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COLLEMBOLA (HEXAPODA) FROM BIBHUTI BHUSHAN WILD LIFE SANCTUARY, PARMADAN, NORTH 24 PGS, WEST BENGAL.

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INTRODUCTION

The collembolans commonly called "spring-tails" are small, entognathous, wingless hexapods possessing a spring-like forked jumping organ, the furcula underneath the fourth abdominal segment. They are minute in size (less than 6 mm in length); antennae primarily with 4 segments. The presence of antennae and absence of cerci distinguish them from the other entognathous hexapods. The collembolans have very diverse distribution occurring in all Zoo-geographical regions of the world inhabiting a wide range of ecological niche and climate. They are prevalent in almost all kind of situations, in mosses, under stones, caves, in ant and termite nests, surface of lakes and ponds even in the intertidal zone. Some species viz, the snowflea, *Hypogastrura nivicola* live permanently on glacier or snow fields. The greatest diversity and density are seen in soil rich organic matter. There are about 8000 species described worldwide (Frans Janessens, 2011) and from India 299 species under 103 genera of 19 subfamilies and 18 families were reported (Mandal, 2010).

This was the first consolidated report of Collembolan fauna from Bhibhuti Bhushan Wild life Sanctuary, Parmadan, North 24 pgs, West Bengal. The present analysis of the composition of the species of Collembola is based on a collection made by Apterygota section of Zoological Survey of India during 2007-2010 from Bhibhuti Bhushan Wild life Sanctuary. The work also provides key to families, genera and species, The classificaton followed in the present study is after Christiansen, K.A and Bellinger, P. (1998).

TAXONOMIC STUDIES

Order COLLEMBOLA

Key to Families of COLLEMBOLA

1. Body linear; at least first 4 abdominal segments dorsally separated by membranes lacking setae, or furcula rudimentary or absent (Suborder Arthropleona) 2
— Body globular; first 4 abdominal segments fused dorsally; furcula always well developed (Buborder-Symphypleona) 9
2. First thoracic segments distinct with dorsal setae (Section-Poduromorpha) 3
— First thoracic segment frequently indistinct without dorsal setae (Section-Entomobryomorpha) 4
3. Pseudo-ocelli present, at least on antennal base or dorsum of fifth abdominal Segment ..... Onychiuridae
— Pseudo-ocelli absent ..... Hypogastruridae
4. Mucro hairy; fourth antennal segment shorter than third; body scaled (first instar juveniles lack all these characters except of at least some species of *Tomocerus* ..... Entomobryidea (Subfamily Tomoccerinae)
— Mucro with at most 1-2 setae; fourth antennal segment at least as long as third; scales present or absent 5
5. Dentes with dentate spines; mucro subequal in length to dens or longer. ..... Entomobryidae (Subfamily Oncopodurinae)
— Dental spine simple (rarely) or absent; mucro usually much shorter than dens 6
6. Post antennal organ present, or absent, and setae at most unilaterally ciliate ..... Isotomidae
— Post antennal organ absent; some setae multilaterally ciliate 7
7. Dens dorsally crenulate and curving upward, basally in line with manubrium ..... Entomobryidae (Subfamily Entomobryinae)
— Dens not crenulate, straight and usually forming a basal angle with manubriam 8

8. Eyes and pigment absent; dens with large dorsal scales and without apical lobe .... Entomobryidae (Subfamily Cyphoderinae)

— Eyes and pigment present; dens without dorsal scales and with apical lobe .... Entomobryidae (Subfamily Paronellinae)

9. Antenae shorter than head; eyes absent .... Neelidae

— Antenae longer than head, or at least 1+1 eyes (sometimes unpigmented) ..... Sminthuridae

Family HYPOGASTRURIDAE

This group of genera may be best recognized by thye absence of true pseudocelli and simplicity of sense organ of third antennal segment.

Key to Subfamilies of HYPOGASTRURIDAE

Mandible with a basal molar plate .... Hypogastrurinae

Mandible without a molar plate or absent .... Neanurinae

Key to genera of Hypogastrurinae

1. Postantennal organ absent ..... *Xenylla*

Postantennal organ present 2

2. Eyes present and without lamellate unguiculus .. .. *Hypogastrura*

Eyes present and with lamellate unguiculus .... *Ceratophysella*

Genus I. ***Xenylla*** Tullberg, 1969

1. ***Xenylla obscura*** Imms

1912. *Xenylla obscura* Imms, *Proc. Zool. Soc. London* : 80-125.

Diagnosis : Body length 1.4 mm; elongate in shape; colour indigo-blue, segmental margins and ventral side pale. Antennal segment ratio as 10 : 12 : 12 : 14. P.A.O. absent; unguis carinate without lateral teeth but with 1, 1, 1 inner tooth near the apex; unguiculus absent. Ventral tube with 4+4 setae. Tenent hair, 2, 2, 2 very long and capitate at the end. Dentes and mucro separated, mucro short, thick about half as long as dens; dens with two long simple posterior setae.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. dist. 22.i.2008, coll. G.P. Mandal, 14exs

Distribution : INDIA : West Bengal, Uttar Pradesh Arunachal, Manipur, Mizoram and Nagaland.

Family ONYCHIURIDAE

This family is characterized by the presence of pseudocelli on the head and trunk, distinctive and usually complex sense organ on the third antennal segment. Eyes are always absent and lacks pigment and of furcula. Body form and mouth part structure are in general as in Hypogastrurinae except in *Willemia* which differs in having the post antennal organ tubercles in a circle instead of in two parallel lines.

Genus II. ***Onychiurus*** Gervais, 1841

2. ***Onychiurus indicus*** Choudhuri and Roy

1965. *Onychiurus indicus Choudhuri and Roy, Rev. Ecol. Biol. Sol.*, : 123-127.

Diagnosis : Colour creamy white. Cuticle uniformly finely granulated and marginal portion of each segment not clearly defined, and antennal base not differentiated from rest of head. Pseudocelli dorsally three at base of each antenna forming a triangle, two obliquely on hind margin of head, ventrally two ventral pseudocelli on either side of head. Antenna cylindrical and shorter than width of head, segment IV apically with a crecentic fold housing a small globular papilla; ratio of antennal segments I : II : III : IV as 3 : 4 : 5 : 10. P.A.O. with 8-12 small free or overlapping compound vesicles. Unguis untoothed; unguiculus without basal lamella. No furcula remnant visible.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 pgs dist. 22.i.2008, coll. G.P. Mandal, 26 exs.

Distribution : INDIA: West Bengal.

Family ISOTOMIDAE

This family includes Arthopleona with distinct antennal segments, mouth parts with well developed mandibular molar plate, pronotum reduced without setae and with a postantennal organ of a single tubercle. Unguis with a single inner margin. Abdominal segments III and IV similar in length lacking scales or 'flexed' setae.

Key to genera of Isotomidae found in the B.B.W.L. Sanctuary

1. P.A.O. present 2

— P.A.O. absent ..... *Isotomiella* Bagnall

2. Ventral manubrial setae 14 or more 3

— Ventral manubrial setae 6 or fewer 4

3. Ocelli 3 + 3, mucro with small apical and large subapical tooth..... *Isotomurus* Borner

— Ocelli 5 + 5, Mucro distinctly separated from dens, fifth & sixth abdominal segment fused .... *Cryptopygus* Willem

4. Dental crenulation absent. Eyes 8 + 8, Manubrium dorsally with dorsal scattered seta .... *Ballistrura* Borner

— Dentes with 20 rather strong setae in 3 longitudinal rows ..... *Isotomina* Borner

Genus III. ***Isotomurus*** Borner, 1903

3. ***Isotomurus balteatus*** (Reuter)

1876. *Isotoma balteatus* Reuter, *Med. Soc. Fauna et. Flora. Fenn.*, **1** : 82.

1963. *Isotomurus balteatus* (Reuter) Yosii, *Contr. Biol. Lab, Kyoto. Univ.*, **15** : 4.

Diagnosis : Colour with a deep violet pigment appearing black which form distinct transeverse band on the anterior margin of tergities. Antennal ratio is 10 : 15 : 16 : 26. Ant. IV with short subapical sense rods. P.A.O as large as anterior ocellus. Ocelli 8 + 8. Furcula large. Dens distinctly annulated with dorsal side; mucro with a small apical, 2 large subapical and large external lateral teeth.

Material examined : B.B.W.L.Sanct, Parmadan, North 24 pgs dist. 25.vi.2008, coll. G.P. Mandal, 14 exs.

Distribution : INDIA : West Bengal, Arunachal, Manipur, Orissa and Tripura, COSMOPOLITAN.

Genus IV. ***Isotomina*** Borner, 1903

4. ***Isotomina thermophila*** (Axelson)

1900. *Isotomina thermophila* Axelson, *Medd. Soc. Faun. et. Flora. Fenn.*, **26** : 113.

Diagnosis : Colour Uniformly gray. Eyes 8 + 8. Antennae slightly dark, with pale extremities; ratio of antennal segments I-IV is 24 : 32 : 34 : 50; segment III with a pair of small sensory organ in a groove, segment IV with a low terminal bulbs and long, curving sensory setae sub-equal. PAO sub-equal, broadly elliptical; unguis carinate without tooth; unguiculus, triangular with a basal inner margin broad and swollen at the middle. Tenent hair absent. Furcula well developed but not reaching the ventral tube. Dentes ventrally with about 20 rather strong setae in 3 longitudinal rows. Mucro short, equally bidentate. Body length 0.7 mm.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. dist. 26.vi.2008, coll. G.P. Mandal, 12exs.

Description : INDIA : Sikkim, Arunachal Pradesh; WORLDWIDE.

Genus V. ***Isotomiella*** Bagnall, 1939

5. ***Isotomiella minor*** (Schaffer)

1898. *Isotomiella minor* Schaffer, *Naturgesch.*, **64** : 939-425.

Diagnosis : White in colour. Posterior face with 2 + 2 setae. Antennal segment I with a ventral sensory seta; ratio of antennal segments I-IV is 5 : 5 : 8 : 10. Eyes and PAO absent. Legs without clubbed setae; unguis carinate, untoothed; unguiculus small, broad, about one half of unguis in length and untoothed. Ventral tube anteriorly with 4 + 4 setae in two rows. Manubrium ventrally with 5 + 5 and dorsally with some 10 weak setae. Dentes indistinctly annulated with more than 40 ventral setae in three longitudinal rows and dorsal setae 6 weaksetae (basal 2, parabasal 2 and median 2). Body length 0.8 mm.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. dist. 13.viii.2008, coll. G.P. Mandal, 22exs.

Distribution : INDIA: West Bengal, Sikkim; WORLDWIDE.

Genus VI. ***Cryptopygus*** Willem, 1902

6. ***Cryptopygus thermophilus*** Axelson

1900. *Cryptopygus thermophilus* Axelson, *Medd. Soc. Fauna et. Flora. Fenn.*, **26** : 113; Stach.

Diagnosis : Colour generally dark brown with numerous pale spots. Eyes 8 + 8. Antennal segment IV without distinguishable seta. P.A.O about 3 times as long as the nearest eye. Unguis without lateral teeth but with a clear inner teeth; unguiculus tooth-less. Ventral tube with 2 basal posterior setae and 4 + 4 distal anterior setae. Manubrium 1/2-2/3 as long as dens, with 1 + 1 ventral setae dens with numerous dorsal crenulations, 6 + 6 dorsal setae, and about 20 ventral setae. Body length 1.2 mm.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. dist. 14.viii.2008, coll. G.P. Mandal, 16exs.

Distribution : INDIA: West Bengal Manipur, Assam, Orissa; NORTH AMERICA, JAPAN.

Genus VII. ***Ballistrura*** Borner, 1906

7. ***Ballistrura bengalensis*** Yosii

1966. *Ballistrura bengalensis* Yosii, *Kyoto Univ., Sci., Expd, to the Karakoram and Hindukush,* 1955, **8** : 333-405.

Diagnosis : Body length 0.8 mm. Colour uniformly reddish purple upon antennae and dorsal side of the body. Eyes 8+8, black. Antennae slightly longer than head, ratio of antennal segments 7 : 12 : 16 : 25. PAO is broadly oblong. Unguis straight, not toothed; unguiculus triangular, tenent hairs 2, 2, 2. Ventral tube with 3 + 3 anterior and 1 + 1 posterior setae. Furcula well developed. Manubrium dorsally with numerous short scattered dorsal setae, ventral side smooth and without setae. Dentes not much taperied; mucro elongate, carinate ventrally and apically bidentate and equal with many ventral dental setae with no dental dorsal crenulations.

Material examined : West Bengal: B.B.W.L. Sanct, Parmadan, North 24 Pgs. dist. 14.viii.2008, Coll. G.P. Mandal, 15exs.

Distribution : INDIA: West Bengal.

Family ENTOMOBRYIDAE

This family includes members of the Arthropleona charcterised by reduced prothorax, without setae and postantennal segment and with scales or multilateral ciliate setae on all trunk segments, trochanteral organ, a series of short differentiated setae on the inner surface of the trochanter, fourth abdominal segment of some species much longer than the third. Without postantennal organ. Unguis and unguiculus always well developed and the former has a characteristic lamellar structure in most subfamilies. Furcula always well developed; dens and mucro are characteristics of the different subfamilies. Sexual dimorphism little or absent.

Subfamily ENTOMOBRYINAE

It is distinguished by dorsal crenulate dentes and the short hook-like or bidentate mucro. Body with hairs or scales or both, the chaetotaxy of head and trunk, and number of eyes.

Key to genera of Entomobryinae found in the B.B.W.L. Sanctuary

1. Body with scales 2
— Body without scales. Fourth abdominal segment at midline more than 3 times as long as the third ..... *Entomobrya*
2. Mucro falcate and eyes present ..... *Seira*
— Mucro bidentate and eyes 8 + 8 ..... *Lepidocyrtus*

Genus VIII. ***Lepidocyrtus*** Bourlet, 1839

Subgenus ***Ascocyrtus*** Yosii, 1963

8. ***Lepidocyrtus (Ascocyrtus) magnificus*** (Carpenter)

1924. *Lepidocyrtus magnificus* Carpenter, *Rec. Ind. Mus., Cal.*, **26** : 285-289.

Diagnosis : Body length 2.75 mm. Pale yellow in colour. Antenna twice as long as head, Antennal segments III and IV relatively short; ratio of antennal segments I-IV is 6 : 14 : 10 : 17. Mucro with the strong teeth. Mesonotum very prominent, four times as long as metanotum. Claw elongate, little curved with narrow internal lamella proximal and distal teeth. Manubrium somewhat longer than dentes; mucro relatively stout with strong teeth, the dorsal spine short. Fourth abdominal segment seven times as long as third. Spring half as long as body. The last abdominal segment dark violet.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 19.xi.2008, coll. G.P. Mandal, 22exs.

Distribution : INDIA : Arunachal, Manipur, Mizoram, Nagaland, Sikkim, Tripura and Uttar Pradesh.

Elsewhere : SINGAPUR, MALAYASIA, INDONESIA.

Subgenus ***Cinctocyrtus*** Yosii, 1989

9. ***Lepidocyrtus (Cinctocyrtus) medius*** (Schaeffer)

1898. *Lepidocyrtus medius* Schaeffer, *Naturgesch.*, **64** : 393-425.

Diagnosis : Colour brownish white. Eyes black with a median spot between eyes. Eyes 8 + 8. Antennae pigmented purple distally, segments without scales, segment I with denunded setae; ratio of antennal segments I-IV is 12 : 28 : 30 : 42. Ant/Head as 28 : 15. Ths .II is protruded considerably over the haed. Thoracic segments. II : III 15 : 7. Legs without scales at least on distal segments; unguis and tenent hair usual; unguiculus strongly truncate on its inner side. Furcula with mambrium. dens as 1 : 1. Manubrium is ventrally scaled and with 3 + 3 terminal setae. Dentes are normally with 4 rows of setae. Mucro with apical tooth elongated, anteapical tooth little smaller. Abdominal segments III : IV 1 : 3. Body length 1.5 mm.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 20.xi.2008, coll. G.P. Mandal, 10exs.

Distribution : INDIA: West Bengal, Uttar Pradesh, Manipur, Mizoram, Nagaland, Sikkim and Tripura.

Elsewhere : SINGAPUR and MALAYASIA.

10. ***Lepidocyrtus exploratorius*** Carpenter

1917. *Lepidocyrtus exploratorius* Carpenter, *Rec. Ind. Mus., Calcutta*, **26** : 286.

Diagnosis : Body length 1.7mm, body colour uniformly pale yellow, antennae deep violet and faint violet string on coxae. Relative length index of antennae as 5 : 7 : 7 : 11. Furcula nearly half as long as body; manubrium slightly larger than dentes; mucro relatively slender with prominent teeth, the dorsal spine elongate and acute.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist 20.xi.2008, coll. G.P. Mandal, 26exs.

Distribution : INDIA: Meghalaya and West Bengal.

Genus IX. ***Seira*** Lubbock, 1869

11. ***Seira indica*** (Ritter)

1911. *Callistocyrtus indicus* Ritter, *Naturhist. Hofmus. Wien.*, **24** : 379-398.

1966. *Seira indica* Yosii, *Kyoto Univ. Sci. Exp.* 1955, **8** : 333-405.

Diagnosis : Body length 1.8 mm. Eyes 8 + 8. Body colour brownish with bluish pigments with yellowish brown pigments covering abdominal segments II, III, some spots of head and thoracic segment. II. Antennae

scaled dorsally, segments III and IV faintly annulated; ratio of antennal segments I-IV as 7 : 9 : 9 : 45. Furcula well developed. Manubrium dorsally with many ciliated setae. Dentes dorsally crenulated. Mucro falciform.

Material examined : Grass field, B.B.W.L. Sanct, Parmadan, Noath 24 Pgs. Dist. 20.xi.2008, coll. G.P. Mandal, 13exs.

Distribution : INDIA : Uttar Pradesh, Arunachal, Assam, Nagaland and Maharashtra.

Genus X. ***Entomobrya*** Rondani, 1861

Subgenus ***Homidia*** Borner

1906. *Entomobrya* Borner, *Mitt. Naturhist. Mus. Hamburg* **23** : 147-188.

12. ***Entomobrya (Homidia) cingula*** Borner

1906. *Homidia cingula* Borner, *Mitt. Naturhist. Mus. Hamburg,* **23** : 147-188.

Diagnosis : Back ground yellowish. Body not compressed. Dentes with 33 spines. Abdominal segments III and IV with black blue pigmented transverse bands. Apical mucronal tooth smaller than anteapical.

Material examined : Grass field, B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 19.xi.2008, coll. G.P. Mandal, 16exs.

Distribution : INDIA : Uttar Pradesh, Arunachal Pradesh, Manipur, Sikkim, Mizoram, Nagaland, Orissa and West Bengal.

Family CYPHODERIDAE

Members may be distinguished from other entomobryids by the ocelli, dental crenulations, and dental spines.

Genus XI. ***Cyphoderus*** Nicolet, 1842

13. ***Cyphoderus javanus*** Borner

1906. *Cyphoderus javanus* Borner, *Mitt. Nat. Hist. Mus. Hamburg,* **23** : 180.

Diagnosis : Body white without trace of pigment. Ant./Head as 12 : 7. Ratio of antennal segments I-IV as 2 : 7 : 4 : 10. Furca in ratio as 8 : 5 : 2. Manubrium ventrally scaled and without setae, dorsal side with many ciliated setae. Mucro subequal to the distal outer scale in length bidentate apically and with a slight lateral edge. Body length 1.7 mm.

Material examined : B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 20.xi.2008, coll. G.P. Mandal, 6exs.

Distribution : INDIA : Arunachal pradesh, Manipur, Mizoram, Sikkim, Orissa, West Bengal, Kerala.

Elsewhere : INDONESIA, THAILAND AND JAPAN.

Family PARONELLIDAE

Members of this subfamily may be distinguished from other entomobryids by the straight unringed dentes, without spines but with a terminal bladder like projection. The mucro is short and blunt and quite different from that of other entomobryids.

Genus XII. ***Salina*** MacGillivray, 1894

14. ***Salina bengalensis*** Mitra

1966. *Salina bengalensis* Mitra, *J. Ent, New Delhi,* **28**(1) : 67-73.

Diagnosis : Colouration : General ground colour of body pale yellow. Thoracic tergites II, III dark with orange suffusion at at its margin, pigment continued to on abdominal tergites. I-VI in addition to orange to dark brown patches. *Clothing* : Body clothed with micro and macrochaetae, most of which ciliated, microchaetae slender and acuminate. *Head* : Pear-shaped with two dark ocellar fieldsbearing with 8 ocelli in each field; ocelli G and H smaller; frontal spines 1 + 1 present. Ratio of antennal segments I-IV as 27 : 41 : 31 : 46. *Thorax* : Prothorax reduced, relatively length of segments. II : III 17 : 13; unguis with paired basal and two enpaired inner teeth; tenent hair clavate. *Abdomen* : Relative ratio of length of abdominal segments I-VI is 11 : 5 : 14 : 2 : 49 : 9 : 6. Ventral tube short. Manubrium : microdens 41 : 48; mucro long, superficially lobed into three teeth; dental scale appendage relatively short straited apically. Body length 1.5 mm.

Material examined : Leaf litter, B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 20.xi.2008, coll. G.P. Mandal, 8 exs.

Distribution : INDIA : West Bengal.

Family SMINTHURIDAE

All the members of this family have the antennae longer than the head, which is hypognathus. A post antennal organ is absent and first four abdominal segments are fused. Mucro is always elongate and commonly serrate along one or both margins.

Genus XIII. ***Sphaeridia*** Linnaniemi, 1912

15. ***Sphaeridia pumilis*** (Krausbauer, 1898)

1898. *Sphaeridia pumilis* Krausbauer, *Zool. Anz.,* **21** : 495-504.

Diagnosis : Pale brown ground colouration on the body with or without and light or dense violetish blue mottling. Ant. I-IV with pigment. Head with diffuse pigment. Ocellar field black & Ocelli 8 + 8. Furcula without blue pigment. Clothing of simple setae only. Head with pilose setae. Abdomen with 3 + 3