution and abundance. Also because they are widely distributed, have diverse habits, are sensitive to disturbance, highly abundant and are easily captured and studied. Hagvar (1995) studied on instability in small, isolated microarthropod communities and suggested that populations of springtails are considered to be controlled by exogenous factors such as temperature and moisture or predation.

Coulson et al (1996) had been observing consequences of tent warming on the Webb habitats for 3 years, by simulating excessive summer warming. The number of young Oribatid individuals had increased in semi-desert habitats, but no other significant change had been observed. Krest'yaninova and Kuznetsova (1996) studied on The Dynamics of Collembolan Community (Hexapoda, Collembola) in the Soil of a Boulevard. According to them, the ruderal communities cannot be stable, as they are confined to the initial stages of succession and, hence, are short-lived. The modular communities are formed under hard-to-predict conditions of urban soils, in which one biotopic group of springtails can gain an advantage over the others depending on random events: compost species actively develop in the presence of organic debris; ruderal species, upon an increase in recreational load; forest species, in fallen leaves; etc. However, it is possible to achieve the artificial quasi-stability of these communities by maintaining constant environmental conditions. Hodkinson et al (1996) applied both laboratory and field manipulations, including treatments with temperatures of 30°C and above. It was found that negative effect affecting Oribatids could be experienced only above 35°C, and time interval is an important factor in treatments around 30°C. The extent of tolerance also depends on the moisture of the soil, but it was found that warming had no strong deteriorating effect on Oribatids. Zinkler and Platthaus (1996) studied on tolerance of soil-dwelling Collembola to high carbon dioxide concentrations. According to them, in soil, levels of carbon dioxide in pockets of trapped gas can be high. F. candida has evolved to survive in such conditions for considerable periods and is capable of becoming the dominant species in communities of Collembola subjected to elevated carbon dioxide. The species can survive up to 25% carbon dioxide for one hour or 10% carbon dioxide for six weeks.
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Beare et al (1997) worked on agricultural intensification, soil biodiversity and agroecosystem function in the tropics: the role of decomposer biota. According to them, the relevance of using soil organisms e.g. earthworms and termites to monitor soil ecosystem health is validated by the recognition that they are essential to ecological processes and they also depend on soil as habitat. Trublaevich and Semenova (1997) studied on the estimation of soil toxicity using a laboratory culture of springtails (*Folsomia candida*). According to them, a variety of routes of exposure of *F. candida* to chemicals have been studied. These include food, gas, water, contaminated leaf surfaces over which the collembolans were forced to walk, and topical application of substances onto individual springtails. Van Straalen and Verhoef (1997) worked on the development of a bioindicator system for soil acidity based on arthropod pH preferences. They have investigated that the substrate pH preference of *O. yaodai*, the bottom of a glass chamber was divided into 4–5 pH zones covered with thick filter paper saturated with different pH buffers. The main buffer used was citrate-phosphate buffer, which consists of a solution of di-sodium hydrogen phosphate (Na₂HPO₄) and citric acid (C₆H₇O₇). Some experiments were repeated using McIlvaine’s buffers with equalized ionic strength to ~100mM. The pH was checked before use at room temperature. The animals (20–30 collembolans) were introduced into the middle of the chamber and allowed to move freely between different pH zones. The distribution of the animals in the chamber was recorded in a time-course as indicated in the results. In control experiments animals were placed in a chamber in which all the zones were covered with the same papers saturated with water (~pH 6). Vandermeer and Perfecto (1997) worked on the agroecosystems: a need for the conservation biologist’s lens. According to them, although biodiversity loss has been given prominence all over the world in the last 2-3 decades, most of the conservation efforts have been directed to above ground and in particular large plant and animal species of economic and aesthetic value while smaller animals and lower plants and below ground organisms such as earthworms, termites, bacteria and fungi have seldom been considered among endangered species. Biodiversity loss therefore, seems to attract public attention only when large charismatic, species are endangered or romantic habitats are threatened while hotspots of biodiversity are chosen based on above ground species. Doran and Safley (1997) worked on defining and assessing soil health and sustainable productivity. According to them, agricultural practices often deplete soil organic matter and alter composition and abundance of soil biota. Consequently, physical and chemical properties such as exchangeable cations, soil water retention capacity, contents of fundamental elements and pH, decrease also
denoting a general decrease in soil function. Babenko (1997) studied on the taxonomy and distribution of the genus Anurida (Collembola: Neanuridae) in the northern Palearctic. According to them, at generic level, Micranurida, Cephalachorutes and Isotomiella are best defined by their antennal chaetotaxy. At species level, antennal characters have been successively used in Anurida.

Heneghan et al (1998) studied the influence of climate, substrate quality and microarthropods on decomposition of litter from different forest sites. An important aspect of the effect on microclimatic condition on the interaction within soil faunal communities was observed by Huhta et al (1998). It was observed that in the presence of Collembola (Folsomia sp) the nematode population was greatly depressed at medium and high level of moisture. Van Straalen (1998) studied on the evaluation of bioindicators systems derived from soil arthropod communities. According to him, long-term acid deposition depletes soil buffering capacity and eventually decreases soil pH. This change is potentially harmful to many soil animals. However, different soil animals show different pH preferences, even in Collembola, the pH preferences by different species are widely distributed from pH 2.9 to 7.3. Bengtsson (1998) studied on which species? What kind of diversity? Which ecosystem function? Some problems in studies of relations between biodiversity and ecosystem function. They have been reported that a declining biodiversity is consistent with reduced ecosystem function. However, functional diversity can be difficult to measure and so species diversity is usually estimated instead. Rusek (1998) worked on biodiversity of Collembola and their functional role in the ecosystem and observed that soil dwelling Collembola have mostly been linked to the detritus based food web because they typically feed on decomposer organisms. Mikola and Setala (1998) worked on productivity and trophic-level biomasses in a microbial-based soil food web and they have noted weak or no effects of predators on prey in soil systems. Although predators can have an indirect effect on the rate at which microbes are consumed, the micro-flora can compensate for biomass consumption by altering rate of turnover. Sadaka-Laulan et al (1998) studied on Feeding preferences of the collembolan Onychiurus sinensis for fungi colonizing holm oak litter (Quercus rotundifolia Lam.). According to them, in natural environments, Collembola feed on a great variety of resources, such as fungi, bacteria, mosses, pollen grains, spores, decaying plants and debris. Meyer et al (1998) studied on decreases in soil microbial function and functional diversity in response to depleted uranium. In their studies found slower decomposition in response to decreased bacterial functional diversity caused by
depleted uranium application. Finzi and Canham (1998) worked on non-additive effects of litter mixtures on net N mineralization in a southern New England forest. According to them, a higher nitrogen flux from a more diverse litter than from single-species litter most likely results in higher plant N availability that possibly increases plant growth or alters the competitive balance among species. In contrast, decreased N loss from mixtures may indicate a diminished plant N availability caused by increased N immobilization or decreased N mineralization. This condition, however, does not necessarily imply negative consequences for ecosystem properties. For example, negative litter-mixture effects on N release can help to prevent N losses from the system after disturbances. Also, mixtures may not actually decrease N availability over longer time periods but may change the timing of N release not assessed in most experiments, which typically have a relative short duration. A different pattern of N availability over time could better match plant requirements or could favor some plant species over others. Vreeken-Buijs et al (1998) studied the relationship of soil microarthropods biomass with organic matter and pore size distribution in soils under different land use. The concluded that microarthropod biomass was larger in sandy soil than in loamy soil and generally larger in meadows than in wheat fields. In a study on the affect of drought on springtails it was observed that same epigean collembolans in arable land system are able to survive long periods of drought by Alvarez et al (1999). These finding have implications on the predicted climate changes upon collembolan population.

In a study conducted by Heneghan et al (1999), he stated that soil microarthropods contributions to decomposition dynamics tropical temperate comparison of a single substrate. They hypothesized that microarthropod relation of the microbial population involved in leaf litter decomposition would be stronger in humid tropical forests. Martin et al (1999) studied on Soil microbial diversity, community structure and denitrification in a temperate riparian zone. According to them, a positive correlation between overall functional or taxonomic diversity of soil bacteria and denitrification rates was found in both laboratory and field studies. Maraun et al (1999) studied on middens of the earthworm *Lumbricus terrestris* (Lumbricidae): microhabitats for micro- and mesofauna in forest soil. According to them, litter-feeding macrofauna have a tremendous impact on decomposition because they process large amounts of litter and because of their feedback on performance, activity, and community composition of microbial decomposers and smaller litter and soil fauna. Behan-Pelletier (1999) emphasized that the most abundant and
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diverse group of soil mesofauna were the Oribatids even in forest habitats. Changes in this community can have an important indication role. According to him, the density of groups with parthenogenetics reproduction increased following distribution, which could cause changes in the structure of the community. Several studies tried to determine the changes in Oribatid communities caused by distributions in forest habitats. Numerous types of distributions have been examined in forests but these studies are hard to compare and as a consequence, obtained various results. Kaneko and Salamanca (1999) studied on mixed leaf litter effects on decomposition rates and soil microarthropod communities in an oak-pine stand in Japan and they who observed a higher species richness of oribatid mites and a higher abundance of microarthropods in litter mixtures compared with single-species litterbags. However, the two studies are in contrast with respect to litter-mass loss. Whereas the greater faunal abundance and diversity correlated with increased mass loss in the experiment, found no effect on litter-decay rate. These results might be seen as evidence for a greater importance of faunal abundance over faunal diversity for process rates. Nilsson et al (1999) worked on the effects of plant litter species composition and diversity on the boreal forest plant-soil system. They have documented that competitive interactions among plant species change when plants are grown in humus formed from monotypic versus mixed litters, although these effects were small and tended to be idiosyncratic. Altier (1999) worked on the ecological role of biodiversity in agroecosystems and observed that enhance functional biodiversity in agroecosystems is a key ecological strategy to bring sustainability to production. Thus, the development of agroecological technologies and systems, which emphasized the conservation-regeneration of biodiversity, soil, water and other resources, is urgently needed to meet a growing array of socioeconomics and environmental challenges. Kampichler et al (1999) worked on field mesocosms for assessing biotic processes in soil: how to avoid side effects. According to them, the addition of organic fertilizer to industrial wasteland increases vegetation cover/plant complexity, which can increase species richness and abundance of soil animals.

Vu et al (2000) worked on microarthropod community structures (Oribatei and Collembola) in Tam Dao National Park, Vietnam and their results have shown that microarthropod community structures, particularly species diversity of oribatid and collembolan communities, are related to forest decline. Therefore, they can be used as bioindicators of forest plant succession. In Tam Dao National Park, there was an inverse
relation between species diversity of the oribatid and collembolan communities. The species diversity of the oribatid community gradually decreased with forest decline whereas the species diversity of the collembolan community gradually increased. Herrick (2000) worked on soil quality: an indicator of sustainable land management. According to them, measurements of soil health by means of indicators allow us to understand how soil capacities and properties evolved under certain management systems either for food production or development of environmental functions in several time-space scales. Within this context, it is important to choose the indicators that give complete information about its properties, biological productivity and quality of surrounding environment. Rebecchi et al (2000) worked on the effects of a sulfonylurea herbicide on soil microarthropods. According to them, pollution of soil by a wide range of contaminants can change the species composition within the collembolan community in comparison to “clean” sites. Chernova and Kuznetsova (2000) worked on Collembolan Community Organization and Its Temporal Predictability. According to them, natural and anthropogenically disturbed communities of springtails can be mono- or polydominant. Thus, in the springtail communities of natural forests, dominance belonged to one species (bilberry pine forest, the Darwin Nature Reserve), two species (wood-sorrel spruce forest, Moscow oblast), and three species (green moss spruce forest, Moscow oblast), with this pattern remaining unchanged from year to year. Griffiths et al (2000) studied on ecosystem response of pasture soil communities to fumigation-induced microbial diversity reductions: an examination of the biodiversity-ecosystem function relationship. According to them, experimental reduction in microbial diversity often did not affect gross soil processes or even increased the rate of decomposition of plant residues. After manipulation of the diversity of decomposer biota by use of chloroform fumigation, reported no consistent relationship between microbial diversity and process rates. Although nitrification, denitrification, and methane oxidation decreased along with decreasing biodiversity, plant-residue decomposition tended to be faster in pauperized soil. Axelsen and Kristensen (2000) studied on Collembola and Mites in plots fertilized with different types of green manure. According to them, Collembola are extremely abundant in soil and leaf litter. In most terrestrial ecosystems they occur in high numbers, typically between 10⁴ and 10⁵ m⁻². Densities of springtails of more than 10⁵ m⁻² have been found in pine forests in India and Japan, moorland in England, and dry meadows in Norway. Collembola are particularly abundant in agricultural soils that are farmed “organically”. Zimmer and Topp (2000) worked on species-specific utilization of food sources by sympatric woodlice (Isopoda: Oniscidea). They have found that the
saprophagous macrofauna preferentially feed on certain litter types and are quite sensitive to changes in quality, even within a single-litter species. Byers et al (2000) worked on richness and abundance of Carabidae and Staphylinidae (Coleoptera) in north eastern dairy pastures under intensive grazing. Great Lakes. Their studies have demonstrated that increased stocking rate contributes to a decrease in soil pore space, which in turn leads to a decline in microarthropod numbers because of modifications in habitats (Bardgett et al 1993). Messer et al (2000) studied on Chemical deterrents in podurid Collembola and observed that whenever a podurid is touched by a predator the springtail crouches to the ground presenting to the attacker its back, where most of the pseudocelli are located, and immediately excretes repelling fluids. Chagnon et al (2000) studied on the community structures of Collembola in sugar maple forests: relations to humus type and seasonal trends. According to them, the soils in Wolverhampton displayed a high number of species with a low dominance and a low number of species with a high dominance. Lundberg et al (2000) studied on population variability in space and time. According to them, the analysis of variability and constancy in ecological populations and communities has been a focus of ecological research for decades and still is of the utmost importance for understanding the complexity of intrinsic and extrinsic forces that influence their temporal dynamics (Pimm and Redfearn 1988). Malysheva and Chernova (2000) studied on Springtails as Primary Colonizers of the Grounds of Sanitary Landfills and explained that with respect to the prevalence of a certain biotopespecific group, four categories of springtail communities can be distinguished: specialized, eurytopic, mixed, and ruderal communities. The specialized communities are characterized by the dominance of the corresponding species group (the conventional threshold is 40% of the total abundance) or, in some cases, two groups (e.g., the groups of forest and bog species in a pine–sphagnum bog). They are typical of the majority of natural forests, especially coniferous. In the eurytopic springtail communities (in most meadows of the forest zone, some broadleaf forests, and park forests), the eurytopic group prevails, and none of the specialized groups reaches the 40% abundance threshold. The modular communities include many ruderal or compost species, in addition to specialized and eurytopic species. For example, they are characteristic of most soils found in urban green areas. The communities with the prevalence of ruderal or compost species are classified as ruderal. They have been found in mounds of earth near construction sites. Hedlund and Sjogren Ohm (2000) studied on tritrophic interactions in a soil community enhance decomposition rates. According to them, litter decomposition by twospecies or three-species mixtures of fungi did not exceed corresponding values in the best-performing
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monoculture. Anderson (2000) studied food web functioning and ecosystem processes: problems and perceptions of scaling. According to him, effects of soil organisms on soil processes are intimately linked to their size. Small organisms such as bacteria, fungi, and protozoa are the key drivers of energy and nutrient transformations, whereas larger decomposer organisms such as earthworms, millipedes, and isopods are the dominant habitat transformers. Johnston (2000) studied the contribution of microarthropods to aboveground food webs: a review and model of belowground transfer in a coniferous forest and found that surface-dwelling springtails are soft-bodied plankton of the soil. Winkler and Kampichler (2000) worked on local and regional species richness in communities of surface-dwelling grassland Collembola: indication of species saturation. According to them, Collembola show a hard upper limit to local species richness independent of the size of the regional pool. Although none of these observations in isolation can prove that Collembolan field populations are actually structured by internal biotic forces, the sum of empiric data along with the results of this study strongly suggest this. Oksanen and Oksanen (2000) studied on the logic and realism of the hypothesis of exploitation ecosystems. According to them, apparently, predation of springtails by mites has no dynamic feedback; contrary to speculation that predation by mites regulates springtails. Possibly, the low productivity of prairie ecosystems did not support a predator capable of regulating springtails and mites. Badejo and Ola-Adams (2000) worked on Abundance and diversity of soil mites of fragmented habitats in a biosphere reserve in Southern Nigeria and concluded that

1) Habitat fragmentation in the Biosphere Reserve leads to fragmentation of the soil mite community and alteration of their densities and diversity.

2) Plantation establishment brings about a dominance shift to other mite species.

3) Type of vegetation cover and the resulting litter as well as intensive agriculture affect mite population densities and diversity in the soil.

4) Low soil cryptostigmatid mite densities signify poor fertility in cultivated soils.

Loranger et al (2001) observed that the change in altitude caused a change in species composition of the soil microarthropod communities, because with the change in altitude there is change in the soil chemistry, humus forms and vegetation. Hattenschwiler and Bretscher (2001) worked on Isopod effects on decomposition of litter produced under elevated CO2, N deposition and different soil types. According to them, the saprophagous macrofauna preferentially feed on certain litter types and are quite sensitive to changes in quality, even within a single-litter species. Sabatini (2001) worked on interaction between
plant pathogenic fungi and Collembola. According to him, Collembola may reduce disease by consuming pest fungi. Selective grazing by springtails may be an important factor limiting the distribution of certain species of basidiomycete fungi in the field. However, many of these effects are density-dependent, and too little information is available for quantifying accurately the specific contribution of Collembola to "indirect" or "catalytic" decomposition. Nevertheless, the influence of springtails on decomposition and nutrient availability must be significant in many ecosystems. Balachandran and Khillare (2001) worked on occurrence of acid rain over Delhi. According to them, acid rain in industrial regions around the world poses serious threat to the ecological balance and is of major environmental concern. Increasing evidence suggests that long-term acidic load reduces soil pH, directly damages vegetation and eventually leads to the collapse of ecosystems. Frampton (2001) worked on the large scale monitoring of non-target pesticide effects on farmland arthropods in England: the compromise between replication and realism of scale. According to him, anthropogenic activities may have persistent and long lasting effects on Collembola, although with long-term (centuries) exposure, springtails can become tolerant to metals. Soil microarthropods may have a high degree of site-specificity and are potentially good bioindicators of pollution. Takeda and Abe (2001) worked on templates of food-habitat resources for the organization of soil animals in temperate ad tropical forests. According to them, the functional groups of Collembola in the communities are related to the decomposition processes. Thus, a basic knowledge of population and community structures of soil microarthropods is important for understanding decomposition processes in tropical forests. Carapelli et al (2001) worked on taxonomical revision of 14 south-western European species of Isotomurus (Collembola, Isotomidae), with description of four new species and the designation of the neotype for I. palustris. According to them, as taxonomical categories of Collembola are entirely based on morphology, molecular approaches to explore the evolution of the group are necessarily linked to morphological ones. Limits to morphological approaches are obvious at two main levels: in the process of disentangling species clusters, sibling species and color pattern forms, and in many aspects of phylogenetic reconstructions. Molecular tools are extremely useful in these critical situations. They help evaluating the interest of tenuous morphological characters, such as in Isotomurus. They represent a powerful tool for reconstructing highest relationships in the order and to test the accuracy of current taxonomical hierarchy. Like in other zoological groups they are of increasing importance in all aspects of evolutionary biology of Collembola. Broza et al (2001) while working on the nonsusceptibility of soil
Collembola to insect pathogens and their potential as scavengers of microbial pesticides. Observed that *Folsomia candida* consumes and inactivates entomopathogenic fungi applied as biological pesticides without suffering mortality, reproductive disturbance, or any other harmful effects. Ferguson (2001) studied on changes in trophic abundance of soil arthropods along a grass–shrub–forest gradient. According to him, some general patterns in the trophic organisation of soil animal communities have been observed despite a high degree of stochastic variation high species diversity within trophic groups, tendency to trophic generalism, high numbers and fluctuating mesofaunal predators, and continuity in litter decomposition. Bridge and Spooner (2001) worked on soil fungi: diversity and detection. According to them, species diversity of soil fungi is probably only slightly less than that of bacteria (Hawksworth 2001). Cragg and Bardgett (2001) studied on how changes in soil faunal diversity and composition within a trophic group influence decomposition processes. According to them, the dominance of food generalists suggests high redundancy among soil animals, which supports evidence of a weak relationship between soil-animal diversity and ecosystem processes observed in various experiments (Ekschmitt et al 2001). Loreau (2001) studied on microbial diversity, producer decomposer interactions and ecosystem processes. According to him, soil microbial diversity has been hypothesized to correlate positively with process rates within soils. In one of the few models that linked microbial diversity and decomposition processes, and suggested that microbial diversity has a positive effect on nutrient-cycling efficiency and ecosystem processes through either greater intensity of microbial exploitation of organic matter or functional niche Complementarity. Simonsen and Christensen (2001) worked on clonal and genetic variation in three collembolan species revealed by isozymes and randomly amplified polymorphic DNA. They have most laboratories with cultures of *F. candida* will donate these. Although there are small differences in the responses of clones from different sources, these are not sufficient to be considered a significant problem. Loreau et al (2001) studied on biodiversity and ecosystem functioning: current knowledge and future challenges, their experiments have shown that, in grassland ecosystems, primary productivity is positively related to plant-species diversity. Knapp et al (2001) studied on the frequency and extent of water limitation to primary production in a mesic temperate grassland. According to them, contrary to the top-down hypothesis, evidence was found for bottom-up control of springtail and mite abundance that may relate to low productivity on the prairies. Knapp and Smith (2001) studied on variation among biomes in temporal dynamics of aboveground primary production and concluded that springtail and mite
population density was determined primarily by endogenous factors (delayed density-dependent regulation), which provided a reasonable description of density changes without invoking top-down predation. The predominant factor explaining springtail and mite population growth was 1-week lagged density, whereas including temperature in the model together with delayed density-dependent factors explained additional variance in springtail and mite density. Regulation may occur by means of density-dependent processes acting within years whereas changes in year-to-year abundance may be due to differences in annual temperature and precipitation that may vary spatially with primary productivity. Future studies should use experimental approaches to understand the effects of delayed density dependence and rainfall on the demographic processes of survival, reproduction, immigration, and recruitment of springtails and mites.

Prosser et al (2002) studied on molecular and functional diversity in soil microorganisms. They have reported that soil carbon and energy flow is mainly driven by microbial activity. The diversity of soil microorganisms is assumed to be extraordinarily high but is largely unidentified. Bandyopadhyaya et al (2002) worked on the effect of some physical factors and agricultural practices on Collembola in a multiple cropping programme in West Bengal (India) and summarized that collembolan populations were followed monthly for 3 years in a long-term cultivated and fertilized agricultural field, in East India (West Bengal). Where three crops (jute, paddy rice and wheat) were cultivated and subjected to various doses of NPK fertilizers, herbicides and organic manure. Each crop showed a rise followed by a decrease in collembolan populations. When crossed with crop effects collembolan populations showed a negative correlation with soil temperature and a positive correlation with soil moisture. Application of organic manure induced an increase in the population but the effects of fertilizers and other treatments applied to the field were not as significant as seasonal and crop influences. Petersen (2002) studied on general aspects of collembolan ecology. According to him, collembolans are common detritivorous and fungivorous microarthropods found throughout the vertical structure of forests from the aboveground parts (canopy) to the belowground parts (soil), and they play important roles in the functioning of detrital food webs. Mikola et al (2002) studied on biodiversity, ecosystem functioning and soil decomposer food webs. In *Biodiversity and Ecosystem Functioning—Synthesis and Perspectives*. They have reported that a data compilation that included 24 studies indicated that in virtually all cases, soil animals of the entire decomposer spectrum, from protists to macroarthropods, stimulated decomposition and
nutrient mineralization through their effects on microorganisms. Steven and Damien (2002) investigated whether populations are regulated by density dependent predation. They proposed that composition resources regard each trophic level. Ferguson and Joly (2002) studied on dynamics of springtail and mite populations: the role of density dependence, predation, and weather. They have presented evidence for endogenous control of springtail numbers on forest soils in intra-annual time series by finding negative correlations between population growth rate and 1-week lagged density. It has been suggested that intra- and inter-specific competition and/or predation may lead to the deterministic community structure of the soil fauna, and the evidence that Collembolan communities in particular are structured by intensive biotic interactions has been growing during the last 15 years. First, a number of early laboratory experiments had demonstrated considerable biotic interactions between Collembolan populations (Christiansen et al 1992), including direct interaction, substrate conditioning and airborne allomones. Second, Collembolan populations are food-limited and their density in the field could be increased by 3-4 times in a food enhancement experiment. Ekblad and Nordgren (2002) worked on is growth of soil microorganisms in boreal forests limited by carbon or nitrogen availability? According to them, saprotrophic fungi (ST) fungi, especially basidiomycetes, are generally more effective in breaking down dead organic matter and are almost exclusively responsible for decomposition of lignocellulose. However, because of the wide C/N ratio in most litter types, the activity of litter-decomposing fungi in temperate forests is often restricted by N availability. Lindahl et al (2002) studied on defining nutritional constraints on carbon cycling in boreal forests—towards a less ‘phytocentric’ perspective. According to them, ectomycorrhizal (EM) and saprotrophic (ST) fungi compete for nutrients (including organic nitrogen compounds) in forest soil, and antagonistic interactions are presumably common between these organisms. Schieu and Setala (2002) worked on multitrophic interactions in decomposer communities. According to them, the generalist feeding habit of soil predators is an important prerequisite for this interconnection of the belowground and aboveground food web. Generalist feeding, including polyphagy, omnivory, and intraguild predation, appears to be a characteristic feature of soil predators. Mader et al (2002) worked on soil fertility and biodiversity in organic farming. According to them, in agricultural systems, a clear positive correlation between the amount and composition of plant residues and the density and diversity of decomposer and predator organisms has been observed. These relationships are of key importance for successful pest management, and, therefore, a thorough understanding of trophic interactions and controls in food webs is necessary.
Lindberg et al (2002) conducted extensive studies in Swedish coniferous forests concerning drought effects. He also pointed out that long-term deprivation of precipitation decreases the abundance of Oribatid mites and the diversity of the community. They also examined what kind of long-lasting effects have been caused by drought to the community and how long the regeneration would take: he could not measure similar results even three years after the intervention comparing treated and untreated control sites. Besides, he pointed out that Oribatid mites are more sensitive and possess much moderate regeneration ability compared to Collembola or Mesostigmata (Lindberg and Bengtsson, 2005).

Gerlinde et al (2003) reported that soil invertebrate fauna enhance grassland succession and diversity. They concluded that soil microarthropods strongly affect the composition of natural vegetation. Duelli and Obrist (2003) studied on biodiversity indicators: the choice of values and measures. According to them, among reasons advanced for the need for biodiversity protection is that: biodiversity represents a potential reserve of new compounds for medicine, interesting genes for plant breeding and services for agriculture. Eviner and Chapin (2003) worked on functional matrix: a conceptual framework for predicting multiple plant effects on ecosystem processes. According to them, plant-species composition, in turn, significantly affects ecosystem nutrient cycling through plant-nutrient uptake and use, rhizosphere interactions, production of litter of specific quality, and microenvironmental changes. Distinguishing these different controls is essential for a mechanistic understanding of biodiversity effects on ecosystem functioning. Krivtsov et al (2003) worked on some aspects of complex interactions involving soil mesofauna: analysis of the results from a Scottish woodland. They have showed that collembolan diversity conducted in woodlands in Scotland, it was the most abundant species. Hilligsoe and Holmstrup (2003) studied on Effects of starvation and body mass on drought tolerance in the soil collembolan Folsomia candida. They have reported that all life stages of F. candida are well adapted to dry soil conditions. The species possesses physiological adaptations to desiccation and absorbs water vapor and remains active below 98.9% relative humidity (RH) (the permanent wilting point of plants). Palacios-Vargas and Castano-Meneses (2003) studied on seasonality and community composition of springtails in Mexican forests. According to them, Seira purpurea was the species in which animal remains were more often found. This is of interest because, even if it is not an abundant species in the epiphytic plants, reaching only 2% of the total abundance in the
rainy seasons, its abundance increased during the dry season, reaching 8% of the total number of springtails; this species also showed variation in dietary components. Uvarov (2003) pointed out that daily temperature fluctuation of the soil affected the survival and reproduction ability of Oribatids. Fluctuations with in 5°C and 25°C had strong negative effects, while fluctuations with 10 and 20°C enhanced reproduction. Intermediate values had been gained by measurements on constant 15°C. In order to explore long term changes in microarthropod communities after introduction of livestock grazing in abandoned fields by Petersen et al (2004) in a three year study on soil arthropod community of a dry evergreen forest, observed that grazing by domestic animals constitute a profound human influence in terrestrial ecosystem. In a study related to population abundance, species composition, and community structure of Collembola and Acari, Wiwatwitaya and Takeda (2004) found that humidity was the most important factor determining distribution, abundance and survival of soil Collembola. Bardgett and Wardle (2003) studied on herbivore-mediated linkages between above ground and below ground communities. According to them, herbivory by grazing mammals affects decomposer communities principally through (i) changes due to differences in the patterns of root exudation and carbon allocation, and (ii) changes due to alterations in the quality and quantity of plant litter. In temperate grasslands such effects from herbivory result in positive feedbacks to soil biological communities and their processes, thus enhancing plant productivity. However, such positive feedbacks principally occur in grasslands of high soil fertility where herbivory prevents colonization by the successional plants, which produce litter of low nutrient quality (Bardgett et al 1997, Augustine and McNaughton 1998). Changguo et al (2003) worked on the case study on soil fauna diversity in different ecological system in Shilin National Park, Yunnan, China and concluded that The Acarina, Collembola, Nematoda, Coleoptera and Opistopora are the dominant communities, Onchytraidae, Opilions, Lepidotera, Diptera are the normal community; others are the scarce community. Painolaspidae is adaptive in any environmental vegetation. Gross biomass amounts of community and the index of biodiversity in the soil of natural bush are much higher than those in the soil of other degraded vegetation, which show that the natural bush is the ecological screen protecting the soil fauna from deterioration. The gross biomass of soil fauna is less than those in the forest of the same latitude and the diversity of soil fauna decreased sharply in the various degraded vegetation, which indicate the deterioration of the soil ecosystem.
In a study conducted by Rusek Josef (2004), concluded the biodiversity of Collembola and their functional role in the ecosystem. Collembola play an important role in plant litter decomposition process and informing soil microstructure. Fountain and Hopkin (2004) studied on biodiversity of Collembola in urban soils and the use of Folsomia candida to assess soil quality. They have reported that F. candida is a widespread and common animal. In ecotoxicology, it has been possible to relate soil pollution levels to the point along a pollution gradient where the species dies out. Setala and McLean (2004) studied on decomposition rate of organic substrates in relation to the species diversity of soil saprophytic fungi. Their studies showed a clear positive effect of fungal diversity on decomposition at relatively low diversity but no influence beyond an actual diversity of 5 to 10 fungal taxa. Southorn and Cattle (2004) worked on the dynamics of soil quality in livestock grazing systems. According to them, conventional Australian grazing practices allow stock to remain at low densities on pastures for specific periods of time, from 1-2 seasons in a year to several years. Such practices damage soil structure by compaction and alter the vegetation quality through selective loss of palatable plants resulting in lack of productivity and sustainability of the pasture in the long term (Greenwood et al 1998).

Heemsbergen et al (2004) studied on biodiversity effects on soil processes explained by inter-specific functional dissimilarity. Despite the reasonable expectation that the diversity and composition of functional groups or feeding groups are important for ecosystem processes, the existence and the significance of the great species diversity within functional groups is puzzling.

Parisi et al (2005) worked on microarthropod community as a tool to assess soil quality and biodiversity: a new approach in Italy. They have used the Maturity Index (MI, Bongers 1990), which is based on nematode population, and the Qualita Biologica del Suolo (QBS-ar) index (Parisi 2001), based on soil microarthropods. Identical techniques were used on grassland and woodland sites located in the protected area. These soils, considered natural, were compared with that of the solid waste disposal site. The simultaneous use of MI and QBS-ar permitted the study of two large communities that present groups of organisms differing both in their ecology and their functions within the soil. Cole et al (2005) worked on relating microarthropod community structure and fertility manipulation in temperate grassland the high amount of energy transferred via plants to the soil in this habitat stimulates microbial growth, which results in an increased food resource for edaphic fauna. Lindberg and Bengtsson (2005) compared the effect of drought
on Acari and Collembola and their subsequent recovery after drought. They concluded that surface living species which tended to have narrow habitat width were less negatively affected by the drought. Species with large habitat widths tended to recover faster after the drought. Overall collembolan species recovered faster than Acari. Maria et al (2004) in a significant study concludes that:

1. Drought decreased soil water content and increased soil temperature hence decrease in microarthropod species.
2. Irrigation treatments increased soil organic matter content and species richness. and
3. Infrequent irrigation increased maximum soil temperature and hence collembolans show higher species evenness and diversity.

A few invertebrate groups occurred across all three soil types in similar abundances. Representative of the insect family Collembola, commonly known as Springtails, were always found to be one of the most abundant members of each community. Springtail species are known to be fungus, humus, or soil consumes (Wiwatwitaya and Takeda, 2005). Hattenschwiler and Gasser (2005) worked on soil animals alter plant litter diversity effects on decomposition. According to them, in most of the past experiments, mass loss was measured in litter mixtures as a whole and compared with the predicted or expected value on the basis of single species decomposition. This approach may mask species-specific responses to mixing litter that might well be important for decomposition processes. Individual species might behave distinctly, as was observed in most of the few studies that separated decomposition among species within mixtures. Bardgett (2005) found that in terrestrial ecosystems, the above- and belowground plant-litter input constitutes the main resource of energy and matter for an extraordinarily diverse community of soil organisms connected by highly complex interactions. In terms of biomass and species numbers, the largest number of soil organisms is involved in organic matter turnover, particularly the large groups of bacteria and fungi. Recycling of carbon and nutrients during decomposition is a fundamentally important ecosystem process that has major control over the carbon cycle, nutrient availability, and, consequently, plant growth and community structure (Wardle 2002). This places them in the category of decomposers and indicates that they play an important part in the breakdown of organic matter into new soil. Clergue et al (2005) worked on biodiversity: function and assessment in agricultural areas. According to them, biodiversity became a central concept in agronomical research. This event indicated a world consciousness of the importance of biodiversity protection for
sustainable development. Tsiafouli et al (2005) conducted short-term manipulation studies in Mediterranean sites. Various irrigation and drying methods have been applied and it was shown that drought decreased the species richness of Oribatid and collembolan communities (differences in abundance were not significant), while irrigation increased diversity of both groups. This phenomenon could have been caused by the propagation of rare species after irrigation.

Fagan et al (2006) found in Canadian coniferous forests that species richness of Oribatids in the soil had been greater when comparing Oribatid communities of the foliage and soil. Diversity data can be found primarily in agricultural and forestry studies. It has been pointed out that irrigation (enhancing the moisture content of the soil) increased the diversity of Oribatid communities, because it raised the individual numbers of rare species (Tsiafouli et al, 2005). Ekelund et al (2006) described the significance of soil collembolans, Protozoa and micro organisms and their interactions for soil fertility which a key concept in this discussion. Here they refer to the view presented by Madar et al (2002) who suggested that fertile soils provide essential nutrients for crop plant growth, support a diverse and active biotic community exhibit a typical soil structure and allow for an undisturbed decomposition. An important aspect, at the same time given by Choi et al (2006) who observed a modelling study of soil temperature and moisture effects on population dynamics of *Paronychius kimi* (Collembola: onychiuridae). They suggested that soil moisture is a major limiting factor on field population of *P. Kimi*. Arroyo and Iturrondobeitia (2006) worked on differences in the diversity of oribatid mite communities in forests and agrosystems lands. According to them, the significantly lower densities of mites and collembolans at the polluted habitats were probably caused by direct lethal effects on micro-arthropods, negative impact on their reproductive rates or indirectly on their food sources. The soil pollution might have posed a risk to soil processes and soil-based trophic networks. Pollution primarily caused decrease in density; however, Skubala and Kafel (2004) stated that species richness and density were also affected, while Migliorini et al (2005) observed qualitative changes. Qualitative (species richness) and quantitative (density) indices were adversely affected by the oil pollution. Badejo and Akintola (2006) studied on micro environmental preference of orbatid mite species on the floor of a tropical rainforest in Nig Exp. The have emphasized that the relationship between soil moisture content and the density of micro arthropods within the 0-5 cm soil litter. The work became imperative In view of the numerous benefits accruing from the continual presence of soil
microarthropods to the field of Agriculture and ecosystem balance. Janssen et al (2006) added that, they have been convincingly useful for monitoring of heavy metal pollution in industrialized and urbanized areas. Though, there are enormous gaps in the knowledge of soil animals, some of the soil microarthropods have the potential of being excellent indicators of heavy metal pollution because of their relative history and limited tolerance to changes in environmental conditions. Johanna and Reynolds (2006) studied the effect of different cutting zone width on the structure and function of riparian zones within the Southern Appalachians and looked at the effects of riparian zone width on soil microarthropod populations, which play a critical role in decomposition by fragmenting leaf litter and adding vital nutrients to the soil. Preliminary results indicate high soil microarthropod abundance when soil temperatures are moderate. In another recent study, Eaton and Robert (2006) tried to isolate important factors from the terrestrial ecosystem by treatments. He observed that organic matter removal and vegetation control treatments had a significant negative effect on population during the late spring, summer and early fall months. Soil composition had no significant effect. Physical litter characteristics, nitrogen, phosphorous and carbon to nitrogen ratio were significantly correlated to collembolans population. Adl et al (2006) worked on slow recovery of soil biodiversity in sandy loam soils of Georgia after 25 years of no-tillage management. According to them, difficulties in its realization depending on crops and soils, it is a practice which is encouraged by means of agricultural policies because of its positive effects on environmental health. In the absence of the plough, the soil profile is undisturbed and the environment is less oxidative, the most important consequence being an improvement in soil quality and health over time. Syrek et al (2006) worked on the species abundance distribution of Collembolan communities in forest soils polluted with heavy metals. According to their studies conducted on the effect of land use intensification, soil chemistry and soil organic matter on the abundance and diversity of Collembola in France, Portugal and Brazil, have shown that, they have a significant effect on the population of Collembola communities (Jose et al 2004).

Sinka et al (2007) worked on the indirect effect of above-ground herbivory on collembola populations is not mediated by changes in soil water content. According to them, the *Paronychiurus kimi* population was unable to increase at 10% soil moisture content except when provided by a large amount of yeast. In a mesocosm study, showed that *Folsomia candida* have a higher tolerance for dry than for wet conditions. Yang et al (2007) worked on fertilisation responses of soil litter fauna and litter quantity, quality, and
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turnover in low and high elevation forests of Puerto Rico. They have investigated the relationship between soil fauna biodiversity, soil structure and function, the impacts of different agricultural practices, such as conventional tillage, no-till and fertilisation on the soil fauna biodiversity. Few studies have been carried out on the entire microarthropod community, much data regarding the most numerically important groups in the soil, such as Collembola and Acari. Groups such as Symphyla, Pauropoda, Diplura and others have scarcely been studied at all and the effects of agricultural practices on density and biodiversity are still unknown. Paoletti et al (2007) studied on the detritivores as indicators of landscape and soil degradation. According to them, among the acari, Cryptostigmata (Oribatids) are considered suitable indicators of soil systems; they have high diversity, densities and are sensitive to environmental changes. Reicosky and Saxton (2007) worked on the benefits of no-tillage. They have reported that no-tillage is one of the most sustainable soil management systems in that it increases soil organic matter, improves soil quality, reduces labour requirements and machinery costs, reduces fossil-fuel inputs, increases available plant water by reducing runoff and soil erosion, increases available plant nutrients, and improves the global environment.

Brussard et al (2007) worked on soil biodiversity for agricultural sustainability. According to them, the integrated management of soil fauna and agricultural practices is a holistic process that combines locally available resources, the climate, socio-economical conditions and management practices. Melamud et al (2007) showed increasing species richness proceeding upwards on Mt Carmel (Israel), while the moisture gradient has grown downwards. Chauvat et al (2007) studied on response of collembolan communities to land-use change and grassland succession. They have reported that the higher abundance of microarthropods allows the soil to perform key functions such as decomposition and nutrient cycling. In fact, most of the effects of edaphic fauna in fundamental processes for agricultural management are driven mainly by abundance and biomass rather than by species composition. Tripathi et al (2007) studied the mesofounal biodiversity and its importance in Thar desert. Their study supports that soil arthropods exhibited seasonal variation in their populations. There were two population peaks, one in February/March and other in August/September and faunal that the population showed a significant positive correlation with soil moisture, organic carbon and total nitrogen. Their study also suggests that the plantation may be done for improvement of physiochemical and biological health of soil on a sustainable basis in desert. Dermody et al (2007) worked on how do elevated
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[CO₂], warming, and reduced precipitation interact to affect soil moisture and LAI in an old field ecosystem? According to them, climate changes, however, will not happen in isolation of one another. For example, elevated [CO₂] may ameliorate negative effects of soil drying through reducing plant stomatal conductance and transpiration, while increased evapotranspiration resulting from higher temperatures may exacerbate effects of soil drying. Iloba and Odon (2007) worked on Studies on the biodiversity of soil microarthropods and their responses to Crude Oil Spills and concluded that the various populations or the biotic community of an established ecosystem is generally stable. However, the ability of a system in equilibrium to recover from a disturbance is an indication of its resilience. The biodiversity studies shows that disturbance in the form of crude oil pollution disrupted the activities of soil microarthropods rendering some dead and others redundant. If needed these soil microarthropods are functionally essential in maintaining soil ecosystem balance, their individual responses to perturbations become crucial. With the identification of sensitive, resistant and resilient species of soil microarthropods to crude oil pollution, it becomes easier to specify species that could serve as good bio-indicators of soil pollution.

It has been proposed that there exist a strong inter-relationship between soil microarthropods and soil microflora (bacteria and fungi) which seem some what symbiotic in nature. Hence, soil microarthropods could also serve as good agents of bioremediation of organic pollution since microbes are functionally responsible for the break down of organic pollutants.

Cole et al (2008) stated that increasing the organic matter content of the soil had not affected the diversity of the Oribatids. Kibblewhite et al (2008) worked on soil health in agricultural systems. Their results showed the soil fauna, a part of Eucaryota is grouped into macrofauna, mesofauna and microfauna. These soil biota contribute positively to ecosystem processes, which in turn support provision of ecosystems services that contribute to the maintenance and productivity of ecosystems by influencing soil quality and health (Brussaard et al 1997). Schroeder (2008) focused on mesofauna and great importance for the turnover of organic matter and decomposition process in soil. Yoshida and Hijii (2008) studied the efficiency of extracting microarthropods from the canopy litter in a Japanese Cedar (Cryptomeria Japonica D. Don) plantation; a composition between washing and Tullegren methods. On the basis of the experiment, they suggested that the washing method is appropriate for the mite whereas Tullegren method is good for the Collembolan population. In another recent study, Steinaker and Wilson (2008) proved scale
and density dependent relationships among roots, mycorrhizal fungi and Collembola in grassland and forest. They concluded that Collembola were significantly positively correlated with root production in forest and with both fungal and root production in grassland.

Bautista et al (2009) studied on changes in soil macrofauna in agroecosystems derived from low deciduous tropical forest on Leptosols from Karstic zones and they concluded that ecological indexes and discriminant analysis revealed that macrofauna soil communities in agroecosystems and low deciduous tropical forest in Leptosols differ from each other. The practices of managing of the agroecosystems cause changes in the macrofauna communities and therefore it is possible to predict the structure of the community of macrofauna soil based in the management of the studied agroecosystems, focus on the response of specific macroinvertebrate taxa to soil disturbance. Hymenoptera and Orthoptera are the main groups that define the macrofauna soil communities. As it was expected from management intensity and periodicity, the least favorable agroecosystem for soil macrofauna was 12 year old star–grass pasture, which showed low richness, low–intermediate diversity and evenness and a homogeneous distribution of individuals among taxonomical groups of macrofauna. Silvopastoral system was the agroecosystem that less change (compared to the deciduous forest) produces in macrofauna soil communities. Orthoptera can be considered as indicators of healthy soils. In contrast, Coleoptera can be considering as indicator of soil degradation in grass agroecosystems in Leptosols from Karstic zones. Wachira (2009) and Okoth et al (2009) have reported enhanced population build up of fungi like arthrobotrys species in organic amendment plots. High organic matter, shade, high soil carbon and nitrogen have a significant influence in supporting high population of soil Collembola and Mites (Muturi et al 2009 and Maribie 2009). The presence of organic manure resulted in an increase in the abundance and diversity of total collembolan. Nishida et al (2009) worked on short-term response of abuscular mycorrhizal association to spider mite herbivory. According to them, aboveground herbivory by spider mites increased root biomass in a nutrient-rich environment. However, the effects of nutrient manipulation and aboveground herbivory on belowground biomass of intact plant communities in the Weld have rarely been examined. Anu et al (2009) worked on seasonality of litter insects and relationship with rainfall in a wet evergreen forest in South Western Ghats: according to them, invertebrate seasonality patterns play an important role in regulating the feeding and breeding patterns of many tropical rain forest vertebrate
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species. The data on the seasonal component of litter insect abundance from the Western Ghats forests will be useful in the effort to understand the breeding, foraging ecology and distributional pattern of insectivorous vertebrate species in the regions. Marinia et al (2009) worked on impact of farm size and topography on plant and insect diversity of managed grasslands in the Alps. According to them, Modern cultivation, chemical fertilization, artificial irrigation, pesticides, and herbicides are frequently employed in modern agriculture, and all are detrimental to soil organisms. The intensification of agricultural practices and the associated decline in natural habitats are the major drivers of biodiversity loss. Seymour and Collett (2009) worked on the effects of fire retardant application on heathland surface-dwelling ant species (Order Hymenoptera; Family Formicidae) in Victoria, Australia. According to them, the humidity plays an integral part in softening the soil, which presumably enables them to build nests more easily. In turn, their nesting habits also greatly influence soil structure and their presence or absence has a strong influence on the distribution of other kinds of insects. Furthermore, they are important in many food webs, providing prey for a number of birds, reptiles and mammals; they also increase nutrient cycling. Yang and Chen (2009) worked on plant litter quality influences the contribution of soil fauna to litter decomposition in humid tropical forests, southwestern China. According to them, soil insects and other soil fauna enhance ecosystem services by accelerating key determinants of ecosystem primary productivity including organic matter decomposition, soil mineralization, energy flow, nutrient cycling and by maintaining soil physical structure. Soil insect diversity and abundance have been used as indicators of soil stress, soil quality, pollution, and environmental changes (Parisi et al 2005). Eyles et al (2009) worked on Shifts in biomass and resource allocation patterns following defoliation in Eucalyptus globulus growing with varying water and nutrient supplies, according to them, insect herbivory did not affect total belowground biomass production or fine root production, but it did lead to a decrease in coarse root production. These results are congruent with work on a single species—Eucalyptus globulus— which showed that herbivory aboveground can lead to reduced biomass production of coarse roots belowground. Karanja et al (2009) worked on soil macrofauna community structure across land use systems of Taita, Kenya, they demonstrated that quantitative change in diversity and density of soil fauna communities occur when various land use is subjected to varying levels of intensification. These changes could be associates with management practices that consequently results in destruction of nesting habitats, modification of soil microclimate within these habitat and removal of substrate, low diversity and availability of food sources.
for the associated macrofauna groups the significant correlation between some soil macrofauna groups with selected soil chemical properties shows that, soil chemical characteristics may indirectly play a role in influencing the density, distribution and structure of macrofauna communities. However, there is need to demonstrate how changes in macrofauna diversity and abundance associated with land use changes affect ecosystem functions and how such functions are beneficial at farm level.

Boer et al (2010) studied on the effect of soil pH and temperature on *Folsomia Candida* transcriptional regulation and their data showed that only 1 or 2 stress response genes were transcriptionally affected by pH and temperature thus exerting minimal effects. The physiological effects of these treatments on *Folsomia candida* might indicate interesting novel molecular mechanisms. Stein et al (2010) worked on impact of invertebrate herbivory in grasslands depends on plant species diversity. According to them, insect herbivory can influence plant biomass production and community structure. However, no significant effects of insect herbivory on total aboveground biomass or on the biomass of dominant plant species. But they did find that, when insects were present, the biomass of subdominant species was nearly twice as high as when they were absent. Because aboveground herbivores often preferentially select high quality host plants, they can have dramatic effects on biomass of particular species, but still have little or no effect on total aboveground biomass of the entire plant community. Listed several reasons why the effects of herbivory on total aboveground biomass may be weak relative to nutrient manipulation. First, herbivores may have been limited by their own predators or by intraguild processes, which might be more common in high productivity environments. Second, some degree of compensation for herbivory, either by individual plant species or by the entire community, may occur such that if the biomass of one species goes down, the biomass of another (or others) increases. Third, taxa other than aboveground herbivorous insects (e.g., gastropods, voles, belowground herbivores) may consume more biomass in this ecosystem (Gruner et al 2008). Moron-Rios et al (2010) worked on the effects of seasonal grazing and precipitation regime on the soil macro invertebrates of a Mediterranean old-field. According to them, climate changes can influence soil microarthropod community abundance and composition directly by altering soil microclimate and indirectly by altering resource availability and the composition of the soil food web. Warming and changes in precipitation amounts, for example, can directly alter soil temperature and moisture, factors that strongly influence microarthropod reproduction.
and development rates. In fact, soil microarthropods are extremely responsive to changes in soil moisture, a pattern seen in numerous studies across diverse ecosystems. Castro et al (2010) worked on soil microbial community responses to multiple experimental climate change drivers. According to them, long-term ecosystem responses to atmospheric and climatic changes (hereafter 'climate changes') may largely depend on how the soil subsystem responds to these perturbations. While recent studies have focused on how climate changes can impact soil microbial communities and the ecosystem processes that they control, such as litter decomposition and nutrient cycling (e.g., Bardgett et al 2008), effects of climate changes on soil microarthropods received less attention (Hagvar and Klanderud 2009). Sackett et al (2010) worked on linking soil food web structure to above- and below-ground ecosystem processes: a meta-analysis. According to them, soil microarthropods play an important role in the functioning of the decomposer food web by, for example, exerting top-down control of primary (bacteria, fungi) and secondary (nematodes, protozoa) decomposers. Soil microarthropods also affect decomposition processes directly through fragmentation of litter and through fecal production. Iloba and Ekrakene (2010) worked on soil arthropods recovery rates from 5-10 cm within 5 months period following endosulfan (an organochlorine pesticide) treatment in designated plots in Benin City, Nigeria. According to them, there was consistent decrease in the mean numbers of soil arthropod sampled from April to June and the decrease was more as concentration of applied endosulfan increased. However, July to August witnessed very remarkable increase in mean soil arthropod sampled compared to the controlled stations, an indication of recolonisation. On the basis of concentration of endosulfan pesticide applied, the soil hydrocarbon content was significant (P<0.05) while soil pH, soil temperature and soil moisture were not. However, increase in soil moisture from April to August was observed to result in the increase in mean numbers of soil arthropod groups sampled. Besides the enhancement of agricultural productivity when the pesticides are properly applied, the problem of ecosystem imbalance has a natural solution path.

Okiwela et al (2011) studies on Soil microarthropods in a secondary rainforest, Rivers State, Nigeria: Ecosystem health indicators of oil pollution and the summarized that Comparisons were made of the species richness and densities of soil microarthropods- (mites, collembolans) from a relatively undisturbed secondary forest and a nearby area, where there had been an oil spill, approximately 1 year before the commencement of the 2 yr study, May, 2007 to April, 2009. Soil samples were taken monthly with an 8.5 cm
diameter bucket-type auger. Extraction was by the Berlese-Tullgren funnel. Identification was undertaken with the aid of standard keys and comparisons were made with type specimens. Mean Total Hydrocarbon (THC) values were 630 mg/kg (43.0 to 1000.0) and 10 mg/kg at the polluted and undisturbed habitats respectively. Among the mites, Cryptostigmata (Oribatids) were dominant in both undisturbed (69.85%) and polluted (74.25%) habitats; the least abundant were the prostigmates. Within the oribatids, Scheloribates spp., Galumnidae spp., Parallonothrus nigeriensis and Bichytheimamia nigeriana were collected from both habitat types. In contrast, Mixacarus sp., Aunecticus sp., Atropacarus sp., Bellidae sp., Cephalidae sp., Oppia sp., Basilobellidae sp., Epilohmaunia sp., Mesoplophora sp., Aecheogozettes magnus and Northrus lasebikani were restricted to the undisturbed habitat. In the Mesostigmata, only Parasiticidae sp. and Rhodacaridae sp. were found in both habitat types; Polyaspidae sp., Uropodidae sp. and Asca sp. were restricted to the undisturbed habitat. The Prostigmata, Bellidae sp. were collected from undisturbed and polluted habitats. Among Collembolans, Cryptophagous and Paranolla were found in both habitat types while Hypogastina, was restricted to the undisturbed habitat. Abundance and densities of mites and collembolans were respectively significantly reduced in the polluted habitat (p < 0.05; df = 9; F = 20.5; p < 0.05; df = 9; F = 30.08). N'Dri and Andre (2011) Studied on Soil mite densities from central Ivory Coast and summarized that Four sites, the Lamto savannah, the Oume primary forest and Oume teak plantation (Sudanese domain) and the Tai primary forest (Guinean domain) were sampled twice (in the rainy and dry season) in Ivory Coast. During this study three hypothesis were investigated: (1) soil mite densities vary with habitat type and season; (2) soil mite densities are affected by soil physico-chemical parameters; and (3) soil mite densities vary with depth (vertical distribution) and along transects (horizontal distribution). After a 1-week extraction in Berlese-Tullgren funnels, mite densities were higher during the rainy season than during the dry season. Despite the site and the season, density generally decreased from the litter to the deep layers despite the appearance of a bimodal distribution in some sites. The seasonal effect was more marked in topsoils.Inspite of the season, the same density succession was observed: Oume forest - Lamto savannah - Oume teaks - Tai forest. Major taxa Oribatida and Gamasida decreased with the depth in all sites and in all seasons. Contrary to what is observed in temperate areas, the soil depth 50 indicated that the study of top soils may be sufficient to describe the soil mite densities in the Tropics. Physico-chemical parameters such as water content and apparent density influenced the vertical mite distribution. Kardol et al (2011) worked on Climate change effects on soil
microarthropod abundance and community structure and reported that Long-term ecosystem responses to climate change strongly depend on how the soil subsystem and its inhabitants respond to these perturbations. Using open-top chambers, we studied the response of soil microarthropods to single and combined effects of ambient and elevated atmospheric [CO₂], ambient and elevated temperatures and changes in precipitation in constructed old-fields in Tennessee, USA. Microarthropods were assessed five years after treatments were initiated and samples were collected in both November and June. Across treatments, mites and collembola were the most dominant microarthropod groups collected. They did not detect any treatment effects on microarthropod abundance. In November, but not in June, microarthropod richness, however, was affected by the climate change treatments. In November, total microarthropod richness was lower in dry than in wet treatments, and in ambient temperature treatments, richness was higher under elevated [CO₂] than under ambient [CO₂]. Differential responses of individual taxa to the climate change treatments resulted in shifts in community composition. In general, the precipitation and warming treatments explained most of the variation in community composition. Across treatments, they found that Collembola abundance and richness were positively related to soil moisture content, and that negative relationships between collembola abundance and richness and soil temperature could be explained by temperature-related shifts in soil moisture content. Their data demonstrate how simultaneously acting climate change factors can affect the structure of soil microarthropod communities in old-field ecosystems. Overall, changes in soil moisture content, either as direct effect of changes in precipitation or as indirect effect of warming or elevated [CO₂], had a larger impact on microarthropod communities than did the direct effects of the warming and elevated [CO₂] treatments. Moisture-induced shifts in soil microarthropod abundance and community composition may have important impacts on ecosystem functions, such as decomposition, under future climatic change. Wichaikam et al (2011) worked on seasonal and habitat-specific differences in soil insect abundance from organic crops and natural forest at the Ang Khang Royal Agricultural Station, Chiang Mai, Thailand and explained soil organisms play an integral role in decomposition and nutrient cycling, but pesticides and artificial irrigation from agriculture can kill soil organisms and thereby compromise the vital ecosystem services that they provide. Organic farming practices are known to alleviate the native effect of agriculture on soil insects. Soil insect abundance was examined in a variety of organic farms and in natural forest in northern Thailand using pitfall traps. More than 7,000 insects were collected and sorted to order. Soil insect
abundance varied significantly with season, treatment, and agricultural crop. Insects were most abundant in Asian pear (AP), hill evergreen forest (HF), Chinese teas (CT), strawberries (ST), Asian maple trees (MT) and vegetables for human consumption (VH). Collembola were most abundant in most treatments, and ants were disproportionately common in samples from treatments with trees. There were more insects in the wet season than in the dry season in all treatments. Collembola, Orthoptera, Coleoptera and Hymenoptera differed significantly among different treatments, but Diptera did not. Their conclusion was that the abundance of soil insects at a site in northern Thailand varied significantly with season, treatment, and agricultural crop. The rank order of insect abundance was: AP, HF, CT, ST, MT and VH. Eight insect orders were recorded, and Collembola was the dominant order in all treatments. The rank order of Collembola abundance was: HF, AP, CT, MT, ST and VH. Collembola, Orthoptera, Coleoptera, and Hymenoptera were significantly different among treatments while Diptera showed no difference. Except Collembola, ants (Formicidae) were the dominant ground insects under tree covers. Gryllidae is a major group of omnivorous scavengers which was commonly found feeding on the decaying leaves of vegetables. Insects were significantly more abundant in permanent trees than in annual crops and they were significantly more abundant in the wet season than in the dry season across all habitat types.

Innocenti et al (2011) studied on Does substrate water content influence the effect of Collembola-pathogenic fungus interaction on plant health? A mesocosm study and concluded that the soil moisture seems, on the basis of the data, to be a factor able to influence the biocontrol ability of P. armata against G. graminis var. tritici disease. It could be interesting to verify also their result in relation to soil moisture. Therefore, generalisations about the effect of moisture on Collembola - fungi interactions should be made with caution since the complexity of these interactions. Muturi et al (2011) studied on Effect of integrated soil fertility management interventions on the abundance and diversity of soil Collembola in Embu and Taita districts, Kenya and their study has demonstrated the potential of organic soil amendments in enhancing edaphic soil Collembola as well as diversity due to the increased substrate niche for soil Collembola. However, dry conditions negatively affect the trend. Therefore, use of organic manure in agricultural fields would not only boost agricultural food production, but, also sustain soil Collembola which are important in nutrient cycling. Souza et al (2011) worked on differential effects of two dominant plant species on community structure and invasibility in an old Weld ecosystem. According to them, if the biomass of subdominant species increases, but the biomass of dominant
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species does not decrease, then overall biomass has to be higher when herbivores are present. But they found no effect of herbivores on total biomass or on the biomass of dominant species. One possibility is that herbivores could have reduced the biomass of particular dominant species (such as *Solidago altissima*), which has an especially strong effect on the biomass of subdominant species in this system.