First records of Collembola and their diversity measurement from B.A.U., Ranchi, Jharkhand

Ramesh Singh Yadav

Abstract

Collembola are the highly diversified group of soil mesofauna. They are found in the almost all climatic conditions. The present survey was carried out in the campus of Birsa Agricultural University (BAU), Ranchi, Jharkhand during March, 2009. The aim of this research was to study the diversity of Collembola in the Ranchi, Jharkhand. About 288 individuals of Collembola belonging to the family Entomobryidae were collected by Aspirator and soil sample. The study revealed that 11 species belonging to 7 genera of 4 subfamilies of Entomobryidae were identified. Out of that 3 species namely, **Entomobrya indica** (Bajial, 1955) (16.67%), **S. grieta** (Tyagi & Bajial, 1979) (0.35%) and **Cyphoderus javanus** Borner, 1906 (3.13%) were first time recorded from Jharkhand and 8 species were firstly from Ranchi district. The study resulted that **Lepidocyrtus** Bourlet, 1839 was the dominating family having 3 species were reported. There was first time different ecological measurements like, Shannon’s diversity index ($H' = 1.77$) and Pielou evenness index ($J' = 0.74$) were carried out from the Jharkhand for this fauna and it’s indicated that fair Collembola diversity is there. Margalef’s richness index ($Dmg= 1.77$) indicated species fair richness of species in the present study.

Keywords: Diversity measurement, **Cyphoderus javanus**, Pielou evenness index

1. Introduction

Collembola are 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].

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 (1963), Yosii (1966a and 1966b) for Himalayan and Siachen Collembola, Mitra (1966, 1973, 1975 and 1993), Prabhoo and Muralidharan (1980), Prabhoo (1971) for Kerala, south India, Mandal (2013, 2014a and 2014b), Mandal and Hazra (2002, 2004 and 2009) studied for Arunachal Pradesh, Himachal Pradesh and other parts of north east India [14-25]. Nevertheless, the Collembola of Jharkhand is very less studied fauna. Some surveys were made by Mandal for Koderma Wildlife Sanctuary, Jharkhand and Hazaribagh National Park. There he recorded 5 and 8 species respectively [21, 22]. This was an initiation. There are not any accurate estimates regarding diversity and ecological measurements of Collembola from this province so far. Therefore, the Entomobryid diversity and some indices were pointed out from the survey data of Ranchi, Jharkhand by author during his Ph.D. research entitled “Studies on Biodiversity of Collembolans (Insecta: Collembola) in different Ecosystem of India (unpublished)”.  

2. Materials and Methods

2.1 Location, sampling and identification: The present survey was carried out at Birsa Agricultural University, Ranchi, Jharkhand from litter fall of **Tectona** orchards and channel
side of agricultural form during March 2009. The latitude and longitude of the Birsa Agricultural University, Ranchi is 23.4425 and 85.3156 respectively. The average temperature range from 16.8°C to 31.5°C in the month of March and average annual rainfall is 1397 millimeter. Collections were made by aspirator as well as soil sample in the 8.00 to 10.00 AM. The collected specimens through aspirator were kept in 70% alcohol immediately whereas, soil samples were brought to the laboratory for the extraction of the fauna. Extractions were made through the standard modified Tullgren’s funnel method. Soil samples were putted in separate funnels of Tullgren’s funnell fitted with mesh in the lower side of funnels. Collection vials containing 70 percent alcohol and a few drop of glycerol were kept to the lower sides of funnels. During extraction, the samples were initially exposed to less intensity of light to give low heat for a period of 12 hours and later the samples were given more intensity of light. Light intensity was controlled with the help of illumination timer and light intensity controller fitted in the modified Tullgren’s machine. The collected specimens during survey were sorted and separated out under zoom stereomicroscope 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 softened 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 [26-28]. The species were confirmed by Dr. SK Mitra.

2.2 Data analysis: The following diversity indices were used-

2.2.1 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

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

\[
\text{Diversity index (H')} = -\sum \frac{S_i}{N} \log \frac{S_i}{N}
\]

Where,

- \( S_i \) = \text{No. of individual of one species}
- \( N \) = \text{Total no. of all individuals in sample}
- \( \log \) to the base \( e \) (2.7182818)

2.2.3 Margalef’s richness index: Margalef’s index was used for richness index [31].

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

Where,

- \( S \) = \text{Total no. of species}
- \( N \) = \text{Total no. of individuals in sample}
- \( \ln \) = Natural log.

2.2.4 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

\( S \) = \text{Total no. of individuals in sample}

\( \ln \) = Natural log.

3. Results

During only two day survey of BAU, Ranchi, Jharkhand a total of 288 individuals belonging to the 4 subfamily of Entomobryidae of Collembola were collected and 11 species of seven genera were 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 most dominating family representing with 5 species namely, Lepidocyrtoctis curvicollis Bourlet, 1839 (25.00%), Entomobrya indica (Bajjal, 1955) (16.67%), L. heterolepesis Yosii, 1959 (14.58%), L. cyanus (Tulber, 1869) (17.71%), Seira indica (Ritter, 1911) Yosii, 1966 (14.93%) followed by Cyphoderinae Börner, 1913 with only one species Cyphoderus javanus (Börner), 1906 (3.13%) and Paronellinae with 5 species i.e. Callenutra lineata (Parona, 1892) Yosii, 1961 (2.78%), C. vestita (Handschin, 1925) (0.69%), Salina cf indica (Imms, 1912) (3.13%), S. grieta (Tyagi & Baijal, 1979) (0.35%) and Yosiia dehradunia Mitra, 1967 (1.04%) were recorded (Fig. 1) Among these 11 species, 3 species namely, Entomobrya indica (Bajjal, 1955), S. grieta (Tyagi & Baijal, 1979) and Cyphoderus javanus Börner, 1906 were first time recorded from Jharkhand and 8 species i.e. Lepidocyrtoctis curvicollis Bourlet, 1839, L. heterolepesis Yosii, 1959, L. cyanus (Tulber, 1869), Seira indica (Ritter, 1911) Yosii, 1966, Callenutra lineata (Parona, 1892) Yosii, 1961, C. vestita (Handschin, 1925), Salina cf indica (Imms, 1912) and Yosiia dehradunia Mitra, 1967 were firstly reported from Ranchi district. 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 Ranchi, Jharkhand were 0.91, 1.77, 1.77 and 0.74 respectively.

4. Discussion

During the survey of BAU campus, Ranchi, Jharkhand 11 species from 7genera produces good numbers of Collembola fauna who revealed that the Ranchi, Jharkhand has good diversity of this group of fauna also. On the density basis Entomobryinae Schaffer, 1896 was reported to be the most dominant subfamily over all the families and the Paronellinae was the second dominating subfamily, probably due to their larger size and collected through both of the method of collection i.e. aspirator as well soil sampler. According to available literatures reveals that Cyphoderinae Börner, 1913 was the firstly reported from Jharkhand in this study. From Koderma Wildlife Sanctuary, Jharkhand only 5 species of Collembola of Isotomidae Schaffer, 1896, Entomobryidae Schaffer, 1896 and Paronellidae Börner, 1913 and only 8 species of Collembola of Hypogastruridae Borner, 1906, Isotomidae Schaffer, 1896, Entomobryidae Schaffer, 1896 and Paronellidae Börner, 1913 were recorded from Hazaribagh National Park [21, 22]. On the basis of the diversity Entomobryinae and Paronellinae both represented same numbers of species of Collembola (5, 5 each) in this study. Hazra et al. (2006) recorded similar trend in the Arunachal Pradesh [33] and Mandal (2014) have also collected maximum species from these two family from Jharkhand [21, 22]. The
maximum (3) numbers of species were recorded in the genus *Lepidocyrtus* Bourlet, 1839. Mandal (2014) also recorded 3 species under *Lepidocyrtus* Bourlet, 1839 from Jharkhand and Raghuraman et al. (2010) also recorded similar result from Varanasi. 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 at Ranchi, Jharkhand were carried out and the finding was found somewhat similar with Greenslade et al. (2016).

**Table 1:** Checklist of Entomobryid Collembola collected from Ranchi, Jharkhand

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Family/Subfamily</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1</td>
<td>Entomobryinae</td>
<td><em>Entomobrya indica</em> (Baijal, 1955)**</td>
</tr>
<tr>
<td>2</td>
<td>Schäffer, 1896</td>
<td><em>Lepidocyrtus curvicolis</em> Bourlet, 1839*</td>
</tr>
<tr>
<td>3</td>
<td><em>L. heterolepsis</em> Yosii, 1959*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><em>L. cyaneus</em> (Tulber, 1869)*</td>
<td></td>
</tr>
<tr>
<td>B 5</td>
<td>Seirinae Sensu Deharverg, L. 2004</td>
<td><em>Seira indica</em> (Ritter, 1911) Yosii, 1966*</td>
</tr>
<tr>
<td>C 6</td>
<td>Cyphoderinae Börner, 1913</td>
<td><em>Cyphoderus javanus</em> (Börner), 1906**</td>
</tr>
<tr>
<td>D 7</td>
<td>Paronellinae Börner, 1913</td>
<td><em>Callyntrura lineata</em> (Parona, 1892) Yosii, 1961 *</td>
</tr>
<tr>
<td>8</td>
<td><em>C. vestita</em> (Handschin, 1925)*</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td><em>Salina cf indica</em> (Imms, 1912)*</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><em>S. grieta</em> (Tyagi &amp; Baijal, 1979)**</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><em>Yositia dehradunia</em> Mitra, 1967*</td>
<td></td>
</tr>
</tbody>
</table>

Note: * (Asterisk) Species first time recorded from Ranchi, Jharkhand
** (Asterisk) Species are first time recorded from Jharkhand

**Table 2:** Different indices of Collembola Diversity at Ranchi, Jharkhand

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Indices</th>
<th>Values of indices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simpson index of diversity (D)</td>
<td>0.91</td>
</tr>
<tr>
<td>2</td>
<td>Shannon-Weiner species diversity index</td>
<td>1.77</td>
</tr>
<tr>
<td>3</td>
<td>Margalef’s richness index</td>
<td>1.77</td>
</tr>
<tr>
<td>4</td>
<td>Pielou’s evenness index</td>
<td>0.74</td>
</tr>
</tbody>
</table>

5. Conclusion
From the present study it is concluded that Ranchi, Jharkhand has also very rich Collembola density and diversity. A very small study results 11 species of 7 genera under 4 subfamilies from Ranchi, Jharkhand. 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 0.91, 1.77, 1.77 and 0.74 respectively. The results conclude that further more rigorous exploration may produce more biodiversity and enrich the of Collembola records from Jharkhand.

6. Acknowledgements
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7. References


