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Diversity of epigeic Collembola of Bibhutibhusan Wildlife Sanctuary, North 24 Parganas, West Bengal (India)

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Abstract

The present survey was carried out to explore the diversity of Collembola in the Bibhutibhusan Wildlife Sanctuary, North 24 Parganas, West Bengal on 17 December, 2008. More than 104 individuals of Collembola were collected by Aspirator only. The results revealed that 16 species belonging to 10 genera of 6 subfamilies of Entomobryidae were identified. Out of that *Entomobrya marginata* (Tullberg, 1871) firstly recorded from India, *Procerura indica* Baijal, 1958 from West Bengal and 9 species namely, *Xenylla* sp, *Ceratophysella indovaria* (Salmon, 1970), *Entomobrya nivalis* (Linnæus, 1758) Ågren, 1904, *Lepidocyrtus curvicolis* Bourlet, 1839, *L. indicus* Handschin, 1929, *L. magnificus* Carpenter, 1917, *L. orientalis* Handschin, 1929, *L. heterolepis* Yosii, 1959, *Callyntrura lineata* (Parona, 1892) Yosii, 1961 and *Salina montana* (Imms, 1912) from Bibhutibhusan Wildlife Sanctuary Parmadan, W.B. The study revealed that *Lepidocyrtus* Bourlet, 1839 was the numerically dominating genera with 5 species were reported. There was first time different ecological measurements like, Simpson index of diversity (D), Shannon's diversity index (H), Pielou evenness index (J) and Margalef's richness index (Dmg) were 0.90, 1.64, 0.59, and 3.23 respectively, were calculated from the North 24 Parganas (WB) for the Collembola. The indices indicate fair Collembola diversity and richness were there.

Keywords: Bibhutibhusan, Collembola, Diversity, Measurement, West Bengal, 24 Parganas

1. Introduction

Bibhutibhusan Wildlife Sanctuary, Parmadan is situated near the bank of Ichamati River at North 24 Parganas of West Bengal, India which is spread about an area of 0.68 square kilometer. Previously, it was called as Parmadan Forest. The Sanctuary is man-made forest area, more commonly known as Parmadan Deer Park. The survey of the Collembola of Bibhutibhusan Wildlife Sanctuary was one of the interesting explorations of biodiversity of this group. The Collembola fauna are very small insects; the largest species attaining a maximum length of 4-6 mm. In spite of their small size they are the one of the significant soil mesofauna^[1]. They are very tiny but most successful and abundant fauna. They have very wide global distribution. Collembola present in the every habitat and continent including Antarctica^[2] and high altitude of Himalayas^[3, 4]. The greatest diversity and density are seen in the soil having more humus and organic matter. They constitute the second highest mesofauna after Acarina^[5]. Presently, 8279 species of Collembola have been recorded globally^[6] whereas, 301 species under 109 genera of the 19 families are known from India^[7] and there were 13 more species added to sciences later^[8]. They feed on organic matters consequently influence the process of decomposition and soil mineralization^[9]. Hence, they play their role in pedo-ecosystems^[10]. The majorities of the Collembola are the carnivorous and eat nematodes, rotifers and even others Collembola also. They are an ideal bio-indicator^[11, 12]. They also serve as excellent indicator of quality soil^[36].

The first record of Collembola from India was described by Ritter (1910) from Malabar region^[13]. The few major work have carried out by Choudhuri^[14], Yosii^[3, 4] for Himalayan and Siachen Collembola, Mitra^[15, 16, 17], Prabhoo^[18], Prabhoo and Muralidharan^[19] for Kerala, south India; Mandal^[20, 21, 22], Mandal and Hazra^[23, 24, 25] studied for Arunachal Pradesh, Himachal Pradesh and other parts of north east India, respectively. More recently, after this survey Mandal *et al*^[37] recorded 16 species under 14 genera of 5 families from man-made forest ecosystem at Bibhutibhusan Wildlife Sanctuary, Parmadan, District, West Bengal. Therefore, The present investigation was made to explore the biodiversity of Bibhutibhusan Wildlife Sanctuary.

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2. Materials and methods

Location, sampling and identification: The present survey was carried out at Bibhutibhusan Wildlife Sanctuary, Parmadan, 24 Parganas (N), from litter fall of the *Terminalia arjuna*, *Shorea robusta*, *Tectona grandis*, *Ficus religiosa*, *Mangifera indica*, *Azadirachta indica*, orchids and several dry grasses 17 December, 2008. The latitude and longitude of the Bibhutibhusan Wildlife Sanctuary is 23.1084° and 88.6731° respectively. The average temperature range from 9° Celsius to 43° Celsius and average annual rainfall is 1579 millimeter. During collection, Collembola of litters were collected with the help of aspirator, a plastic tray was used for collection of Collembola of litters of orchard and dry grasses. During collection some amount of alcohol was smeared in the tray before beating the forest litters in the tray in order to escape the insect from jump. Thereafter, they were picked up with the help of fine brush as well aspirator and preserved in 70% alcohol mixed with some glycerin to avoid the losses of volatilization. The collected specimens were sorted and separated out under stereo zoom microscope in a petry dish taken from vials. Examinations were made under Leica MZ 16 Microscope and phase contrast microscope. The temporary mounting prepared for identification. They were preserved in 70 percent alcohol with a few drops of glycerol. All the materials were preserved in liquid preservation in leveled vials. Dark specimens were soften and depigmented, for that specimens were kept in KOH for 10 to 15 minutes. They were cleaned in the Marc Andre I medium and slides were prepared in Hoyer's medium. The fauna were identified by following the standard taxonomic keys [26, 27, 28]. The species were confirmed by Dr. SK Mitra.

Data analysis: The following diversity indices were used-

1) **Simpson index of diversity (D):** The Simpson index of diversity was used [29].

$$\text{Simpson index of diversity (D)} = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

Where,

n = Numbers of individuals of each species

N = Total numbers of individuals of all species

2) **Shannon-Weiner species diversity index:** The diversity index was calculated by using the Shannon-Weiner diversity index [30].

Diversity index (H) = $-\sum H \text{ Pi In Pi}$

Where,

Pi = S/N

S = No. of individual of one species

N = Total no. of all individuals in sample

In = log to the base e (2.7182818)

3) **Margalef's richness index:** Margalef's index was used for richness index [31].

$$\text{Richness index} = \frac{(S-1)}{\ln N}$$

Where, S = Total no. of species

N = Total no. of individuals in sample

In = Natural log.

4) **Pielou's evenness index:** Pielou's evenness index of species was used [32].

$$\text{Evenness (e)} = \frac{H}{\ln S}$$

Where, H = Shannon-Weiner diversity index

S = Total no. of individuals in sample

In = Natural log.

3. Results

During only one day survey of Bibhutibhusan Wildlife Sanctuary produced more than 104 individuals belonging to the 16 species of 10 genera from the 6 subfamilies of Collembola were collected and identified. A checklist of collected Collembola fauna is presented in the Table 1. Out of that, highest numbers of Collembola fauna were encountered in the subfamilies Entomobryinae Schaffer, 1896 was the dominating family representing with 7 species namely, *Entomobrya indica* (Bajjal, 1955), *Entomobrya marginata* (Tullberg, 1871), *Lepidocyrtus curvicolis* Bourlet, 1839, *L. indicus* Handschin, 1929, *L. magnijicus* Carpenter 1917 *L. orientalis* Handschin, 1929 and *L. heterolepis* Yosii, 1959 with relative abundance of 8.65%, 7.69%, 11.54%, 7.69%, 6.73%, 5.77% and 8.65% respectively. Hypogastruridae Bourlet 1839 (Hypogastrurinae) was the second highest with 3 species as *Xenylla obscura* Imms, 1912 with 7.69%, *Xenylla* sp with 4.81% and *Ceratophysella indovaria* (Salmon, 1970) with 2.88% relative abundance. Two- two species were recorded in the subfamilies Isotominae Schaffer, 1896 and Paronellidae Börner, 1913 viz. *Isotomurus balteatus* (Reuter, 1876), *Procerura indica* Bajjal, 1958, *Callyntrura lineata* (Parona, 1892) Yosii, 1966 and *Salina montana* (Imms, 1912) with 2.88%, 1.92%, 1.92% and 4.81% respectively, were found. There were single species in subfamilies Seirinae Deharverg, 2004 and the Cyphoderinae Börner, 1913 represented *Seira indica* (Ritter, 1911) Yosii 1966 and *Cyphoderus javanus* (Börner) with 7.69% and 8.65% respectively. Out of that *Entomobrya marginata* (Tullberg, 1871) firstly recorded from India, *Procerura indica* Bajjal, 1958 from West Bengal and 9 species namely, *Xenylla* sp, *Ceratophysella indovaria* (Salmon, 1970), *Entomobrya nivalis* (Linnaeus, 1758) Ågren, 1904, *Lepidocyrtus curvicolis* Bourlet, 1839, *L. indicus* Handschin, 1929, *L. magnijicus* Carpenter, 1917, *L. orientalis* Handschin, 1929, *L. heterolepis* Yosii, 1959, *Callyntrura lineata* (Parona, 1892) Yosii, 1961 and *Salina montana* (Imms, 1912) from Bibhutibhusan Wildlife Sancttuary Parmadan, West Bengal. The survey was indicated that the Simpson index of diversity, Shannon-Weiner diversity index, Margalef's species richness and Pielou's Pielou's evenness of Collembola fauna at Sanctuary were 0.90, 1.64, 3.23 and 0.059 respectively.

4. Discussion

During the survey of Bibhutibhusan Wildlife Sancttuary Parmadan, West Bengal 16 species from 10 genera produces good numbers of Collembola fauna who revealed that the Parmadan, West Bengal has very good diversity of this group of fauna. On the density basis Entomobryinae Schaffer, 1896 was reported to be the most dominant subfamily over all the families and the Hypogastrurinae Börner, 1906 was the second dominating subfamily, probably due to high organic matters of litter fall. The study resulted that *Lepidocyrtus* Bourlet, 1839 was the numerically dominating genera with 5 species were reported. Mandal *et al.* [37] recorded 14 genera of Collembola with *Lepidocyrtus* Bourlet, 1839 was

dominating genus with 3 species. According to available literatures of Mandal^[38] and Mitra and Hazra^[39] reveals that *Entomobrya marginata* (Tullberg, 1871) firstly recorded from India, *Procerura indica* Baijal, 1958 from West Bengal and 9 species namely, *Xenylla* sp, *Ceratophysella indovaria* (Salmon, 1970), *Entomobrya nivalis* (Linnæus, 1758) Ågren, 1904, *Lepidocyrtus curvicolis* Bourlet, 1839, *L. indicus* Handschin, 1929, *L. magnijicus* Carpenter, 1917, *L. orientalis* Handschin, 1929, *L. heterolepis* Yosii, 1959, *Callyntrura lineata* (Parona, 1892) Yosii, 1961 and *Salina montana* (Imms, 1912) from Bibhutibhusan Wildlife Sanctuary Parmadan, W.B. The present study resulted that *Lepidocyrtus* Bourlet, 1839 was the dominating with 5 species were reported and *Lepidocyrtus curvicolis* Bourlet, 1839 was highest in population also recoded similar result from

Jharkhand and Varanasi, respectively^[21, 34]. On the basis of the diversity Hypogastruridae and Isotomidae both represented same numbers of species of Collembola (3, 3 each) in this study. Hazra *et al.*^[33] recorded similar trend in Entomobryinae and Paronellinae in the Arunachal Pradesh. The maximum (5) numbers of species were recorded in the genus *Lepidocyrtus* Bourlet, 1839. Mandal (2014) also recorded 3 species under *Lepidocyrtus* Bourlet, 1839 from Jharkhand⁽²²⁾ and Raghuraman *et al.* (2010) also recoded similar result from Varanasi⁽³⁴⁾. First time ecological study regarding the Simpson index of diversity, Shannon-Weiner diversity index, Margalef's species richness and Pielou's evenness of Collembola fauna Bibhutibhusan Wildlife Sanctuary were carried out and the finding was found somewhat similar with Greenslade *et al.*^[35].

Table 1: Collembola of Bibhutibhusan Wildlife Sanctuary, W.B.

S. No.	Family/ Subfamily	Species
A.	Hypogastruridae Bourlet 1839	Hypogastrurinae
1.		<i>Xenylla obscura</i> Imms, 1912
2.		<i>Xenylla</i> sp*
3.		<i>Ceratophysella indovaria</i> (Salmon, 1970)*
B.	Isotomidae Schäffer, 1896	Isotominae Schäffer, 1896
4.		<i>Isotomurus balteatus</i> (Reuter, 1876)
5.		<i>Procerura indica</i> Baijal, 1958**
C.	Entomobryidae Schäffer, 1896	Entomobryinae Schäffer, 1896
6.		<i>Entomobrya marginata</i> (Tullberg, 1871)***
7.		<i>Entomobrya nivalis</i> (Linnæus, 1758) Ågren, 1904*
8.		<i>Lepidocyrtus curvicolis</i> Bourlet, 1839*
9.		<i>L. indicus</i> Handschin, 1929*
10.		<i>L. magnijicus</i> Carpenter, 1917*
11.		<i>L. orientalis</i> Handschin, 1929*
12.		<i>L. heterolepis</i> Yosii, 1959*
D.	Seirinae Sensu Deharverg, 2004	
13.		<i>Seira cf indica</i> (Ritter, 1911) Yosii, 1966
E.	Cyphoderinae Börner, 1913	
14.		<i>Cyphoderus javanus</i> (Börner), 1906
F.	Paronellinae Börner, 1913	
15.		5) <i>Callyntrura lineata</i> (Parona, 1892) Yosii, 1961*
16.		<i>Salina montana</i> (Imms, 1912)*

Note: * (Asterisk) Species first time recorded from the Sanctuary

** (Asterisk) Species are first time recorded from WB

*** (Asterisk) Species firstly recorded from India

Table 2: Different indices of Collembola Diversity at Bibhutibhusan Wildlife Sanctuary

S. No.	Indices	Values of indices
1	Simpson index of diversity (D)	0.90
2	Shannon-Weiner species diversity index	1.64
3	Margalef's richness index	3.23
4	Pielou's evenness index	0.59

5. Conclusion

From the present study it is concluded that Bibhutibhusan Wildlife Sanctuary Parmadan has also very rich Collembola density and diversity. A very small study results 16 species of 10 genera under 6 subfamilies from Parmada, West Bengal. The present study indicated that the Simpson index of diversity (D), Shannon-Weiner diversity index, Margalef's

species richness and Pielou's evenness of Collembola fauna at Ranchi, Jharkhand were 0.90, 1.64, 3.23 and 0.59 respectively. The results conclude that further more rigorous exploration may produce more biodiversity and enrich the of Collembola records from Bibhutibhusan Wildlife Sanctuary, West Bengal.

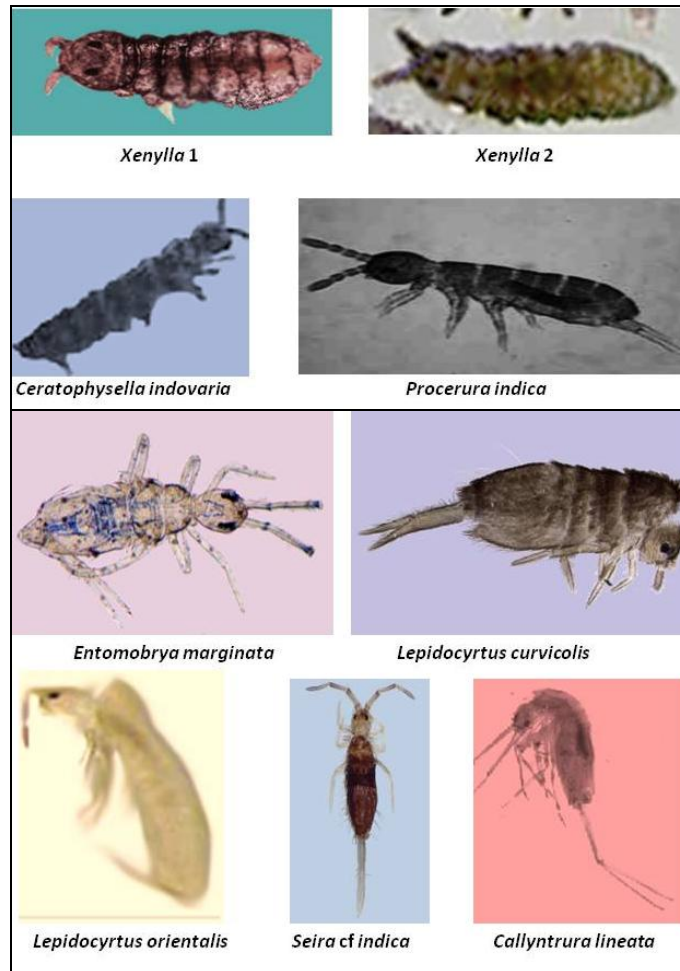


Fig 1: Collembola of Bibhutibhushan wildlife sanctuary

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