

## THE COLLEMBOLA (ARTHROPODA: ENTOGNATHA: COLLEMBOLA) OF NORTH OF WESTERN GHATS

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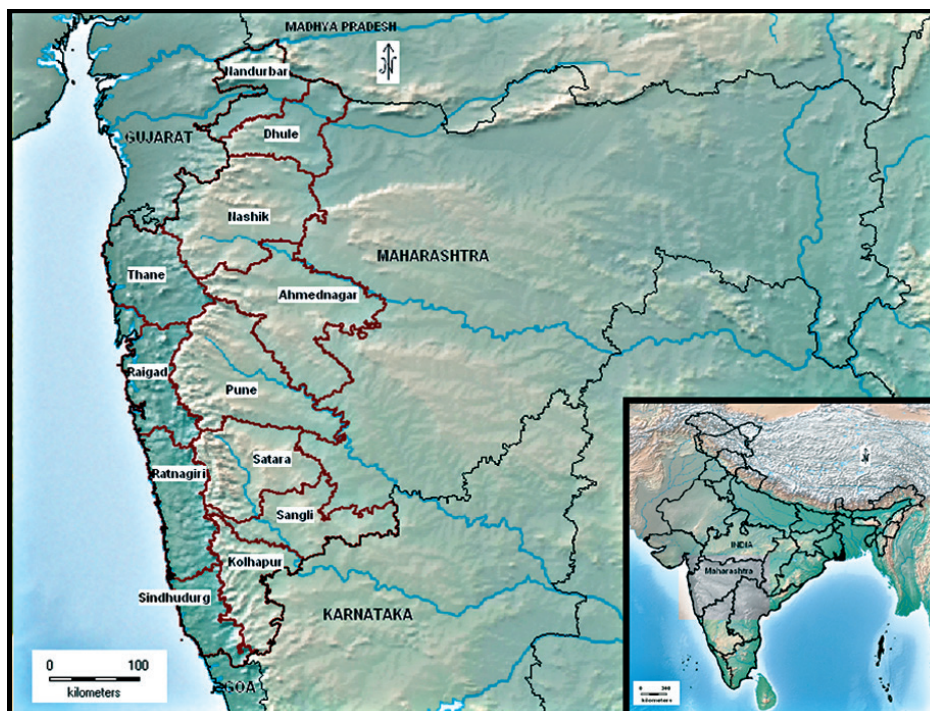
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### INTRODUCTION

Soil Collembola form an important component of soil micro fauna. A high proportion of soil fauna are the arthropods. The most abundant are collembolans while other arthropods include mites, spiders, millipedes, centipedes and insects. Collembolans commonly called as Springtails are omnipresent members of soil fauna. They inhabit both on the surface and the depth of the soil, under overturned rotting logs, under loose tree bark, in leaf litter or in compost and often occur in large aggregations. Some species are even

found inhabiting the nests of ants and termites called as termitophilous Collembola. They found in a wide variety of habitats occurring in all Zoogeographical regions *viz.*, tropical, temperate zone, desert, arctic region etc. and are also located at high altitudes on the mountains. They are soft bodied, wingless, primitive insects possessing a spring like jumping organ called furcula on the underside the fourth abdominal segment. Mouth parts are entognathous type and antennae moniliform mostly 4-6 segmented. They feed as scavengers on dead plant parts, fungal hyphae,



Survey locality of Northern Western Ghat Maharashtra

decaying animal tissues and plant residues. Among arthropods, collembolans and oribatid mites have a great potential as bio indicators of environmental conditions. It constitutes about 72 to 97 per cent of the total arthropod fauna of Indian soil (Prabhoo, 1976).

Extensive taxonomic studies of collembolan have been published throughout the world. There are about 8143 species described worldwide while Indian Collembolans fauna represented 314 species belonging to 104 genera under 19 subfamilies and 18 families (Mandal, 2014). First Indian collembolan species described by Ritter (1910) from Malabar hill region. Prabhoo (1971 a & b) recorded 74 species in Western Ghats and Kerala. Further, there has been a number of studies on taxonomy of collembolan by Baijal (1955) described two new species of *Collembola* during the Entomological Survey of Himalaya. Hazra (1982) described soil and litter arthropods fauna of Silent Valley of Kerala, Hazra and Mandal (2004; 2005; 2009; 2010) studied diversity and distribution of *Collembola* from Western Ghats, 11 species of collembolan belonging to 10 genera from Rajasthan and 31 species under 16 genera of 3 families from different districts of Uttarakhand, India. Mitra (1977) redefined two new genera, *Akabosia* and *Yossia* with special reference to chaetotaxy. Hazra (1998) recorded 9 species of collembolan from Meghalaya. Roy and Bano, (2008) studied the diversity and dynamics of soil meso-fauna associated with natural grasslands in Central India. Roy *et al.*, (2008) studied the dynamics of soil collembolan community associated with grassland, cropland and the tree stand in semi arid Central India. Roy *et al.*, (2014) studied the impact of land uses on community structure of soil collembolan of desert ecosystems. Mandal and Suman (2014) described 8 species from Radhanagari Wildlife Sanctuary and Bano (2015) described 12 species of soil collembolan first time from Phnasad Wildlife Sanctuary, Raigad, Maharashtra.

During past several years, several faunal groups have been studied from different parts of

Maharashtra State but this group has attracted less attention. Therefore, the present investigation is taken to enrich the knowledge on Indian spring-tails with intensive coverage of twelve districts of Northern Western Ghats region of Maharashtra State described 28 species belonging to 22 genera and 9 families.

To determined the diversity of soil collembolans, collections were made during the faunistic surveys of twelve districts (Fig 1&2) viz. Satara, Sangli, Kolhapur, Ahmadnagar, Nashik, Thane, Sindhudurg, Ratnagiri, Raigad, Dhule, Nandurbar and Pune under the Northern Western Ghats region of Maharashtra State have been undertaken from 2012-2014.



Fig. 1. Method of Soil samples collection



Fig. 2. Collected Soil samples

All collected specimens were preserved in absolute ethyl alcohol. Preserved specimens were cleared in Marc Andre1 medium. Hoyer's mounting medium was used for slide mounting

of the specimens. Identification of the specimens is done by using Carl Zeiss Phase contrast compound microscope following Bellinger & Christiansen (1988) and Prabhoo (1971 a & b). Collembolan described from Phansad Wildlife Sanctuary, Raigad and Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra) are also taken into account from published literature to enrich the diversity in this region. Keys to all the taxa dealt with are also incorporated in the paper. All collected specimens are deposited in National Zoological Collection in Zoological Survey of India, Western Regional Centre, Pune.

#### Abbreviations

NZC: National Zoological Collections

ZSI: Zoological Survey of India

WRC: Western Regional Centre

Ent: Entomology

#### LIST OF TAXA

Phylum ARTHROPODA

Subphylum PANCRUSTACEA

Super class HEXAPODA

Class ENTOGNATHA

Subclass COLLEMBOLA

Order ARTHROPLEONA

Family HYPOGASTRURIDAE Borner, 1906

Genus *Ceratophysella* Borner, 1932

1. *Ceratophysella indovaria* Salmon, 1970

Genus *Xenylla* Tullberg, 1869

2. *Xenylla obscura* Imms, 1912

Subfamily NEANURINAE Borner, 1901

Genus *Lobella* Borner, 1906

3. *Lobella kraepelini* Borner, 1906

Family ONYCHIURIDAE Borner, 1901

Genus *Onychiurus* Gervais, 1841

4. *Onychiurus indicus* Choudhuri & Roy, 1965

Genus *Mesaphorura* Borner, 1901

5. *Mesaphorura choudhuria* Yosii, 1966

Family BRACHYSTOMELLIDAE

Genus *Brachystomella* Agren, 1903

6. *Brachystomella terrafolia* Salmon, 1944

Family ISOTOMIDAE Schaffer, 1896

Genus *Isotomodes* Axelson, 1907

7. *Isotomodes dagamae* Prabhoo, 1971

Genus *Isotomina* Axelson, 1900

8. *Isotomina thermophila* Axelson, 1900

9. *Isotomina interrupta* (Schott, 1927)

Subfamily PROISOTOMINAE Stach, 1947

Genus *Folsomides* Stach, 1922

10. *Folsomides purvulus* Stach, 1922

Genus *Proisotoma* Borner, 1901

11. *Proisotoma minuta* (Tullberg, 1871)

Family ENTOMOBRYIDAE Schaffer, 1896

Genus *Lepidocyrtus* Bourlet, 1839

12. *Lepidocyrtus exploratorius* Carpenter

Subgenus *Cinctocyrtus* Yoshi, R, & Yayuk, R.S. 1989

13. *Lepidocyrtus (C.) medius* Schaeffer, 1898

Genus *Pseudosinella* Schaffer, 1897

14. *Pseudosinella petterseni* Borner, 1901

Genus *Homidia* Borner, 1906

15. *Homidia cingula* (Borner, 1906)

Family PARONELLIDAE Borner, 1913

Genus *Salina* MacGillivray, 1894

16. *Salina indica* (Imms, 1912)

17. *Salina montana* Imms, 1912

18. *Salina bengalensis* Mitra, 1973

Genus *Callyntrura* Borner, 1906

19. *Callyntrura lineata* (Parona, 1892)

20. *Callyntrura vestita* (Handschin, 1925)

Genus *Dicranocentroides* Imms, 1912

21. *Dicranocentroides flavescens* Mitra, 1975

Family CYPHODERIDAE Borner, 1913

Subfamily CYPHODERINAE Borner, 1913

Genus *Cyphoderus* Nicolet, 1842

22. *Cyphoderus javanus* Borner, 1906

Genus *Delamarerus* Mitra, 1977

23. *Delamarerus immsi* Mitra, 1977

- Order SYMPHYPLEONA  
 Family NEELIDAE Folsom, 1896  
 Genus *Neelus* Folsom, 1896
24. *Neelus murinus* Folsom, 1896  
 Genus *Megalothorax* Willem, 1900
25. *Megalothorax minimus* Willem, 1900  
 Family SMINTHURIDAE Borner, 1906  
 Genus *Sminthurides* Borner, 1900
26. *Sminthurides velli* Prabhoo, 1971  
 Genus *Sphaeridia* Linnaniemi, 1912
27. *Sphaeridia biniserrata* (Salmon, 1951)
28. *Sphaeridia pumilis* (Krausbauer, 1898)

### TAXONOMIC STUDIES

#### Key to Families of COLLEMBOLA

1. Body form elongate (Order Arthropleona) ... 2  
 ..... 2  
 - Body form subglobular (Order Symphypleona) ..... 10
  2. First thoracic segments distinct with dorsal setae (Poduromorpha) ..... 3  
 - First thoracic segments indistinct without dorsal setae (Entomobryomorpha) ..... 5
  3. Pseudo ocelli present ..... ONYCHIURIDAE  
 - Pseudo ocelli absent ..... 4
  4. Absence of mandibles .....  
 ..... BRACHYSTOMELLIDAE  
 - Presence of mandibles .....  
 ..... HYPOGASTRURIDAE
  5. Post antennal organ present... ISOTOMIDAE  
 - Post antennal organ absent ..... 6
  6. Eye and pigment present or absent, large dorsal scales First thoracic segment ..... frequently indistinct without dorsal setae, Dens dorsally crenulate ..... Entomobryidae  
 - Eye and pigment absent ..... 7
  7. Eye and thoracic dorsal pigmentation absent, dens with large dorsal scales and without apical lobe ..... CYPHODERIDAE
- Eye and thoracic dorsal pigmentation present, dens without large dorsal scales and with apical lobe ..... PARONELLIDAE
  8. Antennae shorter than head, eyes absent .....  
 ..... NEELIDAE
  - Antennae longer than head, or at least 1+1 eyes ..... SMINTHURIDAE

#### Key to subfamilies of Family HYPOGASTRURIDAE

- Mandibles with basal molar plate .....  
 ..... HYPOGASTRURINAE
- Mandibles without basal molar plate .....  
 ..... NEANURINAE

#### Key to Genera of Subfamily Hypogastrurinae

- Post Antennal Organ present .....  
 ..... *Ceratophysella*
- Post Antennal Organ absent ..... *Xenylla*  
 Genus *Ceratophysella* Borner, 1932

#### 1. *Ceratophysella indovaria* Salmon, 1970

*Diagnosis:* Body length 0.8 mm long, dark brown colour in background, ventral side lighter. Ocellar field black. Clothing with sparse to heavy short and long curved simple setae. Antennae shorter than head, ratio as 19:20, segment IV without sensory knob, but with 7-9 short, stout, bent sense rods, numerous long stout simple setae. P.A.O. very irregular, consisting of 4-12 indistinct disconnected lobes. Legs with claw and finely granulate unguiculus, long tenent hair non clavate. The dens with double row setae down anterior face, each row with four setae; mucro finely granulated and spoon-shaped with two distinct lamellae.

*Distribution:* Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra), Jharkhand, Sikkim, Arunchal Pradesh, Assam, Manipur, Mizoram, West Bengal.

Genus *Xenylla* Tullberg, 1869

#### 2. *Xenylla obscura* Imms, 1912

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

1970. *Xenylla obscura* Salmon, *R. Soc. N.Z. Biology Sci.*, 12(13): 145-152

*Diagnosis:* Body elongate and length up to 1.4 mm, colour deep purplish blue. Tergal margins and ventral side pale. Antennal segment ratio as 10: 12: 12: 14. Post Antennal organ absent, unguis carinate without lateral teeth but 1,1,1 inner tooth near the apex, unguiculus absent. Tenent hair very long and capitate at the end. Ventral tube with 4+4 setae. Dentes and mucro separated, mucro short, thick about half as long as dens, dens with two long simple posterior setae.

*Distribution:* Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra), West Bengal, Uttar Pradesh Arunachal, Manipur, Mizoram and Nagaland.

#### Subfamily NEANURINAE

#### Genus *Lobella* Börner, 1906

#### 3. *Lobella kraepelini* Börner, 1906

1906. *Protanura kraepelini*: Börner, Mitt. Naturhist. Mus. Hamburg, **23**: 147-188.

1959. *Lobella kraepelini* (Börner) Yoshii, Contr. Biol. Lab. Kyoto. Univ., **10**: 1-65.

*Diagnosis:* Length up to 2.3 mm long. Body colour red in living and milky white in alcohol. Antenna/Head as 5:6. Ant. III and IV are almost fused dorsally. Sensory hairs of the segment are relatively thin, slightly curving and with rounded apex. Ant. III-organ is normal and with a modified seta on its dorsal side. Eyes 3+3. Postantennal organ is represented by a rounded circle of the integument without granulation. Dorsal tubercles of the body are very insignificant except on Abd.V and is represented usually by the setae upon them. Body setae are all simple, setaceous and slightly brownish in colour. Mandibles are well developed, triangular in shape and with 6 teeth accompanied by a short branch of the mandible. Maxillae are elongated, distally 2 toothed and accompanied by a fringed, hyaline lamella, whose apex is surpassing by far the head of the maxillary shaft. Unguis is dorsally carinate and ventrally with one inner tooth at about the middle.

*Material Examined:* 1ex, On road side to D.Y. Patil College, Akurdi, Pune, 05.viii.2012, NZC/ZSI/WRC/Ent-13/45, Coll. R. Bano,

*Distribution:* India: Pune (Maharashtra), Arunachal Pradesh, Mizoram. *Elsewhere:* Singapore

#### Family ONYCHIURIDAE Börner, 1901

#### Key to Genera of Family ONYCHIURIDAE

- Apical sense organ of III antennal segment with sense clubs.....*Onychiurus*
- Apical sense organ of III antennal segment without sense clubs.....*Mesaphorura*

#### Genus *Onychiurus* Gervais, 1841

#### 4. *Onychiurus indicus* Choudhuri & Roy, 1965

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

*Diagnosis:* Body length up to 1.00 mm. Creamy white background, Cuticle uniformly finely granulated and marginal portion of each segment not clearly defined. Pseudocelli dorsally three at the base of each antenna forming a triangle, two obliquely on hind margin of head, ventrally two pseudocelli on either side of head. Antenna cylindrical and shorter than of head. Antennal segment IV with small globular papilla. Antennal segment ratio as 3:4:5:10. Post Antennal Organ with 8-12 small free compound vesicles. Unguis untoothed, unguiculus without basal lamella. No furcula remnant visible.

*Distribution:* Phansad Wildlife Sanctuary, Raigad (Maharashtra) and West Bengal.

#### Genus *Mesaphorura* Börner, 1901

#### 5. *Mesaphorura choudhuria* Yosii, 1966

1966. *Mesaphorura choudhuria* Yosii, J. Coll. Arts. & Sci., Chiba Univ., **4**(4): 461-531.

*Diagnosis:* Body length 0.8-1.0 mm, white in color. Post antennal organ narrowly elongated. Antennal segments III and IV border. IV antennal segment with small 7 distal sensory setae. Anal spine acute. Unguis small, unguiculus absent. Tenent hair absent.

*Material Examined:* 26 exs., Road side to Katraj, Pune, 28.vii.2012, NZC/ZSI/WRC/Ent-13/47, Coll. S.S. Kamble.

*Distribution:* Pune (Maharashtra), Sikkim.

## Family BRACHYSTOMELLIDAE

Genus *Brachystomella* Agren, 19036. *Brachystomella terrafolia* Salmon, 1944

1944. *Brachystomella terrafolia* Salmon, *Rec. Dominion Mus.*, 1: 2, 135.



*Brachystomella terrafolia* Salmon, 1944

**Diagnosis:** Length up to 1mm. Cuticle coarsely granulated. Dorsally side with dark purplish pigmentation scattered on a creamy white background. Ventral side with very little pigmentation. Ocular field dark black. Maxillae quadrate with many projecting teeth. Antennae, all legs and furcula purplish. Ratio of antennal segments 15:12:14:13; antennal IV segment with a deeply situated apical papilla and 3-4 stout sub apical sense rods. Post antennal organ consists of 6-7 vesicle arranged in a circle. Claws with a single median inner tooth. Unguiculus absent. Tenet hair nonclavate. Furcula short, mucro conical with a pointed distal end. Last abdominal segment without anal spines.

**Material examined:** 34 exs, Harvested Field Shirgaon, Ratnagiri, 30.ix.2013, NZC/ZSI/WRC/Ent-13/76, Coll. R.Bano; 11exs., Open grassland, Dabholi, Sindhudurg, 30.ix.2013, NZC/ZSI/WRC/Ent-13/77, Coll. R.Bano; 2exs, Raigad, 18.i.2013, NZC/ZSI/WRC/Ent-13/67, Coll. R. Bano.

**Distribution:** India: Phansad Wildlife Sanctuary, Raigad, Ratnagiri, Sindhudurg (Maharashtra) and Kerala. *Elsewhere:* New Zealand

Family ISOTOMIDAE Schaffer, 1896

## Key to Genera of Family ISOTOMIDAE

1. Without Ocelli .....

- With Ocelli ..... 3
- 2. Tenet hair absent, furcula present .....  
..... *Isotomodes*
- Tenet hair present, dentes with 20 rather strong setae in three longitudinal rows.....  
..... *Isotomina*
- 3. With Ocelli 2+2 or more..... 4
- With Ocelli 2+2 widely separated pigment patches ..... *Folsomides*
- 4. Ocelli 5+5, mucro distinctly separated from dens, abdominal segment v and vi fused .....  
..... *Cryptopygus*
- Ocelli 8+8, Abdominal segments 5 & 6 separated ..... *Proisotoma*

Genus *Isotomodes* Axelson, 1907

7. *Isotomodes dagamae* Prabhoo, 1971

**Diagnosis:** Body length up to 1.6 mm long. White, slender species. Clothed with plain setae arranged in transverse rows. Laterally on thoracic and abdominal segments with few longer setate. Antennal ratio as 12: 20:25:35; ant. IV with 21 blunt sense rods. Post Antennal organ with eight setae posterior to it. Claw without teeth. Unguiculus half as long as the claw. Tenet hair absent. Chaetotaxy of the apex of abd. V-VI is very distinct. Ventral tube with 4+4 setae on flap and 2+2 setae posteriorly. Mucro with two unequal teeth.

**Distribution:** Phansad Wildlife Sanctuary, Raigad (Maharashtra) and Kerala.

Genus *Isotomina* Axelson, 1900

Key to the Species of *Isotomina*

- Tenet hair absent, Mucro equally bidentate ..... *thermophila*
- Tenet hair present, Mucro bidentate .....  
..... *interrupta*

8. *Isotomina thermophila* Axelson, 1900

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

1947. *Isotomina thermophila* Stach, Family Isotomidae, *Acta Monogr.*, p. 271.

**Diagnosis:** Body length up to 0.7 mm. Colour uniformly grey. Creamish background on ventral

side. Antennae slightly dark with pale extremities. Antennal segments ratio I-IV as 24:32:34:50, segment III with a pair of small sensory organ in groove. Segment IV with a terminal bulbs and long curving sensory setae. Eyes 8+8. Post Antennal Organ subequal, broadly elliptical. Unguis carinate without tooth, unguiculus, triangular with a small basal inner margin broad and swollen at the middle. Tenent hair absent. Furcula well developed not reaching to the ventral tube. Dentes ventrally with about 20 rather strong setae in 3 longitudinal rows. Mucro short, equally bidentate.

*Distribution:* Cosmopolitan: Phansad Wildlife Sanctuary, Raigad (Maharashtra), Assam, Kerala, West Bengal and Sikkim.

#### 9. *Isotomina interrupta* (Schott, 1926)

1926. *Proisotoma (Isotomina) interrupta* Schott, *Medd. Linkopings, horge allm. Iaroverks Redogorelese*, p. 9.

1947. *Isotomina interrupta*, Stach, Family Isotomidae, *Acta Monogr.*, p. 264.

*Diagnosis:* Body length up to 1.6 mm long. Mature individuals with dark bluish colored but immature ones lighter; ventral side lighter background; ocellar fields black; antennal segments uniformly pigmented, legs with little pigmented. Furcula without pigmentation. Clothed with short plain setae which are arranged in regular rows. Antennae slightly longer than head; antennal ratio as 4:5:5:8; antennal IV with a sub apical blunt setae rod. Post Antennal Organ more than twice the diameter of the anterior ocellus. Ocelli 8+8. Unguiculus lanceolate. Tenent hair nonclavate on each tibiotarsus. Dens distinctly annulated and with about 34 setae. Mucro bidentate.

*Distribution:* India: Phansad Wildlife Sanctuary, Raigad (Maharashtra) and Kerala. *Elsewhere:* Camaroons, Germany.

Subfamily PROISOTOMINAE Stach, 1947

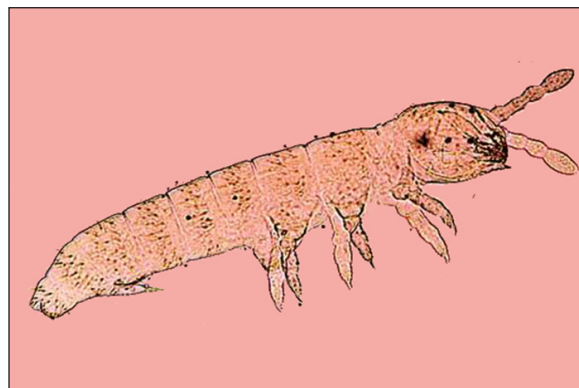
Genus *Folsomides* Stach, 1922

#### 10. *Folsomides purvulus* Stach, 1922

1922. *Folsomides purvulus* Stach, *Annls Hist. -nut. Mus. natn. hung.* **19**: 17.

1934. *Folsomides purvus* Mills, *A Monograph of the Collembola of Iowa*, p. 43.

1947. *Folsomides purvus* Stach, Family Isotomidae, *Acta Monogr.*, p. 101.



*Folsomides purvulus* Stach, 1922

*Diagnosis:* Small species, body length up to 0.65 mm long. White coloured. Clothed with plain setae arranged in transverse rows. Cuticle finely granulated. Antennal ratio as 15:22:25:40, ant IV sub apically six stout and two slender sense rods. Post Antennal Organ elliptical. Ocelli 2+2 in two separated pigmented spots. Claw without teeth. Unguiculus lancet-like and about ¼ as long as the inner margin of the claw. Clavate tenent hair absent. Ventral tube with 3+3 setae on the flap and 1+1 setae on the anterior side. Tenaculum with 3+3; dents on rami. Mucro bidentate with hook like apical tooth; dens with 3 setae dorsally.

*Material examined:* 46 exs., Harvested Field, Vilamb, Guhagar, Ratnagiri, 28.iii.2013, NZC/ZSI/WRC/Ent-13/58, Coll. R. Bano; 33 exs., Harvested rice field, Kelaskarwadi, Sindhudurg, 28.iii.2013, NZC/ZSI/WRC/Ent-13/60, Coll. R. Bano; 39 exs., Harvested Field, Kelaskarwadi, Kasal, Sindhudurg, 31.x.2013, NZC/ZSI/WRC/Ent-13/79, Coll. R. Bano; 4 exs., Hilly grassland, Chila Ghat, Surgana, Nashik, 31.i.2014, NZC/ZSI/WRC/Ent-13/87, Coll. R. Bano & Party; 64 exs., Plain, Agricultural field, Sakri, Dhule, 28.ii.014, NZC/ZSI/WRC/Ent-13/88, Coll. R. Bano & Party; 52 exs., Hilly & Plain, Agricultural field, Dhule, Dhule, 28.ii.014, NZC/ZSI/WRC/Ent-13/90, Coll. R. Bano & Party; 82 exs., Plain, Maalpur, Sakri, Dhule, 31.iii.2014, NZC/ZSI/WRC/Ent-13/92, Coll. R. Bano & Party; 78 exs., Hilly & Plain, Chinchpada 2 km south of Dahivel, Nandurbar, 10.i.2014, NZC/ZSI/WRC/Ent-13/93, Coll. P.S. Bhatnagar & Party.

*Distribution:* India: (Phansad Wildlife Sanctuary, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule Nandurbar) Maharashtra and Kerala. *Elsewhere:* Central and North America, Portugal, Russia, Singapore.

Genus *Proisotoma* Börner, 1901

11. *Proisotoma minuta* (Tullberg, 1871)

*Diagnosis:* Body length up to 1.1 mm length. Mature individuals greyish brown, but juveniles ones lighter; ventral side lighter background. Clothed with plain setae arranged in transverse rows. Ocellar fields black. Eyes 8+8. Furcula focused on the dorsal side of the manubrium. Ventral manubrial setae 1+1 and six ventral setae on the dens. Dorsal side of the dens crenulated. Mucrotridentate.



*Proisotoma minuta* (Tullberg, 1871)

*Material Examined:* 30 exs., Hilly grassland, Navja, Koynanagar, Satara, 30.ix.2013, NZC/ZSI/WRC/Ent-13/78, Coll. R.Bano; 5 exs., Harvested Field, Kelaskarwadi, Kasal, Sindhudurg, 31.x.2013, NZC/ZSI/WRC/Ent-13/80, Coll. R.Bano; 27 exs., Near Water Stream, Balkapra Village, Jawhar, Thane, 29.xi.2013, NZC/ZSI/WRC/Ent-13/82, Coll. R. Bano; 54 exs., Near Water Stream, Kosmata, Vikramgarh, Thane, 20.xii.2013, NZC/ZSI/WRC/Ent-13/84, Coll. R. Bano; 148 exs., Near Water Stream, Kunj, Vikramgarh, Thane, 31.i.2014, NZC/ZSI/WRC/Ent-13/86, Coll. R. Bano & Party.

*Distribution:* India: Satara, Sindhudurg and Thane (Maharashtra). *Elsewhere:* Antarctica, Australia, Austria, France, Germany, Greece, Italy, Latvia, Moldova, Norway, Poland, Portugal, Romania, Sweden, United Kingdom, United States.

Family ENTOMOBRYIDAE Schaffer, 1896  
Subfamily LEPIDOCYRTINAE Wahlgren, 1906

Genus *Lepidocyrtus* Bourlet, 1839

12. *Lepidocyrtus exploratorius* Carpenter

1924. *Lepidocyrtus exploratorius* Carpenter, *Rec. Ind. Mus. Calcutta*, **26**: 286.

1995. *Lepidocyrtus exploratorius* Hazra, *State Faun Seri, Zool. Surv. Ind.*, **4**(3): 13-32.

*Diagnosis:* Body length 1.7 mm long and colour uniformly pale yellow, antennae deep violet and faint violet colour on coxae. Eyes 8+8. Relative index of antennae as 5:7:7:11. mesonotum longer, Unguiculus non truncate, tenent hair present. Furcula nearly half as long as body. Manubrium slightly larger than dentes. Mucro relatively slender with prominent teeth, the dorsal spine elongate and acute.

*Distribution:* Phansad Wildlife Sanctuary, Raigad (Maharashtra), Meghalaya and West Bengal.

Subgenus *Cinctocyrtus* Yoshi & Yayuk, 1989

13. *Lepidocyrtus (C.) medius* Schaeffer, 1898

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

1959. *Lepidocyrtus medius* Yoshii, *Contr. Biol. Lab. Kyoto, Univ.*, **10**: 26.

*Diagnosis:* Body length up to 1.5mm long. Colour brownish white. Antennae pigmented purple distally. A median spot between eyes. Eyes black. Legs and furcula quite pale. Ant./Head as 28:15. Relative index of antennal segments as 12:28:30:42. All antennal segments are without scales. Eyes 8+8. Th. II is protruded considerably over the head. Abdomen III: IV as 1:3. Unguiculus is strongly truncate on its inner side, especially on fore and mid legs. Ventral tube is anteriorly with many long setae. Furcula with Manubrium : Dens as 1:1. Manubrium is ventrally scaled and with 3+3 terminal setae. Dentes with 4 rows of setae. Mucro with apical tooth elongated but anteapical tooth is a little smaller.

*Distribution:* Phansad Wildlife Sanctuary, Raigad (Maharashtra), Manipur, Mizoram, Odisha, Nagaland, Sikkim, and Tripura.



Genus *Pseudosinella* Schaffer, 1897

14. *Pseudosinella petterseni* Borner, 1901

1901. *Pseudosinella petterseni* Borner, *Zool. Anz.*, **24**: 707; Gisin, 1960, *Collembolen fauna Europas*, p. 245.

*Diagnosis*: Body length up to 0.8 mm long. Colour yellowish white. Body fairly clothed with hyaline scales and ciliated setae. Antennal ratio as 2:3:3:6; ant. IV subapically with many blunt sense rods. Claw with a pair of inner unequal teeth, one of which is large, prominent and winglike while the other is rudimentary. Tenet hair single and spatulate. Furcula segments as 35: 47:3; dens only sparsely annulated dorsally. Mucro bidentate with basal spine.

*Distribution*: Phansad Wildlife Sanctuary, Raigad (Maharashtra) and Kerala.

Genus *Homidia* Borner, 1906

15. *Homidia cingula* (Borner, 1906)

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

*Diagnosis*: Body length up to 1.5 mm. Yellowish background. Body not compressed, without scales. Ocellar field black. Ant. III and IV purplish distally; legs and furcula without pigmentation. Abdominal segments III and IV with black blue pigmented transverse bands. Dentes with 33 spines. Apical mucronal tooth smaller than anteapical.

*Distribution*: India: Radhnagari Wildlife Sanctuary, Kolhapur (Maharashtra), Uttar Pradesh, Arunachal Pradesh, Manipur, Sikkim, Mizoram, Nagaland, Orissa and West Bengal.

Family PARONELLIDAE Borner, 1913

**Key to Genera of Family PARONELLIDAE**

Frontal spines 1+1.....*Salina*

Frontal spines 4+4 and antennal segments without thick brush setae.....*Callyntrura*

Frontal spines 4+4 and antennal segments with thick brush setae .....*Dicranocentroides*

**Key to species of Genus *Salina***

1. Body always with pigment..... 2

- Body without any pigment, thoracic tergites II, III and abdominal tergites I, II margins darker and II sometimes with faint violet pigment. .... *indica*

2. Pigmented, thoracic tergites II, III with dark blue-black pigment or orange suffusion extending abdominal tergites.....*bengalensis*

- Pigment usually in the form of violet streaks or patches on thoracic II, III and abdominal tergites I, II..... *montana*

Genus *Salina* MacGillivray, 1894

16. *Salina indica* (Imms, 1912)

1912. *Cremastocephalus indicus* Imms, *Proc. Zool. Soc. London*: 80-125.

1957. *Salina indica* (Imms): Salmon, *Acta. Zool. Cracov.*, **11**(14): 313-362.

1973. *Salina indica* (Imms): Mitra, *Oriental Insects*, **7**(2): 159-202.

*Diagnosis*: Body length up to 1.5 mm long with yellowish background, occasionally the tergal margins and lateral extension of abdominal segment III with faint blue pigment. Antennal segments pale yellow, segments I, II, III with a faint of diffused blue pigments or absent in some cases. Legs and furcula pale yellow without any trace of rings or bands. Body densely clothed with acuminate, stiff microchaete. Ocellar field black, each field containing 8 ocellii, arranged in two longitudinal parallel rows; ratio of antennal segments I-IV: 36:53:40:60. Unguis elongate. Unguculus of truncate type. Tenet hair well developed finely ciliated, clavate, ventral tube well developed. Manubrium: mucrodens 45:54, mucro long, narrow, superficially lobed into three teeth; dental scale appendages relatively small faintly striated.

*Distribution*: Phansad Wildlife Sanctuary, Raigad (Maharashtra), Arunachal Pradesh, Manipur, Mizoram, Sikkim, Tripura, Uttar Pradesh and West Bengal.

17. *Salina bengalensis* Mitra, 1973

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

1973. *Salina bengalensis* Mitra, *Oriental Insects*, **7**(2): 159-202.

*Diagnosis*: Body length up to 1.5 mm; pale yellow background. Thoracic tergites II, III dark and abdominal tergites. I-VI with orange to

dark brown patches. Antennae brown, legs with orange suffusion. Body clothed with, acuminate sparsely micro and macrochaetae. Pear-shaped head with two dark ocellar fields bearing with 8 ocelli in each field; frontal spines 1+1. Ratio of antennal segments I- IV 27:41:31:46. Unguis with paired basal and two unpaired inner teeth; tenent hair clavate. Abdomen: Relative ratio of length of abdominal segments I-VI 11:5:14:2:49:9:6. Ventral tube short with 4+4 ciliated macrochaetae. Manubrium: microdens 41:48; mucro long, superficially lobed into three teeth; dental scale appendage relatively short striated apically.

*Distribution:* Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra) and West Bengal.

#### 18. *Salina montana* Imms, 1912

1912. *Cremastocephalus montanus* Imms, *Proc. Zool. Soc., London*: 80-125.

1957. *Salina montana*: Salmon, *Acta. Zool. Cracov.*, **11**(14): 313-362.

*Diagnosis:* Length up to 2 mm long. Ground colour of head and body usually white, some time pale yellow; Tergal margins of Ths. II, III and Abs. I, II edged with violet to blue black pigment. Antennae pale yellow to dark blue black distally. Furcula white. Lasiotricha on abdomen II (+2), III (3+3) and IV (2+2). Body clothed with acuminate, stiff microchaete. Ocellar field dark with 8+8 ocelli; 1+1 frontal spine present; antennae nearly twice the length of the body; Unguiculus truncate type, tenent hair well developed. Ventral tube short 4+4 ciliated macrochaetae and 7+7 microchaetae on its anterior face. Mucro short and broad, prominently lobed into three teeth, dental scale appendages large and striated apically.

*Material Examined:* 1ex, PWD Guest House, Satara, 18.xii.2012, NZC/ZSI/WRC/Ent-13/51, Coll. R.Bano.

*Distribution:* (Satara) Maharashtra, Mizoram, Manipur, West Bengal, and Uttar Pradesh

Genus *Callyntrura* Börner, 1906

#### Key to species *Callyntrura*

Mucro with 6 teeth ..... *vestita*  
Mucro with 6-9 teeth ..... *lineata*

#### 19. *Callyntrura vestita* (Handschin, 1925)

1925. *Microphysavestita* Handschin, *Treubia*, **10**: 225-270.

1957. *Handschinphysavestita* Salmon, *Acta. Zool. Cracov.*, **11**(14): 313-362.

1974. *Callyntrura (Handschinphysa) vestita* Mitra, *Rev. Ecol. Biol. Sol.*, **11**(3): 397-439.

*Diagnosis:* Body length up to 2.5 mm long. Unique colour pattern and usually without any variation; body green in fresh, pale yellow in alcohol. Head, thoracic II, III and abdominal segments I, II, III with dark purple to blue black patches. Clothing with flexed macrochaetae, acuminate, nonflexed setae and scales. Head with 4+4 dark frontal spines; ocelli 8+8. Antennae subequal or little longer than body. Unguis straight, little curved apically with inner, paired basal teeth reduced, single unpaired tooth small; external basolateral teeth large; unguiculus lanceolate; rami with 4 teeth. Mucro with 6 teeth, dental scale appendages small.

*Distribution:* Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra), Assam, Manipur, Meghalaya, Nagaland.

#### 20. *Callyntrura lineata* (Parona, 1892)

1906. *Callyntrura* Börner, *Mitt. Naturhist. Mus. Hamburg*, **23**: 147-188.

1974. *Callyntrura (Handschinphysa) lineata* Mitra, *Rev. Ecol. Biol. Sol.*, **11**(3): 397-439.

*Diagnosis:* Body length 2.5-4 mm long. Body pale yellow to variable purple blue black. Head, body and appendages clothed with setae and pseudo scales. Thoracic II, III and abdominal segments I, II, III with macrochaetae flexed, obliquely truncated and ciliated setae. Antennae and legs clothed with darker, acuminate, ciliated setae. Frontal spines 4+4; Eyes 8+8. Antennal ratio as I-IV 28:28:18:48; Ant. IV with a conspicuous sense knob encircled with setae apically. Unguis elongate, little curved with paired inner and 2 distal unpaired teeth; unguiculus lanceolate; tenent hair clavate; rami with 4 teeth. Manubrium: microdens 110:148; dentes stout; mucro plump with 6-9 teeth.

*Distribution:* Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra), Himachal Pradesh, Manipur, Tripura and Uttarakhand.

Genus *Dicranocentroides* Imms, 191221. *Dicranocentroides flavescens* Mitra, 1975

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

1966. *Dicranocentroides fasciculatus* f. n. *flavescens* Yosii, *Res. Kyoto Univ. Sci. Exped. Karakoram and Hindukush*, 1955, **8**: 333-405.

**Diagnosis:** Body length up to 3.5 mm long. Body pale yellow to brownish generally without dark patches; lateral edges of thorax and abdomen faintly pigmented; a dark characteristic patch on vertex in between two ocellar fields; antennae without pigmentation. Head pear shaped; 1+1 black ocellar field with 8 ocelli. Antennae subequal to body. Legs similar; unguis little curved with paired external basolateral teeth; unguiculus lanceolate, acuminate usually with 2 outer teeth. Tenent hair present. Ventral tube long with protrusible vesicles retracted. Manubrium: mucrodens 28:38; dentes armed with two closely apposed rows of spines on inner margin; mucro large, parallel sided with 6 teeth.

**Distribution:** Radhanagari Wildlife Sanctuary, Kolhapur (Maharashtra), Himachal Pradesh, Uttar Pradesh, Manipur, Mizoram, Nagaland, Sikkim, Tripura, Arunachal Pradesh and West Bengal.

## Family CYPHODERIDAE Börner, 1913

Genus *Cyphoderus* Nicolet, 184222. *Cyphoderus javanus* Börner, 1906

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

1966. *Cyphoderus javanus* Yosii, *Kyoto Univ. Sci. Exped. Karakoram and Hindukush*, **8**: 381.

1969. *Cyphoderus javanus* Prabhoo, *Orient. Ins.*, **5**(1): 38.

**Diagnosis:** Body length up to 1.7 mm long. Background white without trace of pigment. Antennae uniformly white and antennal ratio I-IV 2:7:4:10. Furca ratio as 8:5:2. Manubrium dorsally ciliated and without setae ventral on side. Mucro subequal and bidentate.

**Material Examined:** 3 exs. Khed and around, Khed, Ratnagiri, 26.xii.2012, NZC/ZSI/WRC/Ent-13/59, Coll. R. Bano.

**Distribution:** Ratnagiri (Maharashtra), Arunachal Pradesh, Manipur, Mizoram, Sikkim, Odisha, Kerala and West Bengal. *Elsewhere:* Indonesia, Japan, Thailand.

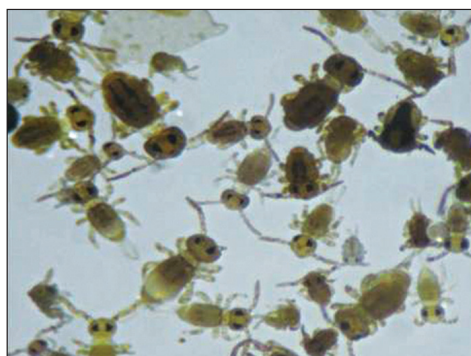
Genus *Delamarerus* Mitra, 197723. *Delamarerus immsi* Mitra, 1977

1976. *Delamarerus immsi* Mitra, *Rev. Ecol. Biol. Soc.*, **13**(4): 645-652.

**Diagnosis:** Body length 1.5 mm long, background white without any trace of pigment. Antennae white uniformly clothed with short setae. Legs clothed with long, ciliated setae. Furcula clothed with short setae and long plumose scales. Unguis with a large tunica at the apex and unguiculi lanceolate without outer tooth. Ratio of antennal segment I-IV 2:8:4:7. Mucro white, long, slender with two apical teeth.

**Material examined:** 2 exs., Hilly & Plain, Samode Village, Sakri, Dhule, 24.xii.2013, NZC/ZSI/WRC/Ent-13/9, Coll. R. Bano & Party.

**Distribution:** Phansad Wildlife Sanctuary, Raigad & Dhule (Maharashtra), Andhra Pradesh and Odisha.



Symphypleonid Collembolans under Stereo-zoom

## Suborder SYMPHYPLEONA

## Family NEELIDAE Folsom, 1896

**Key to Genus of family NEELIDAE**

- Mucro serrated with 15-20 serrations at both sides .....*Neelus*
- Edges of mucro smooth.....*Megalothorax*

Genus *Neelus* Folsom, 189624. *Neelus murinus* Folsom, 1896

1957. *Neelus murinus* Stach. *Families Neelidae and Dicyrtomidae. Acta Monogr.*, p. 8.

**Diagnosis:** Up to 0.5 mm long. White or with brownish pigment granules on white background. Very sparsely clothed with plain setae. Setae on the trunk short and spine like. Anogenital segment with longer and slender setae. Cuticle fine granulated. Sensory areas on the body clearly

visible. Eyes absent. Antenna/Head ratio as 2/3; antennal ratio 2:4:6:7, Claw III with a pair of pseudonychia like prominent lateral teeth, no inner tooth, basal seta present. Unguiculus lanceolate. Ventral tube with a lobe on the posterior side and 2+2 setae at the distal end. Tenaculum with 3+3 dents on rami. Furcula segments as 8:19:11. Mucro serrated gradually tapering and with a blunt tip.

*Material Examined:* 24 exs., Hilly & Plain, Thanepada, Nandurbar, 09.i.2014, NZC/ZSI/WRC/Ent-13/94, Coll. P.S. Bhatnagar & Party; 4 exs., Dry filed (Harvested field), Kerle, Karveer, Kolhapur, 15.ix.2012, NZC/ZSI/WRC/Ent-13/46, Coll. R. Bano; 1ex., WRC Premises, Ravet Road, Haveli, Pune, 14.xi.2012, NZC/ZSI/WRC/Ent-13/48, Coll. R.Bano.

*Distribution:* Nandurbar, Pune and Kolhapur (Maharashtra) and Kerala.

Genus *Megalothorax* Willem, V, 1900

25. *Megalothorax minimus* Willem, 1900

1966. *Megalothorax minimus* Yosii, *Results of the Kyoto Univ. Sci. Exped. Karakoram and Hindukush*, 1955, 8: 333-405.

1957. *Megalothorax minimus* Stach, *Families Neelidae and Dicyrtomidae, Acta, Monogr.*, p. 17.

*Diagnosis:* Length up to 0.5 mm long. The empodium of the foot is about half as long as the claw and the antennal segments third and fourth are not clearly separate. The edges of the mucro are smooth and the sensory field on the abdomen is bordered by five marginal setae.

*Material Examined:* 24 exs., Near Water Stream, Chursi Village, Shahapur, Thane, 29.ix.2013, NZC/ZSI/WRC/Ent-13/83, Coll. R. Bano; 12 exs., Near Water Stream, Kosmata, Vikramgarh, Thane, 20.xii.2013, NZC/ZSI/WRC/Ent-13/85, Coll. R. Bano; 12 exs., Plain, Agricultural field, Sakri, Dhule, 26.xii.2013, NZC/ZSI/WRC/Ent-13/89, Coll. R. Bano & Party,.

*Distribution:* Thane, Dhule (Maharashtra), Kerala.

Family SMINTHURIDAE Börner, 1906

Genus *Sminthurides* Börner, 1900

**Key to Genera of Family SMINTHURIDAE**

- Mucro Spoon-shaped with serrations.....  
..... *Sminthurides*
- Mucro slender with serrations..... *Sphaeridia*

26. *Sminthurides velli* Prabhoo, 1971

*Diagnosis:* Female up to 0.6 mm long. Male is smaller than female. Light violet pigment in background. Antennae and Anogenital segment with slight pigmented. Legs and furcula yellowish. Moderate clothing of short plain stae.. Abdomen with 3+3 long bothriotrichia on each side. Cuticle finely granulated. Ant. IV subdivided in to five subsegmented. But in male it is without annulations. Ocelli 8+8. Claw with only a tooth. Unguiculus with clavate inner margin. Tenaculum with 3+3 dents on rami. Furcula with dens and mucro as 7:3. Mucro slender and spoon shaped with inner lamella having eleven serrations.

*Material Examined:* 6 exs., Deep forest, Bhimashankar, Rajgurunagar, Pune, 18.xii.2012, NZC/ZSI/WRC/Ent-13/52, Coll. R. Bano.

*Distribution:* Pune, Maharashtra, Kerala.

Genus *Sphaeridia* Linnaniemi, 1912

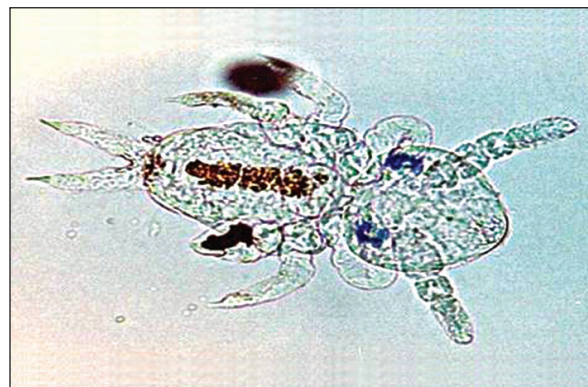
**Key to species of Genus Sphaeridia**

27. *Sphaeridia biniserrata* (Salmon) 1951  
Massoud, 1964

1951. *Sphyrotheca biniserrata* Salmon, *Proc. R. Ent. Soc. London*, B 20: 138.

1956. *Indothea biniserrata* Stach, *Family Sminthuridae. Acta Monogr.*, p. 206.

1964. *Sphaeridia biniserrata* Massoud et Delamare Debouteville, *Rev. Ecol. Biol. Sol.*, 1: 101.



A juvenile of *Sphaeridia biniserrata* (Salmon) 1951

*Diagnosis:* Female up to 0.43 and males up to 0.25 mm long. Uniformly colored with bluish pigment on the body and appendages. Terminal segment of the antennae with slightly denser pigment. Ocellar field dark with ocelli 6+6. Ventral side paler with little pigment. Abdomen with 3+3 bothriotracha, antennal ratio as 5:8:8:20; ant. IV with many slender blunt sense rods subapically. Hind claw with only external teeth. Unguiculus III with a strongly clavate inner lamella without terminal filament. Tibiotarsus III on the inner side with two serrated sex setae each side with four to five denticles while in male it is Y shaped stout seta on the outer side. Mucro with a short dorsal an inner serrated and a smooth outer and ventral lamellae.

*Material examined:* 5 exs., WRC Premises, Ravet Road, Haveli, Pune, 14.xi.2012, NZC/ZSI/WRC/Ent-13/50, Coll. R. Bano; 11 exs., Harvested Field, Naagaon, Poladpur, Raigad, 27.xii.2012, NZC/ZSI/WRC/Ent-13/75, Coll. R. Bano; 6 exs., Harvested Field, Kelaskarwadi, Kasal, Sindhudurg, 31.x.2013, NZC/ZSI/WRC/Ent-13/81, Coll. R. Bano; 22 exs., Ravet road, Haveli, Pune, 02.viii.2013, NZC/ZSI/WRC/Ent-13/109, Coll. R. Bano; 12 exs., office garden, Ravet road, Haveli, Pune, 02.viii.2013, NZC/ZSI/WRC/Ent-13/110, Coll. R. Bano.

*Distribution:* Phansad Wildlife Sanctuary, Raigad, Pune, Sindhudurg & Dhule (Maharashtra) and Kerala.

28. *Sphaeridia pumilis* (Krausbauer, 1898), Agrell, 1934

1891. *Sminthurus pumilis* Krausbauer, *Zool. Anz.* **21**: 495  
1956. *Sphaeridia pumilis*: Stach, Family Sminthuridae. *Acta Monogr.*, p. 49

*Diagnosis:* Female up to 0.32 mm and male 0.25 mm long. Pale brown background coloration on the body with or without and light or dense violet-bluish mottling. Antennae I-IV with progressively more pigmented. Furcula with or without blue pigment. Clothing of simple setae. Head with pilose setae. Abdomen with 3+3 bothriotracha. Antennal /head as 3/2; ratio of antennal segments as 4:7:6:16. Ocellar field dark with 8+8 ocelli. Unguiculus III with a strongly clavate inner lamella and a short sub apical filament. Male sex seta is pilose, bent and placed on a short elevation. Ventral tube with 1+1 seta. Tenaculum with 3+3 denticles on rami. Manubrium with a peg. Mucro with serrated inner, short, dorsal and smooth ventral lamellae.

*Material Examined:* 35 exs., Deep forest, Bhimashankar, Rajgurunagar, Pune, 18.xii.2012, NZC/ZSI/WRC/Ent-13/53, Coll. R. Bano.

*Distribution:* Pune (Maharashtra), Kerala and West Bengal.

## SUMMARY

The present study resulted in enumeration of 28 species belonging to 22 genera under the 9 families of Collembola. The present paper is first consolidated report on Collembolan fauna obtained from the soil from Northern parts of Western Ghats region of Maharashtra State.

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