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PRELIMINARY CHECKLIST OF SPRINGTAILS (ARTHROPODA: COLLEMBOLA) OF UTTAR PRADESH, INDIA

Ramesh Singh Yadav

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PRELIMINARY CHECKLIST OF SPRINGTAILS (ARTHROPODA: COLLEMBOLA) OF UTTAR PRADESH, INDIA

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Abstract: Collembola, the fauna of a hidden habitat, are symbols of soil health. A survey of Collembolan fauna in different habitats in different regions of Uttar Pradesh was carried out from 2008 to 2010. Thirty-seven species were captured belonging to 27 genera from eight subfamilies of eight different families. Thirteen species are first reports from India and from Uttar Pradesh. The subfamily Entomobryinae (27.03%) was dominant whereas the subfamily Isotminae had maximum diversity.

Keywords: Collembola, checklist, India, *Lepidocyrtus*, soil health, Uttar Pradesh.

Collembola (Springtails) is one of the important fauna of phylum Arthropoda and presently considered as a separate class. They are very tiny but the most successful and abundant animal in the world. The body of Collembola is globose or tubular and divided into head, thorax and abdomen distinctly. The head bears a pair of four segmented antenna, ectognathous mouth parts within a pouch and one to several pairs of lateral ocelli, form an eye patch but these are often reduced in soil and cave dwelling species that are blind. Compound eyes are absent. They are primarily wingless fauna and abdomen is six segmented with three pregenital appendages, i.e., ventral tube or Collophore or glue peg, tenaculum or retinaculum and furcula or springing organ. Collophore

is a bilobed adhesive organ found on the first abdominal segment. Lubbock (1873) introduced the scientific name for springtails considering the ventral tube or Collophore to be the most characteristic feature of the group and specifically the Collembola. The retinaculum is present on the third abdominal sternite, to hold furcula. Furcula evolved through the basal fusion of a pair of appendages on the fourth abdominal segment, is the obvious feature of Collembola. The furca is well developed as an escape mechanism to avoid predators. Rusek (2002) mentioned that the first record of Collembola was made on 2 November 1672 from Czechoslovakia whereas; the first study of Collembola from India was made by Ritter (1911) and Imms (1912)

Collembola have a very wide global distribution. They are abundant in every continent including Antarctica (Block 1984) and on newly fallen snow of the Himalaya at 7,742m altitude (Yosii 1966a). Singh & Singh (1975) and Yadav & Singh (2009) reported that they are micro soil arthropods, which together with mites, constitute an important component of soil mesofauna in almost all terrestrial ecosystems; Collembola are the second highest mesofauna after Acarina (mites). According to Maria (1989), Stork & Eggleton (1992), they are ideal for

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bio-indicator studies of environment due to their broad distribution and high abundance.

An initial but notable ecological study of soil arthropods including Collembola was first made by Mukharji & Singh (1970) from Uttar Pradesh, India. Literature is very scattered regarding the contribution of this group except for some of the promising work by Mukherjee (1932), Choudhuri (1963), Mitra (1966), Yosii (1966b), Prabhoo (1971), Mitra (1975), Prabhoo & Muralidharan (1980), Mitra (1993), Hazra (1995), Mandal (2010, 2013, 2014). Mandal & Hazra (2002, 2004, 2009) have presented information from different parts of India. Literature dealing with taxonomy and ecology of Collembola is immense, nevertheless the Collembola reports from Uttar Pradesh (till date) are a very small fraction, except for the work on this group by Baijal (1955) and Mitra (1973). Tyagi & Baijal (1979) provided taxonomic information of Collembola for Uttar Pradesh, India. After a long gap on this group from Uttar Pradesh, recently, Yadav & Singh (2009), Raghuraman et al. (2010), Mandal & Suman (2015), and Santeshwari et al. (2015) presented very intensive information regarding explorations from Uttar Pradesh, India.

In the present study, the author upholds recent workers classifying the Collembola as per Christiansen & Bellinger (1992). Keeping in view the above facts, the present work is aimed at finding out the diversity of Collembola for Uttar Pradesh, the largest state of northern India (Fig. 1) surrounded by Nepal and Uttarakhand to the north, Delhi and Haryana to the north-west, Rajasthan to the west, Madhya Pradesh to the south, Chhattisgarh and Jharkhand to the southeast and Bihar to the east.

MATERIALS AND METHODS

The study sites located at different parts of Uttar Pradesh are given in Table 1. The investigations were carried out from January 2008 to March 2010. Collembola were collected by two methods—through Aspirator and soil sampler. Thirty-six sites of 12 locations and samples were collected at least two times from each site. In the field, Collembola litters were collected with the help of aspirator (Image 1), plastic tray and transparent sheet from litters of orchard and dry grasses. During collection, some amount of alcohol was used in the tray when beating the litters in order to prevent the insects from jumping. Thereafter, they were picked up with a fine brush and preserved in 70% alcohol mixed with some glycerin to avoid the loss from volatilization. Soil samples were also collected by a sampler of size 10x7.5x22.5 cm³. 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. Samples were extracted 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. 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 & 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

Collembola are a very diverse and abundant group of fauna. In published records by Janssens (2012) and

Table 1. Details of survey locality

	Location/ Site	Coordinates
1	Indian Institute of Vegetable Research (IIVR), Varanasi (India)	25.1844 N & 82.8344 E
2	Taria, Varanasi (India)	25.2244 N & 82.9797 E
3	Ramna, Varanasi (India)	25.2398 N & 83.0066 E
4	Susuwahi, Varanasi (India)	25.2560 N & 82.9743 E
5	Vegetable Research Farm, BHU, Varanasi (India)	25.2677 N & 82.9913 E
6	Agricultural Research Farm, BHU, Varanasi (India)	25.2677 N & 82.9913 E
7	Entomological Research Farm, BHU, Varanasi (India)	25.2677 N & 82.9913 E
8	Campus Road Sides of BHU, Varanasi (India)	25.2677 N & 82.9913 E
9	Ghazipur, Uttar-Pradesh	25.6135 & 83.5070 E
10	Campus AMU, Aligarh	27.9135 N & 78.0782 E
11	Harduaganj, Aligarh	27.9451 & 78.1550 E
12	Samneghat, River Bank of Ganges	27.9135 N & 78.0782 E

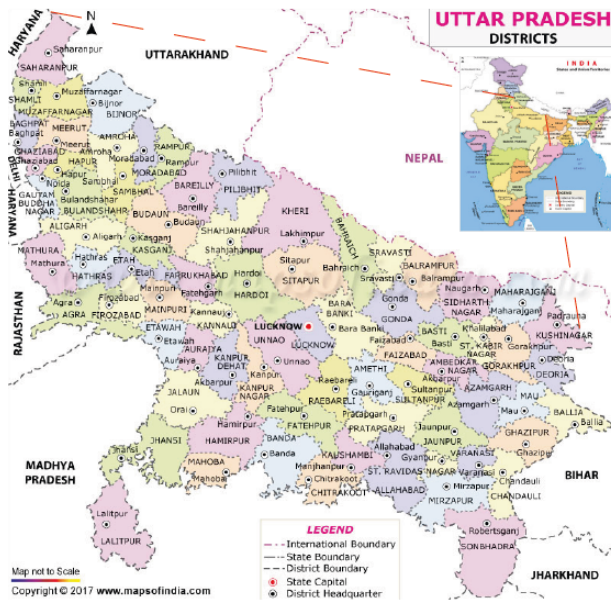


Figure 1. Study area - Uttar Pradesh

Bellinger et al. (2016) 8,279 species of Collembola are globally described whereas, in India 301 species under 109 genera, 19 families and two suborders are described by Mandal (2010). In the present study Collembola of 37 species belonging to 27 genera from two suborders of eight subfamilies from eight different families were collected from different localities of Uttar Pradesh, India (Table 2; Images 2–6). Raghuraman et al. (2010) collected 18 genera of different species of Collembola from Varanasi, Uttar Pradesh and Santeshwari et al. (2015) recorded 26 species of 18 genera from Varanasi, Uttar Pradesh. Most species belonged to genus *Lepidocyrtus* Bourlet, 1839. Matiz et al. (2006) reported two species of *Folsomia* i.e. *F. quadriculata* and *F. peniculata* were dominant whereas, Faisal & Ahmad (2005) reported that *Xenylla obscura* and *Isotomodes dagamae* were the dominant Collembola community at all study sites. Subfamily Entomobryinae was the most diverse and dominant during investigation with 27.03% (Fig. 2) whereas, subfamily Isotominae had the highest diversity in genera, i.e., eight (Table 2). Santeshwari et al. (2015) found divergences among individuals were much higher in *Hypogastrura* sp. (up to 19.03%). The highest numbers of species were found in the Banaras Hindu University (BHU) campus. The common families/subfamilies were Hypogastruridae (subfamily Hypogastrurinae 10.81%), Onychiuridae (subfamily Onychiurinae, 5.41%), Isotomidae (subfamily Isotominae, 21.62%), Entomobryidae (subfamilies Entomobryinae, 27.03%, Paronellinae, 16.22%, and Tomocerinae, 2.70%), Cyphoderidae (subfamily Cyphoderinae, 5.41%),



Image 1. Collection by aspirator (above) and extraction through modified Tullgren's funnel in laboratory (below). © Author

Sminthurididae (subfamily Sminthuridinae, 5.41%), Katiannidae, 2.70% and Neelidae, 2.70% were recorded during investigation. *Onychurus indicus* Choudhuri & Roy, 1965, *Onychurus* sp., *Cryptopygus thermophila* Axelson, 1907, *Isotomurus balteatus* Reuter, 1876, *Folsomia onychiurina* Denis, 1931, *Isotomodes* sp., *Isotomid* sp1., *Pseudosinella* sp., *Lepidocyrtus medius* Schäffer, *Callyntrura* sp., *Yosiia* sp., *Salina indica* (Imms, 1912) and *Tomocerus* sp. were found for the first time in the collection of Uttar Pradesh, India. Santeshwari et al. (2015) have also found eight species first reported from India for Uttar Pradesh. The present investigation will make a distinguished addition to the Collembola of Uttar Pradesh, India and may help to enhance the work for further research in Collembola.

Results of the present study indicate that further studies are required for documenting collembolan communities in different ecosystems of Uttar Pradesh, India. There is a great need for additional research on these environmentally important fauna of the country. The diversity of Collembola is immense and exploration is imperative.

Table 2. Checklist of Collembola of Uttar Pradesh

	Family/ Subfamily	Species	Localities
1	Hypogastruridae/ Hypogastrurinae	<i>Hypogastrura baltica</i> (Tyagi & Baijal, 1982)*	Ramna, Susuwahi,
2		<i>H. sonapani</i> (Baijal, 1958)*	BHU campus, Ghazipur, Harduaganj
3		<i>H. temarpurensis</i> (Tyagi & Baijal, 1982)*	Harduaganj, AMU
4		<i>Xenylla sincta</i> (Baijal, 1956)*	AMU campus, Harduaganj
5	Onychiuridae/ Onychiurinae	<i>Onychurus indicus</i> (Choudhuri & Roy, 1965)	Ghazipur, Ramna
6		<i>Onychurus</i> sp.	BHU campus, Susuwahi
7	Isotomidae/ Isotominae	<i>Cryptopygus thermophila</i> (Axelson, 1907)	Harduaganj, Ramna
8		<i>Isotomurus balteatus</i> (Reuter, 1876)	Ghazipur, Agfarm BHU, Susuwahi
9		<i>Folsomina onychiurina</i> (Denis, 1931)	Ghazipur, Ramna
10		<i>Isotomodes</i> sp.	Ghazipur, BHU campus
11		<i>Folsomia</i> sp.*	Susuwahi, BHU campus, Taria
12		<i>Isotoma himalayana</i> (Baijal, 1955)*	AMU, Harduaganj
13		<i>Folsomides</i> (Stach, 1922)*	BHU campus, Ghazipur
14		Isotomid sp1	BHU campus, susuwahi, Ghazipur
15	Entomobryidae/ Entomobryinae	<i>Pseudosinella</i> sp.	Ghazipur
16		<i>Lepidocyrtus curvicolis</i> Bourlet, 1839*	Harduaganj, Susuwahi, Ghazipur, BHU campus
17		<i>L. medius</i> Schäffer	Ghazipur, AMU
18		<i>L. lignorum</i> Fabricius, 1775*	Susuwahi, Ramna, BHU Campus

	Family/ Subfamily	Species	Localities
19		<i>L. agragensis</i> (Baijal & Sinha 1971)*	Harduaganj, BHU campus
20		<i>Seira indica</i> (Ritter, 1911)	AMU, Harduaganj, Ramna
21		<i>S. lateralis</i> (Yosii, 1966)	BHU campus
22		<i>Sinella</i> sp.	BHU glass house
23		<i>Entomobrya indica</i> (Baijal, 1955)*	AMU, Ghazipur, BHU campus
24		<i>E. longisticta</i> (Baijal, 1958)*	Harduaganj
25	Paronellinae	<i>Callyntrura</i> sp.	Harduaganj
26		<i>Dicranocentoides</i> (Imms, 1912)	Samneghat bank of river Ganges, Varanasi
27		<i>Yosia</i> sp.	Harduaganj
28		<i>Salina indica</i> (Imms, 1912)	Harduaganj
29		<i>S. grieta</i> (Tyagi & Baijal, 1979)*	AMU, Ramna
30		<i>Pseudosalina</i> sp.	Ghazipur, BHU campus
31	Tomocerinae	<i>Tomocerus</i> sp.	Harduaganj
32	Cyphoderidae/ Cyphoderinae	<i>Cyphoderus</i> sp.	Ghazipur, BHU ENT Farm
33		<i>C. ganeensis</i> (Tyagi & Baijal, 1979)*	AMU
34	Sminthurididae/ Sminthuridinae	<i>Sminthurides appendiculatus</i> (Imms, 1912)*	Ghazipur, Vegetable farm, susuwahi, Ramna
35		<i>Sphaeridia</i> sp.	Ag farm, BHU campus
36	Katiannidae	<i>Sminthurinus</i> (Börner, 1901)*	Ramna, Ghazipur, Ag farm, susuwahi,
37	Neelidae/ Neelinae	<i>Neelus</i> sp*	BHU Ag Farm

Note: * species previously recorded from Uttar Pradesh

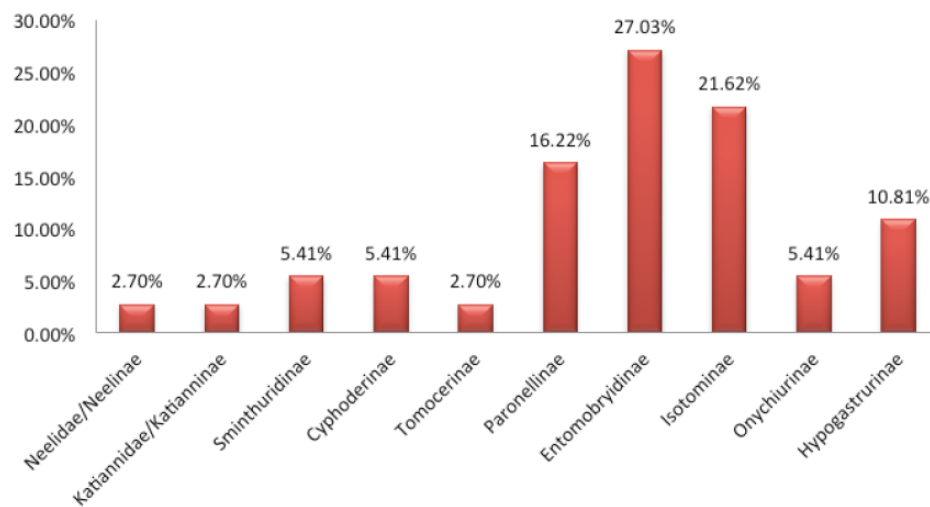
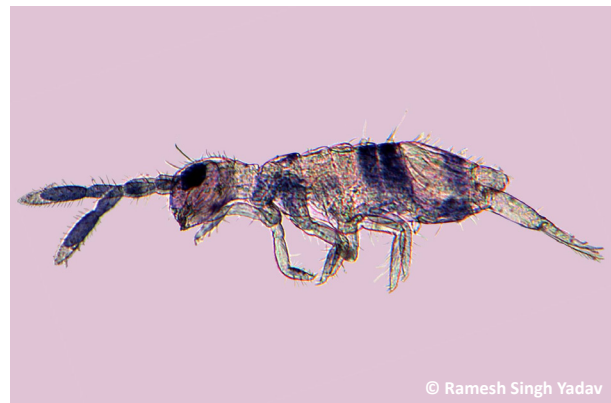


Figure 2. Percentage occurrence of different families/subfamilies of Collembola in Uttar Pradesh, India

Image 2. *Isotomurus balteatus*Image 3. *Entomobrya indica*Image 4. *Cyphoderus* sp.Image 5. *Lepidocyrtus curvicolis*Image 6. *Salina* cf. *indica*

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A first record of the Bentfin Devil Ray *Mobula thurstoni* (Lloyd, 1908) (Myliobatiformes: Mobulidae) from the Indian EEZ of the Andaman Sea
-- Swapnil Shivdas Shirke, M. Nashad, Monalisha Devi Sukham & H.D. Pradeep, Pp. 11074–11080

First records of the Indo-Pacific Finless Porpoise *Neophocaena phocaenoides* (G. Cuvier, 1829) (Cetartiodactyla: Phocoenidae) from Sri Lanka
-- Ranil P. Nanayakkara, Thomas A. Jefferson & Sandaruwan Abayaratne, Pp. 11081–11084

Notes

Largest fungal fruit body from India
-- Manoj Kumar, Prahlad Singh Mehra, N.S.K. Harsh, Amit Pandey & Vijay Vardhan Pandey, Pp. 11085–11086

Ichthyofauna of Udayasamudram Reservoir in Nalgonda District, Telangana State, India
-- Rachamalla Shyamsundar, Kante Krishna Prasad & Chelmala Srinivasulu, Pp. 11087–11094

First record of migratory Grey-necked Bunting *Emberiza buchanani* Blyth, 1844 (Aves: Passeriformes: Emberizidae) as a winter visitor in Tiruchirappalli District, Tamil Nadu, India
-- T. Siva & P. Neelanarayanan, Pp. 11095–11096

New distribution records of Elegant Water Shrew *Nectogale elegans* Milne-Edwards, 1870 (Mammalia: Eulipotyphla: Soricidae) from the western Himalaya, Uttarakhand, India
-- Aashna Sharma, Vandana Rajput, Vineet K. Dubey, Aavika Dhand, Shagun Thakur, J.A. Johnson, S. Sathyakumar & K. Sivakumar, Pp. 11097–11099

The persistence of the Striped Hyena *Hyaena hyaena* Linnaeus, 1758 (Mammalia: Carnivora: Hyaenidae) as a predator of Olive Ridley Sea Turtle *Lepidochelys olivacea* Eschscholtz, 1829 (Reptilia: Testudines: Cheloniidae) eggs
-- Divya Karnad, Pp. 11100–11102

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Book review: A Photographic Guide -- Endemic Woody Plants of The Western Ghats
-- Jis Sebastian, Pp. 11103–11104

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