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Studies on Diversity of Soil Micro- Arthropods Fauna in Sajnekhali Wild Life Sanctuary, Sundarbans, West Bengal

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ABSTRACT: The ecological studies of this investigation were based on the sample survey of two sites in Sajnekhali Wild Life Sanctuary in South 24 Parganas district of West Bengal from April, 2011 to March, 2013. The major invertebrate faunal groups recorded during study were Collembola, Diplura, Acarina, Hymenoptera and Isopoda. Collembola is the most dominant group belonging to 10 species and 9 genera under 6 families, followed 6 species under 5 genera of 4 families of Acarina, 2 species under 2 families of Diplura, 2 species of Hymenoptera and one species of Isopoda. The peak of population also varied from site to site being minimum in pre monsoon (summer months) and maximum population during monsoon. Soil moisture, organic carbon, also showed statistically significant correlation with the micro-arthropod population specially Collembolan fauna in two sites. The general characters of the soil of two sampling sites were Gangetic alluvium in nature and clay loam in texture. Salinity of surface soil is high during dry season but is reduced to tolerable limits in monsoon.

Key words: Micro-arthropods, edaphic factors, Sajnekhali, Sundarbans, West Bengal.

INTRODUCTION

Qualitative and quantitative studies of soil fauna, particularly the micro-arthropods from Indian soils began from the mid-sixties, although ecological studies were initiated much earlier (Trehan, 1945). However, major contributions have been from the agricultural fields, grasslands, abandoned fields and tea gardens, and very few from tropical rainforests. While the micro-arthropod studies from various forest floors included those of Banerjee(1972), Choudhuri(1961), Hazra(1978) and reports from tropical forest soil and litter micro-arthropods are limited to the works of Singh and Pillai (1975), Prabhoo(1976), Hazra(1976), Hazra and Bhattacharyya(2003), Mitra (1993), Guru *et.al.*(1988), Mandal *et al.* (2007, 2009, 2010 and 2011). From the above literature it was assumed that the research works on Soil-Biology have tried to assess the impact of different biotic and abiotic factors on the distribution and diversity of soil mesofauna with special reference to Collembola. In India, Soil micro-arthropods fauna from Mangrove forest ecosyetem studies are very scanty. Hazra and Sanyal(1996), Hazra, Dey and Mandal (2005) studied ecology of micro-arthropods fauna in periodically inundated newly emerged alluvial island on the river Hooghly, West Bengal.

So far no consolidated research has not been conducted on this part of the Sundarban. Hence, the present investigation is taken up to know the impact of major soil factors on the distribution of soil micro-arthropods and specially the collembolan fauna. The relationship between the collembolan species and the soil parameters has also been analyzed statistically.

MATERIALS AND METHODS

Soil samples were collected at random at the rate of 3 samples per plot (5 meter square) every three month (Quarterly) during April, 2011 to March, 2013. Samples were drawn by using of a stainless steel corer (inner cross-section diameter 8.5 sq./cm) from a depth of 5 cm. Separate soil samples units (500 gram) were taken from each site (2 packet from each site) for collection of collembolan and estimation of soil parameters like-moisture, pH, organic carbon etc. were kept immediately in sterile polythene packet in 4ºC in the laboratory for estimations of soil parameters**.**

A total of 96 sample units of core and 64 samples units of packet soil were collected and examined during the study period. All the samples collected were immediately transferred to polythene packets and labelled, taking as much as possible to prevent loss of moisture. The labelled samples were brought to the laboratory for extraction within 24 hours of their collection.

Extraction of Soil Micro-Arthropod Fauna

Extraction of soil samples were carried out by 'Expedition Funnel Apparatus' modified by Macfadyen (1953) with a 40-watt bulbs for providing heat and light. The extraction period varied from 36 to 72 hours depending upon the moisture content of the soil sample.

Analysis of Edaphic Factors

Soil samples dried in a hot air oven at about 105ºC for further bacterial action (some sample was kept separately for the estimation of soil moisture) were then allowed to cool and stored in a desiccators and dried soil was passed through the 2 mm sieve, mixed and fractionated before analysis.

Temperature: Soil-thermometer was put in use to record the temperature of the soil at 5cm depth and the temperature of air, one meter above ground level.

Moisture: Moisture of the soil sample measured by the Moisture meter.

Hydrogen Ion Concentration (pH): pH of the soil was determined by the electronic pH meter.

Organic Carbon: Organic Carbon content of the soil was determined by 'Rapid Titration Method'.

RESULTS

The present investigation involves extraction of soil micro-arthropods fauna from the sampling plots of Sajnekhali Wild life Sanctuary as:

Site: Sajnekhali Wild life Sanctuary, South 24 Pgs, West Bengal.

Location and Characteristic of sampling site: This locality was situated 100 meters from main entry gate of the core area of the sanctuary covered by fencing. The site is located at 22°07'24.2" North latitudes and 88°49'45.8" East longitudes. Soil was humid alluvial in nature and sandy silt in texture. Although the region is situated south of the Tropic of Cancer, the temperature is equable due to its proximity to the sea. Average annual maximum temperature is around 35°C. Average annual rainfall is 1920 mm. Average humidity is about 82% which is more or less uniform throughout the year. The dominating mangroves are- Sundari (*Heritiera fomes*), Bain (*Avicennia* spp.), Passur (*Xylocarpus mekongensis*), Dhundul (*Xylocarpus granatum*), Golpata (*Nypa fruiticans*), Hental (*Phoenix paludosa*), Khalsi (*Aegiceras corniculatum*), Garjan (*Rhizophora apicata*), Garan (*Ceriops decandra*), Gnewa (*Exocaria agallocha*), Keora (*Sonneratia apetala*), Haragoja (*Acanthus ilicifolius*) and Dhanighas (*Porterasia coarctata*).The sampling site was maintained with coverage of litter of the fallen leaves and dried twigs of the above trees.

Soil factors: Soils are alluvial, blackish brown in colour and sandy silt in texture. Salinity of surface soil is high during dry season but is reduced to tolerable limits because dilution by the leaching effects of rainwater. Mechanical analysis of soil showed maximum percentage of medium silt 36.4% and more or less equal percentage of fine sand and fine silt. During summer, soil moisture content was 27% in 2011 and 29.5% in 2012. Maximum moisture content in soil (35.5%) was recorded in July, 2011 and 34.5% in the same period of 2012. During summer, other soil factors such as temperature, pH and organic carbon were found 33.5ºC, 5.8, 1.3%; 34ºC, 5.6, 1.5%; in 2011 and 2012 respectively. Mean values of others revealed more or less identical characteristics (Table 1).

Soil Fauna: The Collembolan fauna obtained from this site belonged to 10 species in 9 genera. Amongst them, the species *Lepidocyrtus curvicollis* was found most dominant and it was (22.5%) of the total fauna recorded from this site. The species *Axelsonia nitida* contributed (18.9%), *Isotoma* sp contributed (16.2%), *Lepidocyrtus caeruleicornis* contributed (12.4%), *Sminthurides appendiculatus* contributed (5.16%), *Sinella curviseta* contributed (5.5%) and *Cyphoderus javanus* contributed (4.14%). Population of other species from this site was numerically low and highly irregular in distribution pattern in the sampling site. Percentage of springtails was found maximum in July in two consecutive years, which coincided with the maximum concentration of soil factors like-moisture, organic carbon and other edaphic factors.

Table1: Values of edaphic factors from April, 2011- March, 2013 at Sajnekhali W.L.S.

Month and Year	Temperature(°C)	Moisture (%)	pH	Organic carbon (%)
April,2011	33.5	27	5.8	1.3
July,2011	31	35.5	6.4	2.38
October,2011	29.5	34	6.0	2.4
January,2012	25	27.5	6.4	2.3
April,2012	34	29.5	5.6	1.5
July,2012	30.5	34.5	6.1	2.7
October,2012	29	31.5	6.2	2.4
January,2013	24.8	28.5	6.4	2.1
March, 2013	34.5	28.5	5.5	1.8

Among Acarina, 6 species under 5 genera are*Scheloribates bhaduri, Scheloribates indicus, Tectocepheus velatus, Hoplophorella sundarbanensis, Hoplophorella scapellata* and *Oppion orientalis* comprising8.69%,7.28%, 5.43%, 4.12%, 3.86% and 2.17% respectively of total population.

Other micro-arthropods group *Lepidocampa bengalensis, Indjapyx indicus, Monomorium floricola, Monomorium destructor* and *Philoscia* spp.constituting-3.52%, 3.48%, 3.44%, 3.2% and 4.25% respectively.

Seasonal changes: Seasonal changes of each predominant species of Collembola, Diplura, Acarina, *Lepidocyrtus curvicollis, Lepidocyrtus caeruleicornis* and *Axelsonia nitida, Lepidocampa bengalensis* and *Hoplophorella sundarbanensis* obtained from this site revealed that had reached at its peak in July in both the years, while *Isotoma* sp and *Scheloribates indicus* showed maximum in January, 2011 but 2012 the peak was shifted to October. It is apparently seen that, predominant forms of soil micro-arthropods obtained from this site exhibited an irregular trend of fluctuation being minimum in summer months, slightly higher in winter months and higher in monsoon months. In this field, the population peak of other genera/ species varied among the years as well as month of observation due to their irregular occurrence**.**

STATISTICAL ANALYSIS OF DATA

The statistical analysis of the complex soil faunal communities has been conducted to show the relationship between the soil factors and Collembola. The application of Linear Correlation was undertaken in the present study involving the data of soil factors and collembolan population densities of soil separately for each site. All the analysis has been carried out by using MINITAB statistical software.

Linear Correlation

The correlation coefficient ('r' value) of each variable (*i.e.* total population of Collembola and four edaphic factors (temperature, moisture, pH and organic carbon) on each other in individual site were shown (Table 2). The correlation revealed identical relationship between the biotic variables in four sites. The correlation coefficient data mentioned in the above table broadly indicated that the edaphic factors like moisture, organic carbon with the biotic variables showed strong positive correlation in almost four sites. The correlation coefficient ('r' value) in respect of other variables like - temperature and pH with the biotic variables was found to be negatively significant correlated in all four sampling sites with the population densities of Collembola.

Table 2: Correlation (r value) between individual collembolan species with edaphic factors.

Name of the species	Temperature	Moisture	pH	Organic carbon
Hypogastrura sp	-0.180147846	0.828530719	-0.652997651	0.652985415
Lepidocyrtus curvicollis	0.109146027	0.872077366	-0.476077623	0.565049206
Lepidocyrtus caeruleicornis	0.11233319	0.740633265	-0.583840341	0.498988274
Sinella curviseta	-0.1471323	0.6677209	-0.568348	0.5597715
Entomobrya sp	-0.4904062	0.1977307	-0.6556189	0.4604979
Axelsonia nitida	-0.0113091	0.5849276	-0.6844386	0.479076045
Lobella maxillaris	0.073256903	0.6271018	-0.5098721	0.469072044
Isotoma sp	0.1328547	0.760909	-0.6889775	0.5749779
Cyphoderus javanus	-0.5243741	0.0777475	-0.371506	0.2472246
Sminthurides appendiculatus	-0.4010517	0.2774619	-0.6175193	0.427766

DISCUSSION

The ecological studies of this investigation were based on the sample survey from Sajnekhali Wild Life Sanctuary, Sundarban Biosphere Reserve, South 24 Parganas, West Bengal from April, 2011 to March, 2013. Salinity of surface soil is high during dry season but is reduced to tolerable limits because dilution by the leaching effects of rainwater. The general natures of the soil of two sampling sites were more or less identical. Among soil micro-arthropod fauna, Collembola belonged to 10 species under 9 genera of 6 families followed 6 species under 5 genera of 4 families of Acarina, 2 species under 2 families of Diplura, 2 species of Hymenoptera and one species of Isopoda. The predominant genera were *Lepidocyrtus* (2 species), *Axelsonia* (1 species), *Isotoma* (1 species), *Hoplophorella* (2 species), *Scheloribates* (2 species), *Cyphoderus* (1 species), *Entomobrya* (1 species), *Sinella* (1 species), *Sminthurides* (1 species) *Lobella* (1 species), *Monomorium* (2species) *Hypogastrura* (1 species) mentioned in order of dominance.

In the present study, the total population of soil micro-arthropod fauna showed numerical variation with the change of season with minimum in summer months and maximum in post monsoon. Moreover, a general pattern of fluctuation with maximum in monsoon and minimum in pre-monsoon (April), which in agree with Hazra and Choudhuri (1990) and Hazraand Sanyal (1996).

During this investigation, the predominant species *Lepidocyrtus curvicollis, Lepidocyrtus caeruleicornis, Axelsonia nitida, Scheloribates bhaduri, Hoplophorella sundarbanensis* and *Monomorium floricola* attained maximum population in July and two species, *Cyphoderus javanus* and *Sminthurides appendiculatus* in January. *Entomobrya* sp. reached its peak in October followed by in March while *Sinella curviseta* and appeared largest population in the month of August. Individuals of other species like, *Hypogastrura* sp, *Lobella maxillaris* were numerically low in summer months with a very irregular trend of fluctuation and these were altogether absent in many of the sampling months. Thus, most of the predominant forms considered here were found to exhibit a single peak in a year.

The role of edaphic factors on the distribution and population pattern of different groups of soil inhabiting micro fauna and flora might be assumed that the factors so far analyzed in this study exerted both significant and insignificant effects either singly or in cumulative way depending on the nature of the site. The population was maximum when the factors like moisture, organic carbon were significantly high and other conditions were optimum.

Of the edaphic factors studied, temperature showed wide variation with the change of season, ranging between 25°C and 34.5°C (Table1). Collembolan population indicated negative correlation with temperature in both sites which confirm the study of Pal et al (1992) and Guru et al (1988). Takeda (1978) also found both positive and negative correlation between temperature and different species of springtails.

Moisture content was recorded maximum (36.4%) and minimum (26.2%) respectively and thus a range of variation was observed in two different seasons. The value of correlation of collembola with moisture was highly significant. The content of organic carbon varied between 1.3% and 2.6% and exhibited strong positive correlations with the population densities of Collembola. (Table 2).

Another important variable affecting the population fluctuation of soil biota was the soil pH which read minimum of 5.2 and maximum of 6.4 **(**Table 1). However, its average value did not differ much and was more or less neutral. The statistical analysis showed strong negative correlation with the population densities of Collembola and pH which agreed with the findings of Agrell (1941), Bellinger (1954) and Pal *et al.*,(1992).

It may be concluded from the present investigation that the organic carbon and moisture are key factors which controlling fluctuations of soil micro-arthropods population. However, the factors considered here and other biotic and abiotic factors not considered at present may also play an important role for the seasonal variation and fluctuation of collembolan fauna.

CONCLUSION

The micro-arthropods fauna of the experimental sites belong to 10 species of 9 genera of 6 families of Collembola, 6 species of 5 genera of Acarina, 2 species under 2 genera of Diplura, 2 species of Hymenoptera and single species of Isopoda. Soil factors like-temperature, moisture, hydrogen ion concentration, organic carbon and the roles of these edaphic factors of soil on the distribution of soil micro-arthropods fauna in the mangrove forest ecosystem were taken into consideration in the study.

The peak of population also varied from site to site being minimum in pre monsoon (summer months)and maximum population during monsoon (in the month of July, August and September).Soil factors *viz*, moisture, organic carbon, also showed significant positive correlation with the Collembolan population while negative correlation was observed in respect to temperature and pH.

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