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Vertical Distribution of Collembola (Arthropoda: Collembola) at Varanasi, India

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A B S T R A C T

The Vertical distribution of Collembola in different soil layers namely, organic layer (O), 0-5 cm soil depth and 5-10 cm soil depth were studied. The majority of Collembola were recorded from the 'O' layer and upper layer in all the season except some exception in hot summer. During summer season, vertical migration of Collembola were seen whereas, such trend is very least seen during winter season where sufficient soil humidity was maintained. Same pattern was seen at species level also expected certain thermopilic species. The study also revealed that smaller species inhabit deeper layers.

Introduction

Collembola are the one of the important group of fauna of phylum Arthropoda. They are the fauna of hidden habitat (Yadav, 2017a). They are primarily wingless animal but play very vital role in the litter decomposition and biological soil formation system (Christiansen and Bellinger, 1980). Collembola are the important soil meso-fauna present in all terrestrial ecosysytem and second highest meso-fauna after acarina in the pedo-ecosystems (Yadav and Singh, 2009). Collembola have very wide global distribution from sea shore to high altitude of the top mountain of the Himalaya (Yossii, 1966). They are ideal bio-indicator also (Maria, 1989 and Stork and Eggleton, 1992). Recently, their vertical distributions were studied by Waikhom *et al.*, (2006) from India and Ponge (2000) and Detsis (2000) from abroad as well as several studies on different aspects of Collembola have been reported by Yadav (2017a, 2017b, 2017c and 2017d), Raghuraman *et al.*, (2010), Shanteshwari *et al.*, (2015) and Mandal and Suman (2015) in India. The vertical study of the fauna is very less known from the country. Therefore, the present study with vertical distribution of Collembola in Teak deciduous forest at Varanasi, India carried out.

Materials and Methods

Soil samples were collected during March 2009 to February 2010 from two different localities of Varanasi namely, teak Plantation of Banaras Hindu University campus (Site 1), 25.2677 N and 82.9913 E coordinates and Samneghat bank of river Ganges (site 2), 25.2769 N 83.0068 E coordinates. Both the sites have heavy litter fall and sufficient moisture in the soil.

Three samples per month per site and a total of 162 soil samples were collected by a sampler of size 10x7.5x22.5 cm^3. All the samplers' collections were made in the mornings and collected samples carried to the laboratory in polyethylene bags, which were punctured to avoid minimum mortality of the fauna. All samples were divided into three parts, Organic layer, 0-5 cm and 5-10 cm and extracted separately through modified Tullgren's funnel techniques (Image 1). Soil samples were put in separate funnels fitted with mesh in the lower part of the funnels, containing 70% alcohol and few drop of glycerol placed under the funnel..

During extraction, the samples were exposed to low intensity of light initially to give low heat for a period of 12 hours and later the samples were given more intensity of light and heat for full extraction with the help of illumination timer and light intensity controller. The specimens were sorted and separated under zoom stereomicroscope in Petri dish from the vials. Examinations were made under Leica MZ 16 microscope and phase contrast microscope.

The temporary mounting was prepared for identification and photography. Photographs were captured by Leica DFC290 camera mounted on Leica MZ16 microscope. Subsequently, they were preserved in 70% alcohol with a few drops of glycerol. All the materials were preserved in liquid preservation in leveled vials. Standard taxonomic keys by Gisin (1960) and Christiansen and Bellinger (1992) were followed for identification. Collected specimens are preserved in the laboratory of Insect Biosystematics, Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India.

Results and Discussion

The total population counts of the Collembola in different soil layers were computed from 162 soil samples during March 2009 to February 2010 yielded 17 species of 9 subfamilies from 7 different families (Table 1). The vertical distribution of *Cryptopygus thermophilus* and *Ceratophysella* sp were analysed. The whole Collembola populations were considered in different layers. The most of the Collembola population were recorded in the 'O' layers in the most of the seasons (Table 2). The population differences were seen between top layer and lower layer. The top layers have more abundant population as compare to the lower layer in the every season except hot summer season. The summer season show highest population in deeper layer and lower population in the upper layers. Present finding is similar to Detsis (2000) and Takeda (1978). Wallwork (1970), Christiansen and Bellinger (1980) and Badejo *et al.,* (1998) has found that maximum density of Collembola were in organic horizon and surface layer.

The vertical distribution of *Cryptopygus thermiphilus* and *Ceratophysella* sp along with whole Collembola followed same pattern of distribution in the study (Table 3). Detsis (2000) has also recorded same vertical distribution pattern of Collembola from Greece.

Table.1 Collembola recorded during survey at Varanasi

S. No.	Family	Subfamily	Genera/species
1.	Hypogastruridae	Hypogastrurinae	*Hypogastrura* sp
2.			*Ceratophysella* sp
3.	Onychiuridae	Onychiurinae	*Onychiurus indicus*
4.	Isotomidae	Isotominae	*Isotomurus* sp
5.			*Cryptopygus thermophilus*
6.			*Folsomides* sp
7.	Cyphoderidae	Cyphoderinae	*Cyphoderus* sp
8.	Entomobryidae	Seirinae	*Seira* sp
9.		Entomobryinae	*Entomobrya* sp
10.			*Pseudosinella* sp
11.		Lepidocyrtinae	*Lepidocyrtus* sp
12.		Paronellinae	*Salina* sp
13.			*Pseudosalina* sp
14.	Sminthurididae	Sminthuridinae	*Sminthurides* sp
15.			*Sminthurinus* sp
16.			*Sphaeridia* sp
17.	Neelidae		*Neelus* sp

Table.2 Seasonal population distribution

Season	Organic Layer		0-5 cm		5-10 cm	
	Site I	Site II	Site I	Site II	Site I	Site II
Rainy Season	128	106	95	80	85	70
Winter season	68	57	50	42	52	42
Summer Season	28	16	36	24	42	26

Table.3 Vertical distribution of *Cryptopygus thermophilus* and *Ceratophysella* sp.

Season	Organic Layer		0-5 cm		5-10 cm	
	Site I	Site II	Site I	Site II	Site I	Site II
Rainy Season	62	48	16	9	6	2
Winter season	28	15	12	8	24	16
Summer Season	2	0	8	3	32	25
***Ceratophysella* sp.**						
Rainy Season	3	2	8	5	15	9
Winter season	5	1	2	2	4	2
Summer Season	0	0	4	3	5	4

Fig.1 Modified Tullgren's funnel

Usher (1970) recorded that the winter is also a cause of downward migration of Collembola. Sgardellis *et al.*, (1993) have found that during summer drought period Collembola population become many to zero which favours the present finding.

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