



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 2359-2362

© 2018 JEZS

Received: 28-01-2018

Accepted: 28-02-2018

Ramesh Singh Yadav

Department of Entomology and
Agricultural Zoology, Institute
of Agricultural Sciences, Banaras
Hindu University, Varanasi,
Uttar Pradesh, India

First preliminary report of diplurans (Diplura: Insecta) from Jharkhand, India

Ramesh Singh Yadav

Abstract

Diplurans are an important subterranean macrofauna. Their distributions are highly aggregated form in the soil. They play a very important role in maintaining soil fertility through decomposition and humification of organic matters. The present survey was carried out on the campus of Birsa Agricultural University (BAU), Ranchi, Jharkhand during March, 2009. About 15 individuals of diplurans, belonging to the family Campodeidae Lubbock, 1873 and Japygidae Lubbock, 1873 were collected through soil sampler. The study revealed 4 species (one damaged) belonging to 4 genera from 2 families of Diplura namely; *Campodea* sp, *Lepidocampa weberi* Oudemans, 1890 *Indjapyx gravelyi* Silvestri, 1931 and a damaged specimen was probably *Indjapyx annandalei* Silvestri 1931 were identified. Out of these 4 species *Lepidocampa weberi* Oudemans, 1890 was highly dominated species followed by *Indjapyx gravelyi* Silvestri, 1931. All of them 3 species were first time recorded from Jharkhand. The diversity measurements viz. Simpson index of diversity, Shannon-Weiner diversity index, Margalef's species richness and Pielou's Pielou's evenness were 0.83, 1.21, 1.11 and 0.87 respectively were also calculated for the diplurans fauna of Jharkhand. A key up to the family level for Diplurans of Jharkhand is also presented in the paper.

Keywords: B. A. U. *Campodea*, Diplura, Diversity, *Japyx*, Measurement, Ranchi

1. Introduction

Apterygotes play their great role in the terrestrial ecosystem. Among them, diplurans are too important especially Campodids. Diplurans are small (3-28 mm) insects ^[1]. They are very confused with some extent to Symphyla (garden centipedes) and Bristletails (silverfish and firebrats) for beginners. In general, it differs from Symphyla by thoracic legs and from Bristletails by lack of medial caudal filament and one segmented forceps like cerci is one of the basic features of this fauna. Diplurans are very agile and fragile fauna. In spite of that they are the one of the significant soil macrofauna. They are blind animal. Presently, fauna of this group are very less studied and neglected by entomologist/zoologist from the India due to their presence are limited to the littered soil and scattered literatures on this group. Presently, 976 species of diplurans have been recorded globally ^[2] whereas, 18 species under 09 genera of the 4 families are known from India ^[1, 8]. They feed on small soil arthropods, soil mites, enchytraeids and fungi ^[3]. They also feed on Diplura, detritus and even diplurans also. Probably, the first record of Diplura from India was made by Silvestri was *Parajapyx (Grassianus) indica* (Silvestri (1913) ^[4]. The few major work have carried out by Silvestri (1931, 1933) ^[5, 6], Rani and Mitra (1977) ^[7] and Conde and Page's (1991) in the checklist of Indian Diplura ^[8]. Rani and Mitra ^[7] erected a subgenus of *Lepidocampa* *bengalensis* Rani and Mitra, 1977. A checklist has prepared by Mandal reflect 18 species in 9 genera under 4 families of Indian Diplura ^[8]. Singh *et al.* ^[16] firstly recorded the *Anajapyx* sp. From Uttar Pradesh is the updated and most recent publication on ecology of this group from India. Literatures are very less, silent and scattered regarding this group of fauna in India as well as worldwide also. SK Mitra (Kolkata), only an Indian man who contributed to the taxonomy of the Diplura. The present study is a supplementary part of a survey of Diplura from B. A. U. Ranchi, Jharkhand by author during his Ph.D. research entitled "Studies on Biodiversity of Collembola (Insecta: Collembola) in different Ecosystem of India".

2. Materials and Methods

A. Sampling site: The present surveys were carried out at Birsa Agricultural University, Ranchi, Jharkhand from littered

Correspondence

Ramesh Singh Yadav

Department of Entomology and
Agricultural Zoology, Institute
of Agricultural Sciences, Banaras
Hindu University, Varanasi,
Uttar Pradesh, India

during March 2009. The both habitats were well moistured and rich with the organic matters. The latitude and longitude of the Birsa Agricultural University, Ranchi (BAU) is 23.4425 and 85.3156 respectively. The average temperature range from 16.8⁰ Celsius to 31.5⁰ Celsius in the month of March and average annual rainfall is 1397 millimeter of the year.

B. Collection and extraction of fauna: Littered soil samples were collected during the 8.00 to 10.00 AM and the samples were brought to the laboratory for the extraction of the dipluran fauna. Extractions were made through the standard modified Tullgren's funnel method. Soil samples were put in funnels which are fitted with fine meshes in the lower portion of funnels. Collection vials containing 70 percent alcohol and a few drops of glycerol were kept under the 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. The Light intensity was controlled with the help of illumination timer and light intensity controller fitted in the modified Tullgren's machine.

C. Taxonomic preparation and identification: The collected specimens during the 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. Slides were prepared in Hoyer's medium. The fauna were identified by following the standard taxonomic keys [6, 9, 10, 11] on this group.

D. Data analysis: The following diversity indices were used-

1. Simpson index of diversity (D): The Simpson index of diversity was used [12].

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

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 [13].

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 [14].

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

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 [15].

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

Where,

H = Shannon-Weiner diversity index

S = Total no. of individuals in sample

In = Natural log.

3. Results

i. Biodiversity study

During the survey of BAU, Ranchi, Jharkhand a total of 15 individuals belonging to the 3 family namely, Campodeidae Lubbock, 1873 and Japygidae Lubbock, 1873 of Diplura were collected (Plate: I and II). From collection 4 species (including one damaged) belonging to 4 genera of Diplura namely; *Campodea* sp., *Lepidocampa weberi* Oudemans, 1890, *Indjapyx gravelyi* Silvestri, 1931 and a damaged specimen was probably *Indjapyx annandalei* Silvestri 1931 were identified. A checklist of collected Diplura fauna is presented in the Table 1, *Campodea* sp. (27%) and *Lepidocampa weberi* Oudemans, 1890 (46%) of the family Campodeidae Lubbock, 1873 whereas *Indjapyx gravelyi* Silvestri, 1931 (20%) and *Indjapyx annandalei* Silvestri 1931 (7%) of the family Japygidae Lubbock, 1873 (Fig. 2). The result revealed that highest numbers of Diplura fauna were encountered in the family Campodeidae Lubbock, 1873 and *Lepidocampa weberi* Oudemans, 1890 was dominating species followed by *Campodea* sp. The diplurans species *Campodea* sp, *Indjapyx gravelyi* Silvestri, 1931 and *Indjapyx annandalei* Silvestri 1931 were first time recorded from the Jharkhand and the *Lepidocampa weberi* Oudemans, 1890 was the first time from Ranchi. The different indices of diversity measurement i.e. Simpson index of diversity, Shannon-Weiner diversity index, Margalef's species richness and Pielou's Pielou's evenness of Diplura fauna at Ranchi, Jharkhand were 0.83, 1.21, 1.11 and 0.87 respectively (Table 2) were also calculated for the diplurans fauna of Jharkhand.

Table 1: Checklist of Diplurans collected from Ranchi, Jharkhand

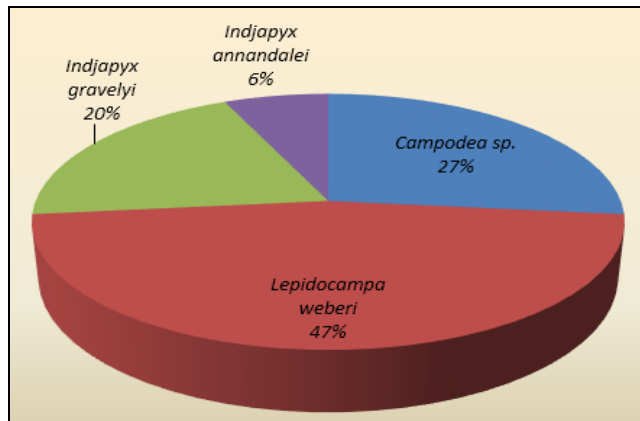
S. No.	Family	Species
A.	Campodeidae Lubbok, 1873	
1.		<i>Campodea</i> sp.**
2.		<i>Lepidocampa weberi</i> Oudemans, 1890*
B.	Japygidae Lubbock, 1873	
3.		<i>Indjapyx annandalei</i> Silvestri, 1931**
4.		<i>Indjapyx gravelyi</i> Silvestri, 1931**

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

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

Table 2: Different indices of Diplurans Diversity at Ranchi, Jharkhand

S. No.	Indices	Values of indices
1.	Simpson index of diversity (D)	0.83
2.	Shannon-Weiner species diversity index	1.21
3.	Margalef's richness index	1.11
4.	Pielou's evenness index	0.87

**Fig 2:** Population densities of Diplura at Ranchi, Jharkhand

ii. Taxonomic account

The classification of surveyed group was made based on the Rusek, 1982-

Order: Diplura Börner, 1904

Suborder: Rhabdura Cook, 1896

Superfamily: Campodeoidea Lubbock, 1873

Family: Campodeidae Lubbock, 1873

Genus: *Campodea* Westwood, 1842

Lepidocampa Oudemans, 1890

Superfamily: Japygoidea Lubbock, 1873

Family: Japygidae Lubbock, 1873

Genus: *Indjapyx* Silvestri, 1931

Identification keys of Diplurans' families of Ranchi, Jharkhand is presented below-

1. Cerci filiform, multi-segmented 2
- Cerci forceps like and one segmented 3
- 2(1) Cephalic suture 'Y' shaped, 3 pairs of the thoracic spiracles CAMPODEIDAE Lubbock, 1873
- Cephalic suture not clear, 2 pair of thoracic spiracles present PROCAMPODEIDAE Silvestri, 1948
- 3(1) only some species have trichobothria in antennae (IV to VI or VI to VII), 4 pairs of thoracic spiracle present..... JAPYGIDAE Lubbock, 1873
- Trichobothria absent in antennae, only 2 pairs of thoracic spiracles present PARAJAPYGIDAE Womersley, 1939

A. Family: Campodeidae Lubbock, 1873

Under this family two species of two different genera were collected from Jharkhand.

I. *Campodea* sp. (Plate I): The genus was determined by Westwood as *Campodea* Westwood, 1842. The fauna was characterized by its Metanotum with postero.lateral macrosetae. Abdominal tergites possessing either antero·median or postero·median macrosetae. All segments of eerci with long hairs.

Remark: The *Campodea* Westwood, 1842 have about 115 species globally. This species probably may be nearer to *Campodea silvestrii* Bagnall.

II. *Lepidocampa weberi* Oudemans, 1890 (Plate I): The species were characterized by 'Y' shaped cephalic suture. First, second and third segment of the thorax were gradually larger, antennae have 26 articulation. Abdominal macrochaetae typical long,robust, urosterni of abdomen oval shape, cerci with 10 articulations.

B. Family: Japygidae Lubbock, 1873

In this family only two species from single genera were recorded.

I. *Indjapyx annandalei* Silvestri 1931 (Plate II fig. 1 and 2): Damaged specimen. Antenna has more than 38 articulations, 5 maxillary tooth, Tibial claw fork like, Thorax pronotum long setae 5+5 abdominal styli present, abdominal tergites 3-7 have also 5+5 setal pattern, Forceps were infuscated, forcep segment longitudinal subsquare

II. *Indjapyx gravelyi* Silvestri, 1931(Plate II fig. 3): Antenna has more than 36 articulations, trichobothrial setae are also present, long; pronotum have 5+5 long setae; unguicula of medium leg wide clawed; abdominal tergites 3-7 have also 6+6 setal pattern;forcep segment longitudinal subsquare

4. Discussion

During the present survey of Birsa Agriculture University, Ranchi, Jharkhand 4 species from 3 genera of 2 families produces satisfactory numbers (22.22%) of Diplura fauna as compared to 18 species of 9 genera from 4 families known Diplura from India ^[1, 8]. This revealed that the Ranchi, Jharkhand has a good diversity of this group of fauna also. The family Campodeidae Lubbock, 1873 was reported to be the most dominating family over the families. The family Japygidae Lubbock, 1873 was the second dominating family. Singh *et al.* (2008) ^[16] recorded same pattern in the TMC floral garden whereas the contrary result in Bamboo grooves ^[16]. It reveals habitat specificity of the Diplura. According to available literatures on diplurans species, *Campodea* sp, *Indjapyx gravelyi* Silvestri, 1931 and *Indjapyx annandalei* Silvestri 1931 were first time recorded from the Jharkhand and the *Lepidocampa weberi* Oudemans, 1890 was the first time from Ranchi. Silvestri (1933) has only described *Lepidocampa weberi* Oudemans, 1890 from the Chhota Nagpur region ^[6]. The *Lepidocampa weberi* Oudemans, 1890 was most diversified species of Diplura which is similar with finding of Silvestri ^[6]. First time ecological study regarding the Simpson index of diversity, Shannon-Weiner diversity index, Margalef's species richness and Pielou's evenness of Diplura fauna from Ranchi, Jharkhand were carried out. Probably, it is a first indices calculation on the Dipluran fauna from the India. Whereas, from only relative count were made by Singh *et al.* ^[16] and Yadav and Singh ^[17]. After an Indian worker Rani and Mitra (1977) ^[7] were studied the first preliminary work carried out on this group by any Indian worker so far. Some other literatures are other than the English. Hence, the interpretation of the result facing more difficulties here.

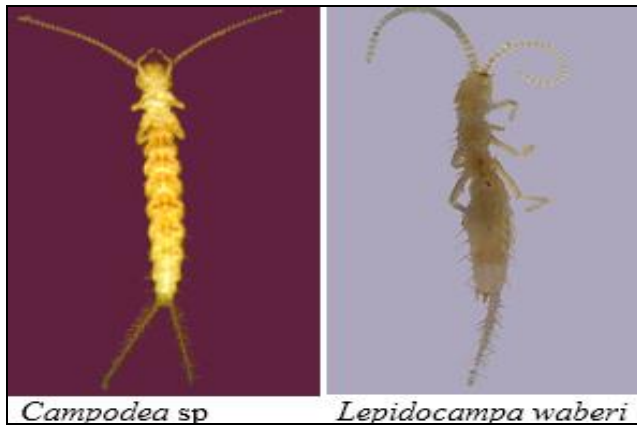


Plate I



Fig 1 and 2: Forceps and middle unguicula of *Indjapyx amandalei*,
3. *Indjapyx graveleyi*

Plate II

5. Conclusion

From the present study it is concluded that Jharkhand has also satisfactory density and diversity of Diplurans is there. A very small study results 22.22% diplurans from Jharkhand of the total 16 species studied from India and 3 species were first time recorded from 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 Diplura fauna from Jharkhand were 0.83, 1.21, 1.11 and 0.87 respectively. The results conclude that it is the baseline study of Diplurans from Jharkhand.

6. Acknowledgements

I wish to extend our gratitude to the Head and PI (P 27/113), Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi for providing the all necessary facilities. Thanks are also due to Dr. M. Raghuraman who companied with survey.

7. References

1. Chandra K. Insect fauna of states and Union Territories in India. ENVIS Bulletin: Arthropods and their Conservation in India (Insects & Spiders), Zoological Survey of India. 2011; 14(1):189-218.
2. Zhang ZQ. Animal biodiversity: an introduction to higher-level classification and taxonomic richness. Zootaxa. 2011; 3148:7-12.
3. Kuhnelt W. A breaf introduction to major group of soil arthropods and their biology. In: Soil Zoology: Proceeding of University of Nottingham Second ester School in Agriculture Science, (ed. Kevan, DKMcE), London Butterworth Scientific Publication, 1955, 34-35.
4. Silvestri F. On some Thysanura in the Indian Museum.

5. Japygidas. Rec. ind. Mus. 1913; 9:52-53.
6. Silvestri F. Campodeidae (Insecta: Thysanura) dell estremo oriente. Boll. Lab. Zool. Portici., 1931; 286-320.
7. Silvestri, F. First contribution to knowledge of Indo-Malayan Campodeidae (Thysanura-Entotropha). Records of the Indian Museum. 1933; 35(4):379-392.
8. Rani IS, Mitra SK. New subgenus of *Lepidocampa* (Apterygota: Diplura: Campodeidae) from India. Oriental Insects. 1977; 11:17-26.
9. Mandal GP. [http://zsi.gov.in/checklist/Diplura%20\(Insecta\).pdf](http://zsi.gov.in/checklist/Diplura%20(Insecta).pdf) Zoological Survey of India, M-Block, New Alipore, Kolkata, 2010.
10. Silvestri F. Contributions to a knowledge of the Indo-Malayan Japygidae (Thysanura). Records of the Indian Museum. 1930; 32:439-489(Inc.).
11. Bareth C, Conde B. Diploures Campodeides des grottes du Pendjab. (*Simlacampa clayae*). International Journal of Speleol. 1972; 4:55-59.
12. Paclt J. Diplura. Genera Insectorum de P. Wytzman, 212^e fascicule. Imprimerie ET Editions Mercurius, Anvers, 1957, 109.
13. Simpson EH. Measurement of Diversity. Nature. 1949; 163:688-688. Doi: 0.1038/163688a0.
14. Shannon CE, Weiner W. Mathematical theory of communication. University of Illinois Press Urbana, 1949, 117.
15. Margalef R. Temporal succession and spatial heterogeneity in phytoplankton. In: Perspectives in Marine biology, Buzzati-Traverso (ed.), Univ. Calif. Press, Berkeley. 1958, 323-347.
16. Pielou, EC. The measurement of biodiversity in different types of biological collections. Journal of Theoretical Biology. 1966; 13:131-144.
17. Singh J, Raghuraman M, Yadav RS, Prasad S. First report of diplurans (Insecta: Diplura) from Uttar Pradesh, India. Indian Journal of Entomology. 2008; 70(4):337-340.
18. Yadav RS, Singh J. Biodiversity of soil arthropods under Mango (*Mangifera indica* L.) orchard ecosystem in Varanasi, Uttar Pradesh. Environment and Ecology. 2009; 27(3A):1228-1230.