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Heritiera fomes (Buch-Hum) leaf litter decomposition of a newly emerged virgin deltaic Island (Nayachar) located on north eastern part of Midnapore coast of West Bengal, India.

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Abstracts:

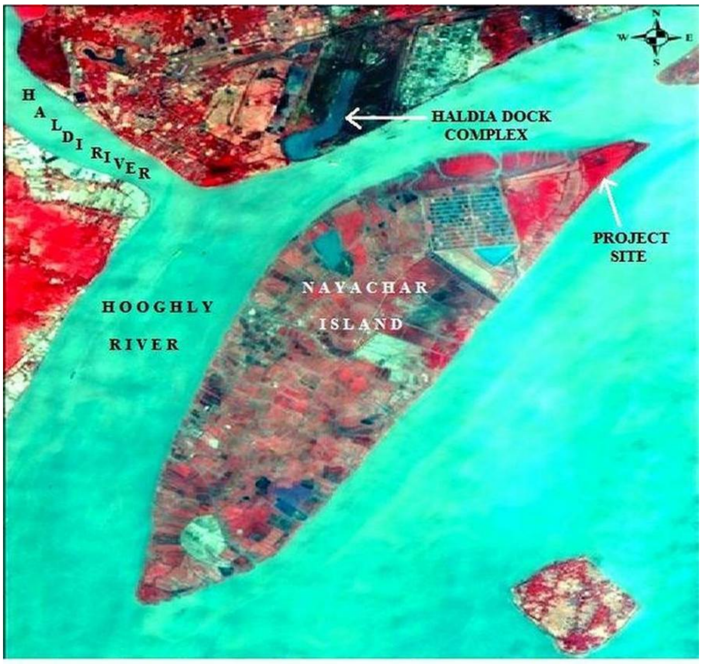
Litter fall and decomposition of *Heritiera fomes* (Buch-Hum) leaves were compared for different seasons and sites in Nayachar Island (Latitude 21°58'33'' and longitude 88° 04'54''). *Heritiera fomes* (Buch-Hum) leaf litter decomposition was estimated using litter bags method. Seasonal changes and soil microarthropods abundance has an impact on the decomposition of mangrove leaf litter. This study analysed the influence of weather conditions on the decay rate, physio-chemical parameters and microarthropods population abundance as a decomposition indicator of leaf litter of *Heritiera fomes*(Buch-Hum). This study present the decomposition rate for *Heritiera fomes*(Buch-Hum) leaf litter throughout the year. It also quantifies soil microarthpods (Acarina, Collembola, Coleoptera, Hymenoptera, Isopoda etc) abundance and different value of Physico-chemical parameters throughout the decomposition process. Finally this study emphasizes that the different groups of soil microarthropods not only plays important role in litter decomposition. Simultaneously, they also plays important role in the nutrient cycling in the coastal environment.

Key words: Mangrove, Litter decomposition, Soil microathropods.

Introduction: -

Mangrove is one of the most extraordinary ecological formations occurring almost exclusively in the tropics. Like the tropical rain forests, the mangroves have also played a very important role in the economy of our coastal population for thousands of years, providing a wide variety of goods and services including wood production, support for commercial and subsistence fisheries aquaculture, salt production and shoreline and coastal erosion control. Mangroves are salt tolerant forest ecosystems of tropical and subtropical interdial coastal regions near river mouth. They form highly productive ecosystems since the inorganic nutrients, brought in by the incoming freshwater from land run-off, are trapped to form the source of energy for many organisms. A mangroves ecosystem constitutes as reservoir, refuge, feeding ground and nursery for many useful and unique plants and animals confined to this region. Through the export of decomposable organic matters into adjacent coastal waters, the mangroves provide an important nutrient input and primary energy source for many tropical estuaries. Soil fauna exists both in and below the litter layer often moving from one to the other. It is a broad term applicable to all the groups of animals, which spend their whole life or one or more of their developmental stages, in soil or litter [1] . Arthropods are one of the groups of soil fauna, which inhabit the soil, and the overlying layer of organic debris. According to Kuhnelt (1963) [2] , there was hardly an arthropodan group, which was not found in the soil. The arthropods usually referred to collectively as the soil micro arthropod fauna [3] , including Acrarina, Collembola, Protrua, Pauropoda, Diplura and Symphyla. The first two groups are the abundant faunal groups in most soils in comparison to other groups [4] *Heritiera fomes* is a species of mangrove tree in the family Malvaceae. Its common name include "Sundri" . It is the dominant mangrove tree species of Nayachar Island . *Heritiera fomes* is a medium –sized evergreen tree growing to the height of 15 to 25 metres. The leathery leaves are elliptical and tend to be clustered at the ends of the twigs. The present investigation also laid emphasis on the study of the decomposition process of *Heritiera fomes*(Buch-Hum) leave litters and the succession of different micro- arthropods population in the different phases of litter decomposition processes of the Nayachar Island of Midnapore coast, West Bengal, India. Therefore, those micro- arthropods of mangrove fauna have been dealt with in the present communication in much detail with a comparative account of different selected study sites located in different parts Nayachar Island.

Material and method



***Heritiera fomes*(Buch-Hum)** mangrove plants were chosen for the study of mangrove leaves decomposition. Litter decomposition rate has been determined by litterbags methods. The litterbags were made of nylon, mesh sizes ($6mm^2$) were used for present study [5] . Freshly fallen leaves of different mangroves plant were collected from the mangrove belt of Nayachar Island. The leaves were chopped with size (1inch) into uniform lengths then dried in air. Each nylon bags was filled with 200gm air-dried litter. A set of 4 such bags was made for each selected sites. A total of 12(4×3) bags were made in three different localities. Bags were placed at a depth 5 inch under the soil. The litter bags at the rate of decompose leaves were drawn at an intervals of 3 months for one year. Microarthropods from each litter bags were extracted by modified Tullgreen funnel [6] . The collected fauna were sorted out into different groups and identified with the help of Stereoscopic binocular microscope followed by taxonomic key. Decompose soil sample were study with the help of laboratory slandered method [7-9] and statistical analysis done by STATISTICA , Version 7.0.

Result and Discussion:

Heritiera fomes mangrove plants have been chosen for measuring decomposition rate in order to find out their role of microarthropods in decomposition.

Litter decomposition study with *Heritiera fomes*

Heritiera fomes locally named as "Sundari" represents one of the important species of mangrove in the study area. The name Sundarbans was supposed to have been derived from the local name of this plant vis-à-vis was selected for litter decomposition. The successional occurrence of different microarthropodal faunal components, rate of decomposition and changes of different physicochemical parameters associated with decomposing litters have been presented below:-

a. **Rate of Decomposition**: The rate of litter decomposition of *Heritiera fomes* was found to have increase gradually throughout the decomposition period and were estimated as 15%, 24%, 35.5%, and 55% at the end of 3rd, 6th, 9th and 12th months respectively (Table-1).

b. Table-1 .Mangrove litter decomposition in three months interval (Expressed in %)

		Plant
Months	**Weight (gm)**	**H.F**
Jun04-Aug04	**Initial**	200
	Final	170
	Difference	30
	%	15%
Jun04-Nov04	**Initial**	200
	Final	152
	Difference	48
	%	24%
Jun04-Feb05	**Initial**	200
	Final	129
	Difference	71
	%	35.50%
Jun04-May05	**Initial**	200
	Final	90
	Difference	110
	%	55%

Faunal Occurrence (Mean value) in different phase of decomposition:

The number of different faunal groups when litter bags were withdrawn after 3 months were - Acarina (5) , Collembola(6), Diptera(3) and other microarthropods(1) .After 6 months of decomposition of litter, the number of different faunal groups were – Acarina (9), Collembola (8), Coleoptera (2), Diptera (2), Isopoda (1) and other microarthropods(2).After 9 months, when the litter bags were withdrawn, the different faunal groups which were encountered were - Acarina (3), Collembola(4), Coleoptera (3), Diptera (3), Isopoda (3.67), Hymenoptera (3) and other microarthropods (2). At the end of 12 months when the litter bags were withdrawn, Acarina (4), Collembola (3), Coleoptera (5), Diptera (3), Isopoda (5.33), Hymenoptera (5) and other microarthropods (2) constituted the litter faunal community

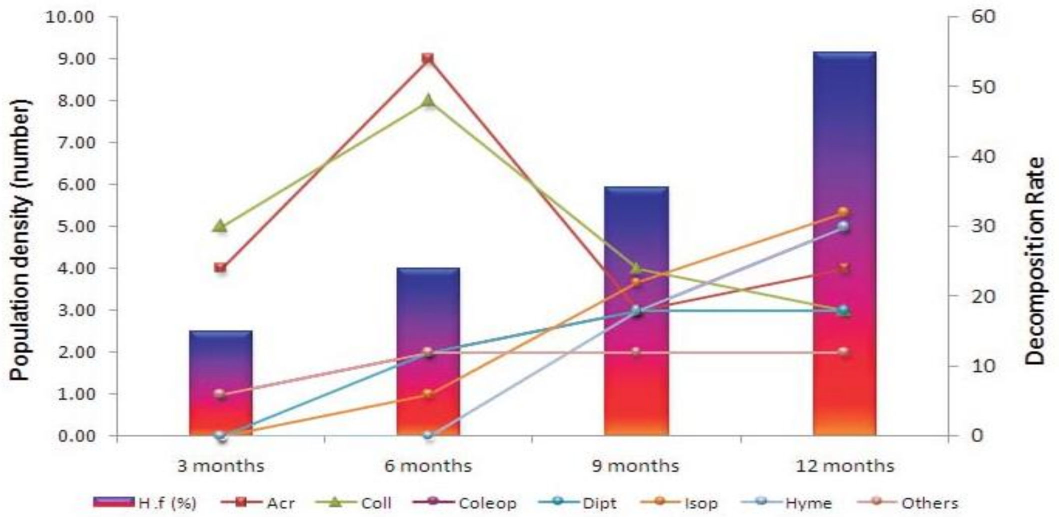


Fig-1

Different decomposition rate and with the occurrence of soil microarthropods population during different phases of decomposition of *Heriteria fomes.*

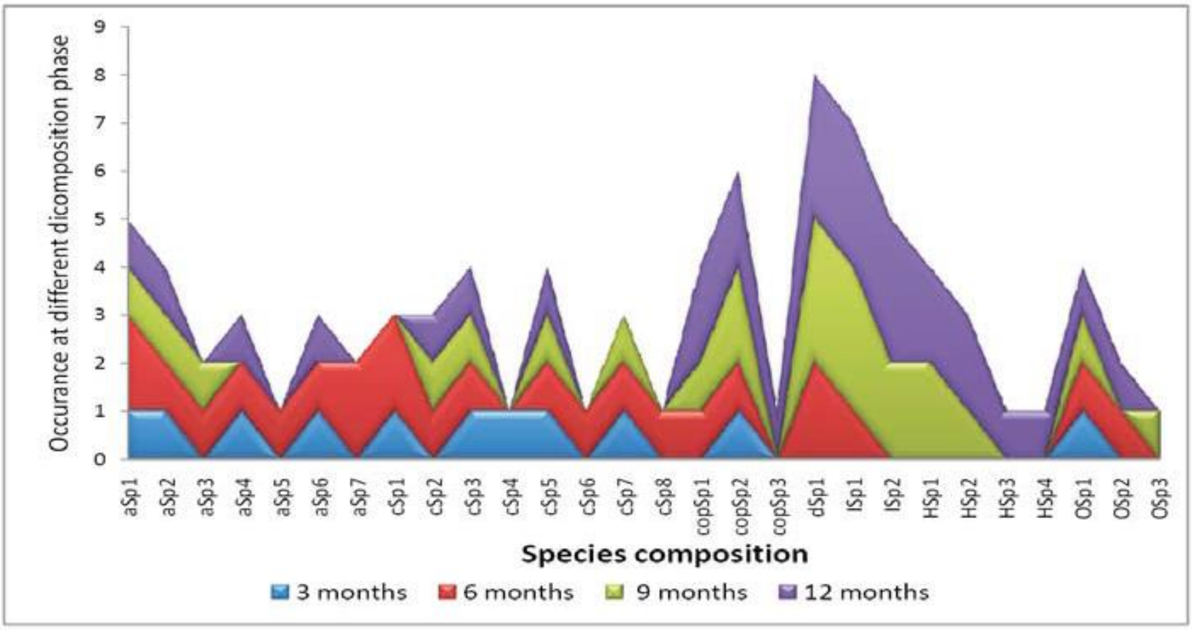
Relative abundance (%)

Relative abundance of soil microarthropods revealed that after 3 months of decomposition, % of occurrence of Collembola was 45.45% followed by Acarina (36.36%) , Coleoptera (9.09%) and other microarthropods (9.09%). After 6 months of decomposition, % of occurrence of Acarina was 37.5% followed by Collembola (33.33%), Coleoptera (8.33%) , Diptera (8.33%) , other microarthropods (8.33%) and Isopoda (4.16%). After 9 months of decomposition, % of occurrence of Collembola was 18.45% followed by Isopoda (16.93%) Acarina (13.84%), Coleoptera (13.84%) Diptera (13.84%) , Hymenoptera (13.84%) and other microarthropods (9.22%). After 12 months of decomposition, % of occurrence of Isopoda was 19.5% followed by Hymenoptera (18.29%), Coleoptera (18.29%), Acarina (14.63%), Collembola (10.97%) and other microarthropods (7.31%) .

Diversity of microarthropods in different phase of decomposition

During the yearlong (12 months) studies on litter decomposition, differential appearance of different groups of microarthropods at different phases of litter decomposition were noticed. During the first phase (Initiation to 3 months), the Acarina population was found to be maximum followed by Collembola , Coleoptera and other microarthropods. On the second phase of decomposition (3 to 6 months), gradually different groups of microarthropods *viz.,* Acarina, Collembola and Coleoptera displayed almost equal population density while Diptera population marked its first appearance in the decomposing litter. In the 3rd phase (6 to 9 months), the population density of Acarina and Collembola showed a declining trend while the population density of Diptera and Hymenoptera revealed an increasing trend, Isopoda was found to appear during this phase. In the last phase (9months to12 months) , the population density of Acarina and Collembola totally dwindled with the maximum density of Hymenoptera and Isopoda population (Figure-2).

Fig -2 .Occarance of difference microarthropods species during difference phases of litter decomposition of *Heritiera fomes*



Changes in the population density of different microarthropods species during different phases of decomposition

Fluctuation of population density of different microarthropods showed different trend in different phases of litter decomposition.

The population density of microarthropods species started increasing after 3 months of decomposition of litter whereas their population density showed declining trend after 6 months. This category of microarthropod included species like *Scheloribates thermophilus (asp1), Scheloribates praeincisus (asp3), Galumna flabellifera (csp1), Lepidocyrtus sp (csp7), Lepidocyrtus medis (csp8)).* Exception was noted for the species *Uroctea sp* under the order Araneae where the increasing population density was observed after 6 months and population started declining during last phase (9 months to 12 months) of decomposition of litter (Fig-3)

The definite population fluctuation of litter inhabiting microarthropod species was observed where population density started increasing after 3 months and continued upto 6 months of decomposition of litter while declining population density was registered after 9 months of decomposition and again an increasing trend of population was recorded after 12 months decomposition of litter (*viz. Xylobates seminudus (asp4), Oppia sp(asp6), Artema sp (osp2)(Fig-3)*

The clear population fluctuation of litter inhabiting microarthropods species was noticed where population density started increasing after 6 months and these increasing trends were continued upto 12 months of decomposition of litter (*viz. Isotomiella minor (csp2), Family* Carabidae, Staphlinidae, Dytiscidae, Mycetophilidae*, Philoscin sp (Isp1), Procellionides ap (Isp2), Monomorium destrucor (hsp1), Monomorium floricola (hsp2), Monomorium latinode (hsp3), Pheidola sp (hsp4)*

The marked population fluctuation of litter inhabiting microarthropods species was recorded where the population density was found to be maximum during all phases of decomposition *viz. Scheloribates parvus (asp2), Sinella sp (csp5), Marpissa sp (Osp1)* (Fig-3)

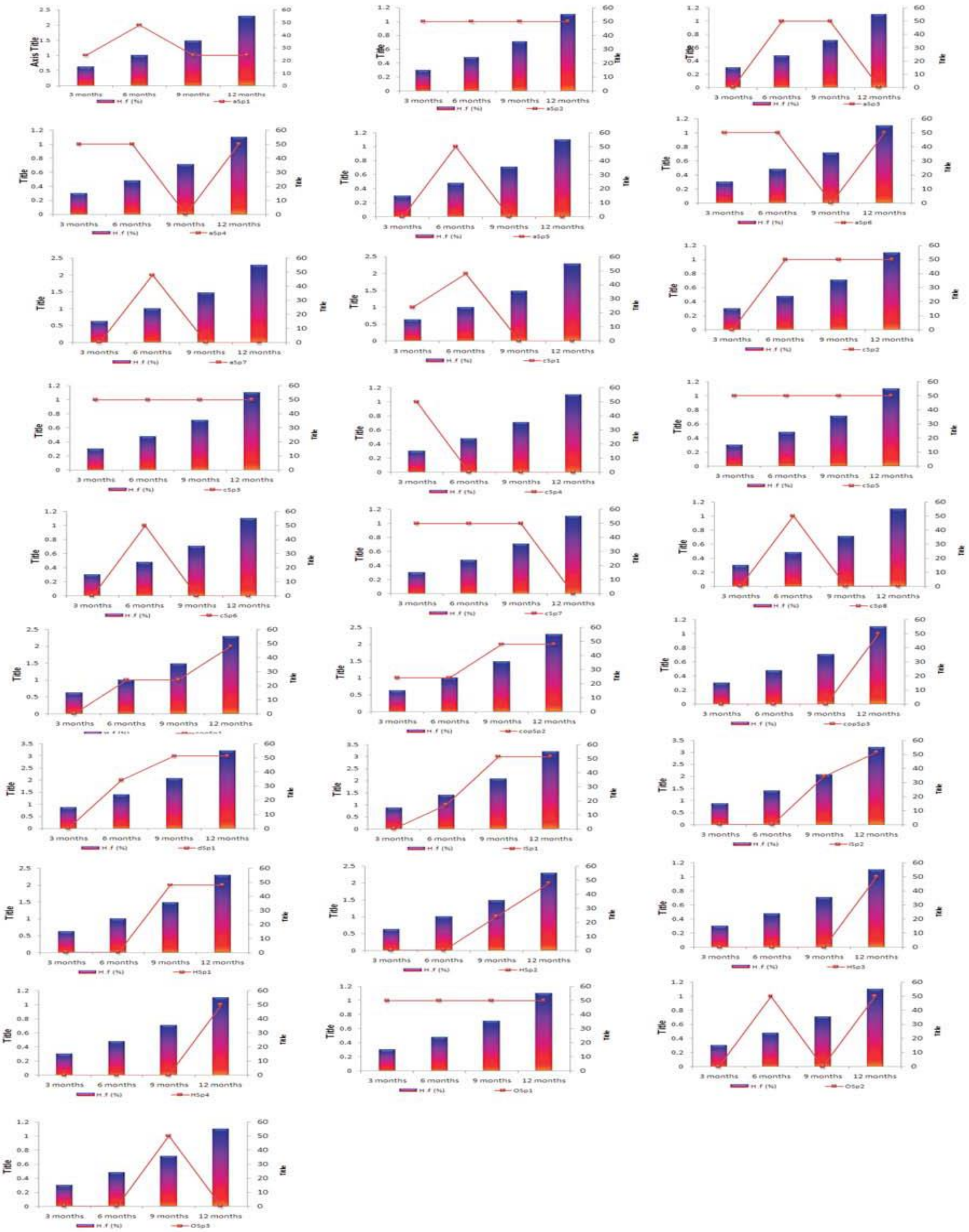


Fig-3: Trends of population fluctuation of soil microarthropods in relation to different phase of decomposition of *Heriteria fomes.*

f. Physicochemical parameters during different phases of decomposition

pH : Minimum p H (6.3) was recorded after 6 months of decomposition and maximum p H(7.3) was recorded after 3 months of decomposition period (Figure-4)

Organic carbon (%): Organic carbon showed its minimum value (5.20%) after 3 months of decomposition and maximum (6.8%) was recorded after 9 months of decomposition period (Figure-4).

Salinity (ppt): Salinity was found lowest (0.01ppt) after 9 months of decomposition and that of highest (0.1ppt) was noticed after 3 months of decomposition period (Figure-4).

Total Nitrogen (ppm): Total nitrogen showed its minimum value (1200 ppm) after 12 months of decomposition and that of maximum value (1240ppm) was found after 6 months of decomposition period (Figure-4).

Total phosphorus

Minimum total phosphorus (82ppm) was recorded after 3 months of decomposition and that of maximum (94ppm) was recorded after 6 months of decomposition period (Figure-4).

Available potassium: -

Minimum available potassium (12ppm) was estimated after 12 months of decomposition and that of maximum (14ppm) was found after 6 months of decomposition period (Figure-4).

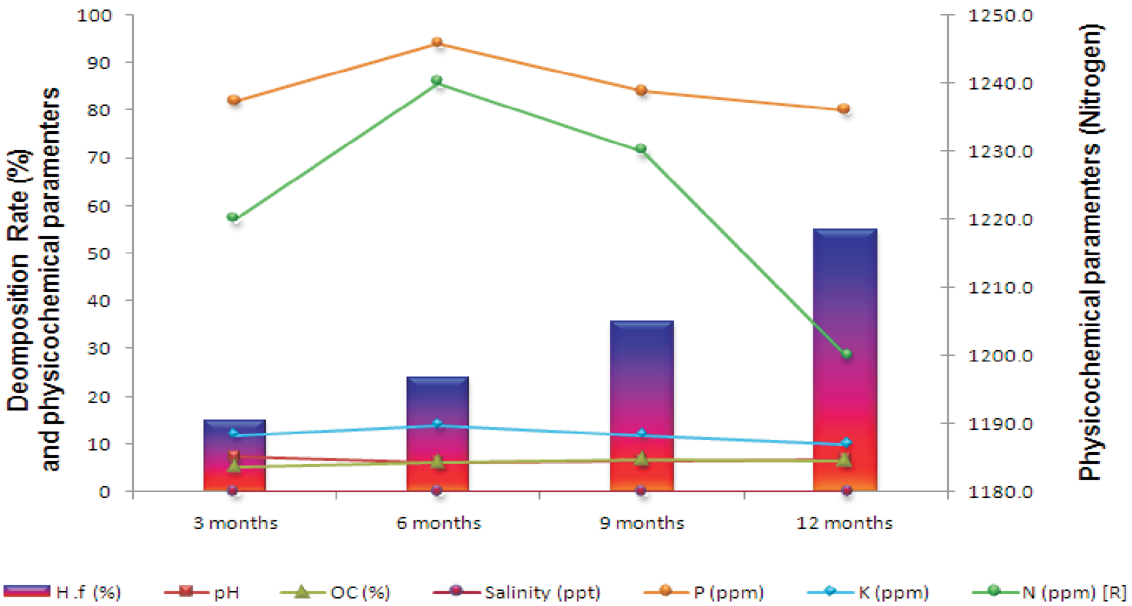


Fig-4 : Density of soil microarthropods population with relation to physichochemical paramentrs during different phases of decomposition of *Heriteria fomes*

Discussion

Decomposition of litter and mineralization of nutrients strongly influence soil nutrient availability and ultimately ecosystem primary productivity. Disturbances, which alter decomposition and other soil process, can allow nutrient losses and a decline in site productivity [10] . The study of microhabitat development and successional changes in soil organism communities during the break down and decomposition or organic materials in the soil could provide useful information towards an understanding of the large system. Successional occurrence of the soil microflora on leaves has been demonstrated in a number of studies [11-12] but there have been few investigations of the soil fauna associated with decompositing leaf litter. The present study attempted to analysis soil microarthropods population extracted from mangrove litters under the process of decomposition over a interval period of 3 months throughout one year to investigate the successional development of soil microarthropods population, structure and tropic relationships of soil microarthropods communities during different phases of decomposition . The rate of decomposition of forest litter has been used as an indication of soil fertility and decomposition activity [13-15] For such a breakdown of organic matter in the soil, the role of soil organisms in relation to the size in terms of biomass and numbers has often been discussed and frequently cited as evidence that these population were important [14] The present work incorporated the study of enclosed selected mangrove (*Heriteria fomes)* litter in nylon mesh bags and an attempt to relate the activity of soil microarthropods over the season to the loss of litter weight during different phases of decomposition. The most of the abundant organisms in dry funnel extracts of decompose selected mangrove plant litter have been Collembola and Acarina and in most studies they are referred to as litter microathropods [15] . However, most of the other groups as included in the present study in addition to these two, came under the broad definition of this. The present investigation incorporated a detailed study of these microarthropods in relation to selected mangrove litter decomposition as the 6-mm^2 mesh size of the nylon bags were used. Maximum decomposition was recorded in 12 months and that of minimum was estimated during 3 months of decomposition periods. Maximum faunal occurrence was observed during 6 months of decomposition phase whereas minimum faunal components were noted during 3 months decomposition phases. Maximum relative abundance of Collembola was recorded on 3 months; Acarina on 6th months; Coleoptera on 9th months and Isopoda on 12th months of the decomposition. Maximum values of organic carbon, N, P, K. were recorded during 6th month decomposition phases. The dynamic activity of soil microarthropods during different phases of decomposition were varied. The litter gets primarily broken down by Collembola and this partially decomposed litter gets acted upon by Acarina followed by Coleoptera, Diptera, Hymenoptera and others. Maximum number of total microarthropods occurred during the 6 months of decomposition phases, when organic carbon, N, P, K values also maximum yet, pH and salinity did not seen to play any role and the possible reason may be due to the minute range of fluctuation in litter bags . However, it was seen that the organic carbon, N, P, K, in all the litter bags of different phase of decompose litter displayed significant positive relationship with the soil microarthropods which corroborated the findings of Gulis and Suberkropp, 2003. Hence the organic carbon, N, P, K, after leaching out from the litter, seemed to play a greater role in the regulation of microarthropods population. Correlation coefficient analysis between Collembola and ecological factors like N. P, K and organic carbon, showed significant positive correlation in most of the selected mangrove litter's decomposition.

The present study revealed that though there was a succession of population in microarthropods, their role differed either individually or conjointly in litter decomposition. However, Harding and Stuttard (1974) [15] were opined that metabolism, chemical decomposition of litter and microarthropods were less important compared with microflora. However, Howard and Howard (1974) [16] stated that burst of activity of micoarthropods, particularly Collembola and Acarina was triggered because of the fungal population rise. Subsequently, the activities of these microarthropods were responsible for the reduction of not only plant debris but also the fungal hyphae forming the organic matter of the soil. In the present study appearance and steady increase of Acarina, Collembola and Coleoptera population were found during the 1st phase of decomposition. On the second phase of decomposition, gradually different groups of microarthropods *viz.* Acarina, Collembola, Coleoptera appeared and also displayed increasing trend in their population while Hymenoptera and other microarthropods started to record their appearance in the last phase of decomposition process. In the 3rd phase, the population density of Acarina, Collembola and Coleoptera showed declining trend while the population density of Hymenoptera, Isopoda and other microarthropods revealed an opposite trend. In the last phase, the population density of Acarina, Collembola and Coleoptera totally dwindled with the recording of maximum density of Isopoda and other microarthropods . Overall findings of this study emphasizes that the different groups of soil microarthropods not only plays important role in litter decomposition simultaneously, they also plays important role in the nutrient cycling in the coastal environment

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