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Dr. K. VENKATARAMAN
Director
Zoological Survey of India

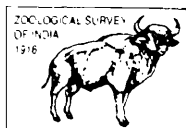
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Dr. K. VENKATARAMAN
Director
Zoological Survey of India



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TWO NEW SPECIES *HYDROVATUS SRINGERIENSIS* AND *COPELATUS WAYANADENSIS* (COLEOPTERA : DYTISCIDAE) FROM WESTERN GHATS OF SOUTH INDIA

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INTRODUCTION

The genus *Hydrovatus* was introduced by Motschulsky (1853), with type species *Hyphydrus cuspidatus* Kunze. It comprises about 50% of the species known from the African continent. Another closely related genus *Queda* occurs in South America. Later, the genus *Hydrovatus* was divided into 2 subgenera *Hydrovatus S. str* and *Vathydrus* depending on the appearance of the frontal part of head margined, not margined or frontal margin reduced (Guignot, 1954 & 1956). Guignot (1959) separated 7 sub groups of the sub genus *Vathydrus* on the basis of body size, colour pattern and elytral microsculpture. Omer Cooper (1963 & 1965) divided the genus into two main groups on the basis of body length. Bistrom (1996) described the genus *Hydrovatus* and he reported 202 species under 15 species groups, in which 37 new species and new synonymies to 104 species were noted. Nilsson (2001) has stated that the genus *Hydatonychus* Kolb, *Oxyoptilis* Schaum, *Vathydrus* Guignot are synonyms of *Hydrovatus*. Subfamily Copelatinae was mentioned as a tribe of Colymbetidae with type genus *Copelatus* (Branden, 1885). Vazirani (1970a) treated Copelatini as a tribe under subfamily Colymbetinae. Miller (2001) raised it to subfamily in which a single tribe Copelatini that has 4 genera *Agaporomorphus*, *Aglymbus*, *Copelatus* (subgenus : *Copelatus* and *Papuadytes*) and *Lacconectus*. Erichson (1832) reported the genus *Copelatus* with type species *Dytiscus posticatus* Fabricius. Gueorguiev (1968) gave a modern description of the genus *Copelatus*. Vazirani (1970b & 1973) has reported only *Copelatus*, as having longitudinal rows of striae on elytra, under which 5 species *C.*

bangalorensis, *C. assamensis*, *C. ceylonicus*, *C. mysorensis* and *C. neelumae* were described and 10 species were redescribed, with a key to 3 groups *Haemorrhoides*, *Irinus* and *Duodecistriatus*. Balke (1998) has reported a new subgenus *Papuadytes* under the genus *Copelatus* and he described 31 new species with illustrations and species ecology was summarized. The genus *Copelatus* has 468 species examined from Australia, Africa, Nearctic, Neo-tropical, Oriental and Palearctic regions. The subfamily Copelatinae comprises about 540 species (Nilsson, 2001). The present study adds one more species in the genus *Hydrovatus* and *Copelatus* which is delineated from rest of the species of pustulatus and Irinus group by the structure of male genitalia respectively.

MATERIALS AND METHODS

Hydradephagan beetles were collected from ponds, puddles, rivers and streams from Western Ghats of South India. The D-net (300X 400X 330 mm) with a mesh size of 0.5 mm was used for collection. The preserved specimen is observed under compound microscope, Trinocular stereozoom microscope and camera lucida along with eye piece 10X and objective 10X used for morphological illustrations. The Holotype species were deposited in Southern Regional Station, Zoological Survey of India, Chennai.

Hydrovatus sringeriensis sp. nov.

Diagnostic characters : Length 2.8 mm; breadth 1.8 mm; Form : oval, convex and slightly acuminate posteriorly (Fig. 1 & 7). Head testaceous; clypeus feebly raised anteriorly and rebordered; punctures fine, sparse irregular and more close along the inner margin of eyes;

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Keywords : Coleoptera, Dytiscidae, Hydroporinae, Copelatinae.

reticulation fine, distinct, polygonal and simple; antenna 3-10 segments distinctly enlarged. Pronotum testaceous, anterior and posterior border black in the middle, side narrowly rebordered, almost straight, a transverse line along the anterior margin; punctures large, uniformly dense and impuncture area narrowly on the anterior margin in transverse but irregular on the disc; reticulation fine and indistinct. Elytra black with testaceous marking as under : lateral marginal lines extending inwards (i) subbasally (ii) post medially (iii) near the apex, all the three irregular in shape and not approaching the suture, sublateral carina from median to apices; punctures large rather sparse and irregular; reticulation fine, polygonal meshes not well impressed; apices acuminate. Ventral side testaceous without any stridulatory files on the sternum; punctures large, distinct and moderately dense on metacoxal plate and abdominal sternites; reticulation indistinct; prosternal process broadened at the apex. Proleg testaceous, coxa with sparse punctures; femur dorsally with a row of sparse spines, ventrally with a row of spines on the posterior half and three setae anteriorly; tibia dorsally with a row of swimming hairs and sparse spinulae, ventrally a row of spines, distally with 5 long spurs; first three segments of tarsi with sucker palettes underneath in male, fourth segment reduced, fifth segment with sparse spines, claws equal (Fig. 4). Mesoleg testaceous, coxa with sparse punctures; femur with short setae on dorsal side and three long spines ventrally; tibia and tarsi similar to proleg (Fig. 5). Metaleg testaceous; femur smooth; both sides of tibia with sparse spines, distally one long and four small spurs; tarsi five segmented, each segment with a pair of distal spines on either side, ventrally a row of swimming hairs, claws equal (Fig. 6). Male genitalia median lobe moderately curved quite narrow, very much narrowed in the apical 1/3rd and pointed forward (Fig. 2 & 8). Lateral lobe broadened at base and narrowed towards rounded apex without any hook (Fig. 3 & 9).

Holotype : Male, Allotype : Female, Paratype, 19 ex., India : Karnataka, Agumbe, 24.xii.2003, 9 ex, Collection. J. Issaque Madani & D. Manivannan, Register No. 1/CL/8, dated, 24.5.2006, ZSI, Chennai.

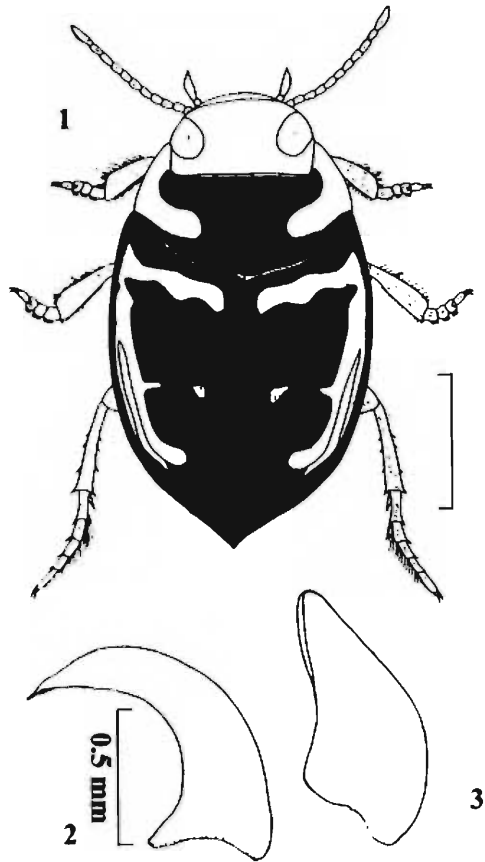
Etymology : The species name *sringeriensis* is derived from the name of collection place.

***Copelatus wayanadensis* sp. nov.**

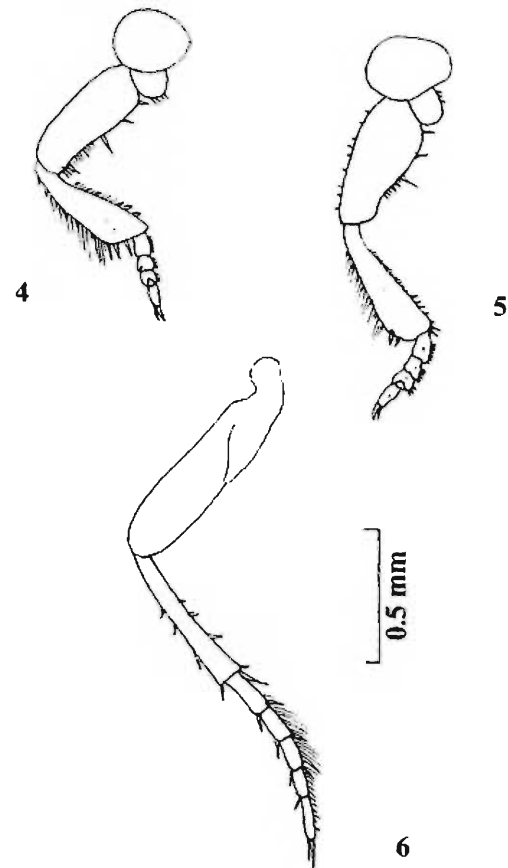
Diagnostic characters : Length 4.2 mm; breadth 2.0 mm; Form oblong, slightly convex dorsally (Fig. 10 & 16). Head brownish black; clypeus raised anteriorly and

not emarginated; punctures fine, sparse and separated about 3-4 times of its own diameter; a transverse cervical stria at the posterior margin of the eyes. reticulation fine distinct with hexagonal meshes. Pronotum brownish black; a row of punctures only along the anterior margin; punctures fine, sparse and separated by about 3-4 times of its own diameter; sides moderately curved; reticulation fine, distinct and hexagonal meshes; lateral anterior margin with spinulae; anterior margin, posterior margin and both sides pale testaceous. Elytra black, lateral margin testaceous; 6 dorsal stria abridged at base (i) 1 and 2 not abridged at the apex (ii) 3-6 stria abridged at the apex, submarginal stria absent; punctures fine, sparse and irregularly distributed; reticulation fine, distinct, hexagonal meshes; sutural stria present; apices not acuminate; epipleura without oblique cavity. Ventral side brownish black, pale testaceous at the margin; punctures fine, sparse on metacoxal plate and abdominal sternites; reticulation fine, hexagonal meshes; striation on metacoxal plate and abdominal sternites; a row of stridulatory files on the margin of mesocoxal cavities; prosternal process lanceolate. Proleg testaceous; coxa and trochanter almost smooth; femur with a row of spinulae at the anterior margin as posterior margin has a row of spinulae and sparse swimming hairs; tibia with a row of spines at the anterior margin and a row of weak spines on posterior margin, with 4-5 distal spurs; tarsi 5-segmented, first 3 segments fringed with 4 rows of sucker palettes, 4th and 5th segments with sparse spinulae; claws equal (Fig. 13). Mesoleg testaceous; coxa and trochanter smooth; femur with a row of spines on the posterior margin, innerface (facing abdomen) with more spines distributed irregularly; a row of spines and swimming hairs at the anterior margin only a row of spines on posterior margin of tibia with 4-5 distal spurs and small spines; tarsi similar to proleg (Fig. 14). Metaleg testaceous; femur smooth; tibia with a row of strong spines on both sides and sublaterally, with 2 long and 2 small distal spurs with a row of bifid spines; each segment of tarsus fringed with a row of spines on posterior margin and single distal spur on each side and also a row of sublateral spines; claws equal (Fig. 15). Male genitalia median lobe broadened at base, narrowed and 1/3rd of the apex curved and acuminate towards the rounded apex (Fig. 11 & 17). Lateral lobe broadened at base, somewhat triangular in shape, apex with a bulb-like structure, behind the apex with a row of ciliae (Fig. 12 & 18).

Holotype : Male, India : Kerala, 1 ex, Panamaram, 10.iii.2004, Collection. J. Issaque Madani & D.



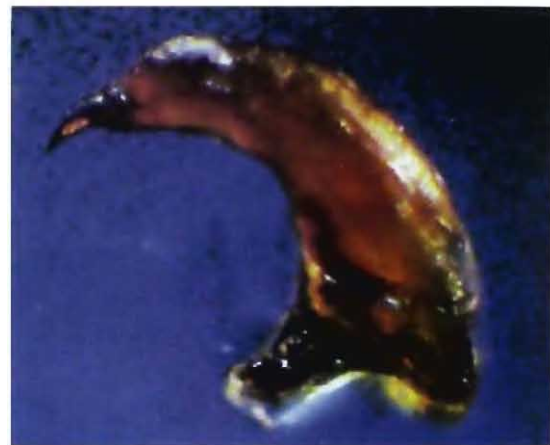
Figs. 1-3. *Hydrovatus sringeriensis* sp. nov. Male : 1. Entire; 2. Median lobe (Penis) lateral aspect; 3. Lateral lobe (Parameres).



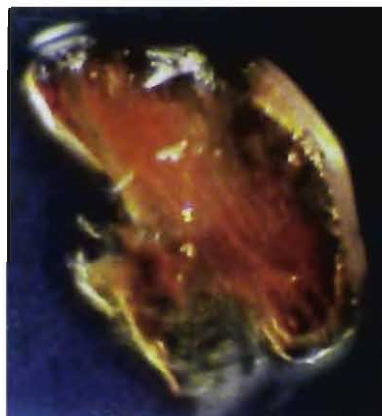
Figs. 4-6. *Hydrovatus sringeriensis* sp. nov. 4. Posterior face of proleg; 5. mesoleg; 6. metaleg.



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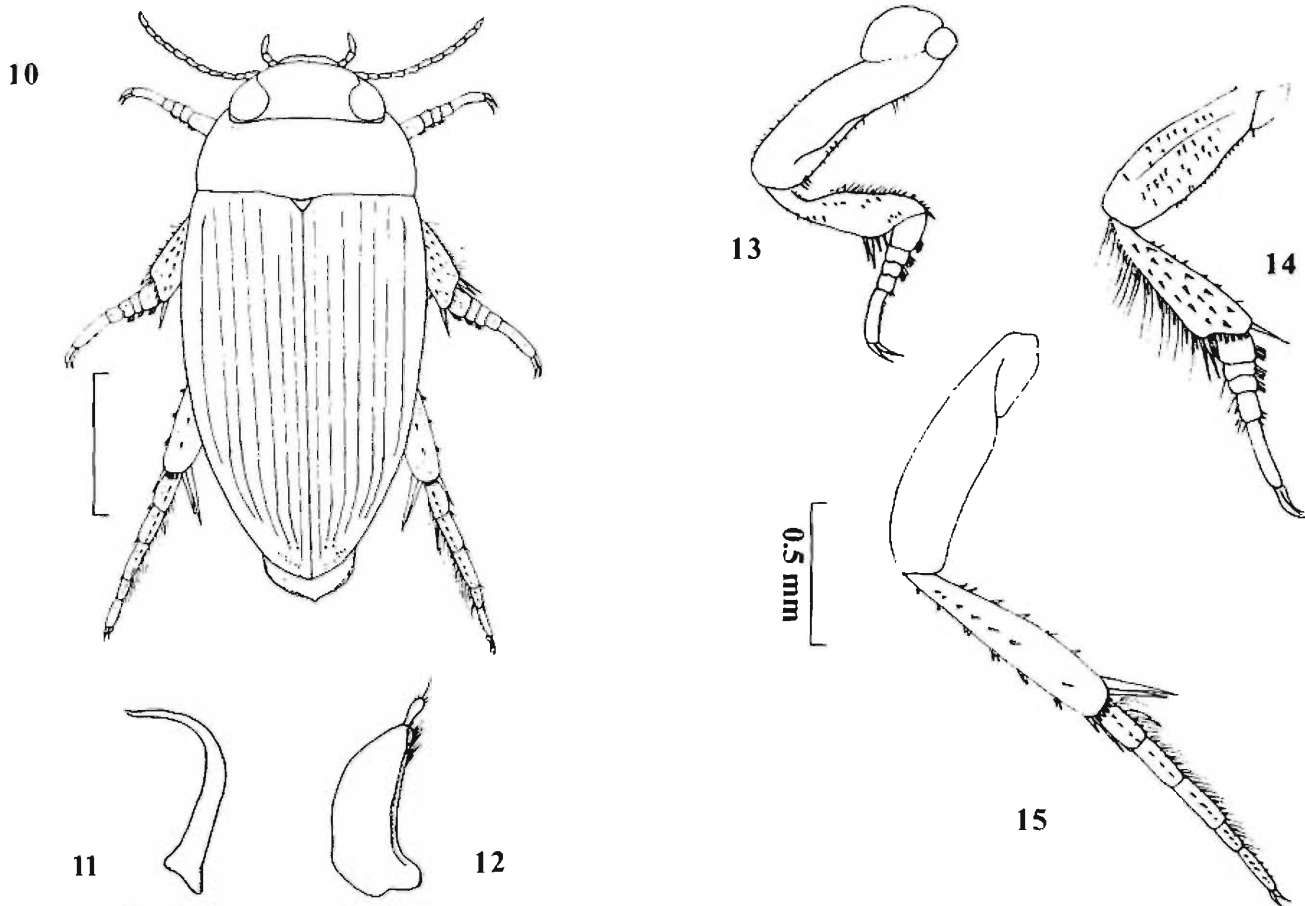


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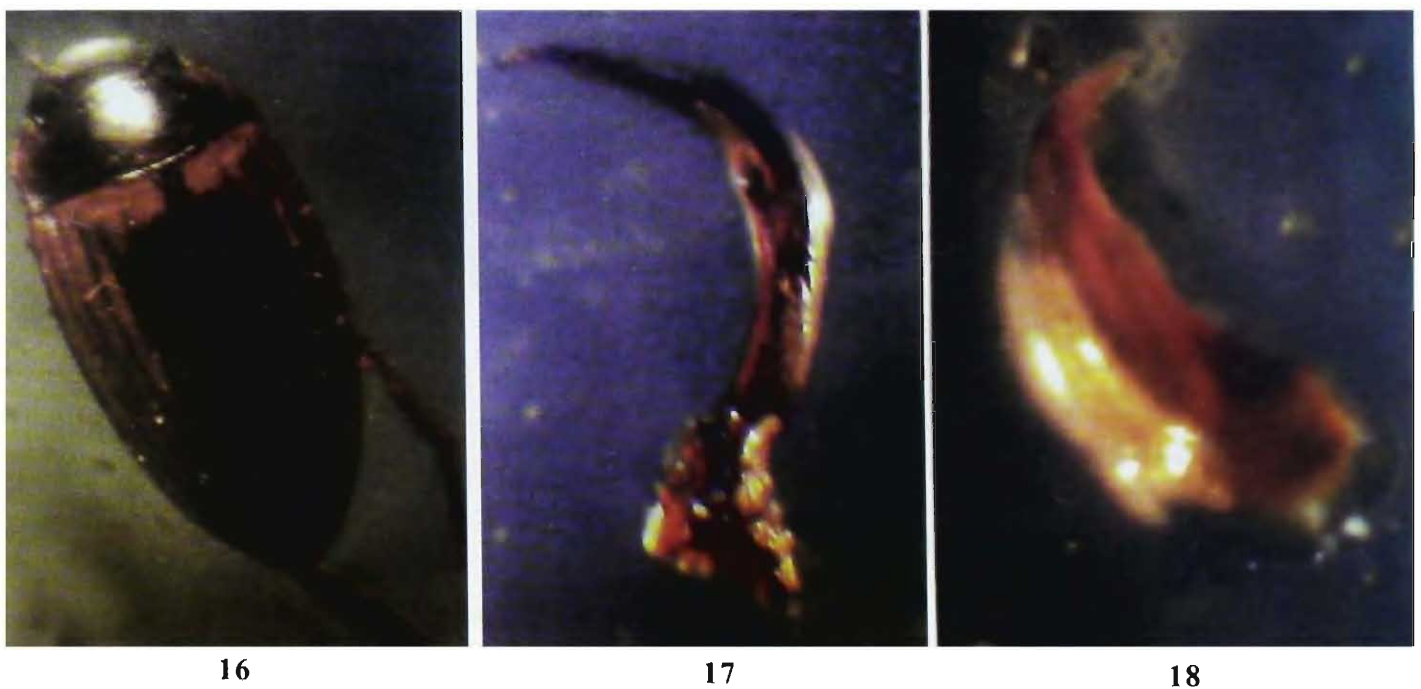
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Figs. 7-9. *Hydrovatus sringeriensis* sp. nov. Male : 7. Entire; 8. Median lobe (Penis) lateral aspect; 9. Lateral lobe (Parameres).



Figs. 10-12. *Copelatus wayanadensis* sp. nov. Male : 10. Entire; 11. Median lobe (Penis) lateral aspect; 12. Lateral lobe (Parameres).

Figs. 13-15. *Copelatus wayanadensis* sp. nov. 13. Posterior face of proleg; 14. mesoleg; 15. metaleg.



Figs. 16-18. *Copelatus wayanadensis* sp. nov. Male : 16. Entire; 17. Median lobe (Penis) lateral aspect; 18. Lateral lobe (Parameres).

Manivannan, Register No. I/CL/10, dated, 24.5.2006, ZSI, Chennai.

Etymology : The species name *wayanadensis* is derived from the name of collection place.

DISCUSSION

Hydrovatini Sharp 1882 is suggested as a group of Hydroporides with type genus *Hydrovatus* and it is allowed the new status by Zimmermann (1919). Later, Larson *et al.*, (2000) described the genus *Hydrovatus*. Vazirani (1970c) redescribed 14 species of *Hydrovatus*, *Queda* is not reported so far in oriental region. Bistrom (1996) divided the genus into 15 species groups based on character analysis of 202 species. *Hydrovatus sringeriensis* is close to *H. cardoni* in having distinct elytral marking with reticulation not well impressed but it is distinguished by the three elytral markings not approaching the suture and punctures large moderately dense on the metacoxal plates. But it is also close to *H. platycornis* in having 3-10 antennal segments distinctly enlarged. It differs in distinct colour pattern on elytra and punctures large rather moderately dense and irregular. Pronotal moderately dense uniformly, without narrow impuncture area discally and also the median lobe of male genitalia moderately curved quite narrow, very much narrowed in the apical 1/3rd and pointed forward.

Copelatini is represented by a single genus *Copelatus* India. (Vazirani, 1970b). *Copelatus* in India it has 15 representative spp. spread over three groups namely *Haemorroidalis*, *Irinus* and *Duodecimstriatus*. *C. wayanadensis* belongs to *Irinus* group. The presence of elytra with six striae and submarginal striae is the key character of *Irinus* group. *C. wayanadensis*

differs from *C. crytarchoides* by the character of posterior row of punctures lack on pronotum and the median lobe of male genitalia broadened at base, narrowed and 1/3rd of the apex curved and acuminate towards the rounded apex. Vazirani (1970b) deals with 52 species belonging to 9 genera of Colymbetinae from India, except the genus *Copelatus*, no other genus is so far reported from Southern India. Various field collections in a number of localities of Western Ghats were under taken and it is found that *Copelatus* occurs in Wayanad region of Kerala, India besides *Rhantus* which also occurs in Western Ghats collections. It seems that colymbetine and copelatine beetles prefer higher altitude rather than plains. Further field studies are expected to throw more light on this aspect.

SUMMARY

Two new species *Hydrovatus sringeriensis* and *Copelatus wayanadensis* is described from Western ghats of South India. *H. sringeriensis* differs from other species of *pustulatus* group in the structure of median lobe (Penis), 3 elytral markings, and 3-10 antennal segments enlarged. *C. wayanadensis* belongs to *Irinus* group which differs from *C. crytarchoides* in the structure of median lobe broadened at base, narrowed and 1/3rd of the apex curved and acuminate towards the apex. Suitable diagrams are provided for identification.

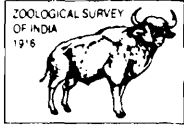
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POPULATION FLUCTUATION OF SOIL ARTHROPODS IN RELATION TO EDAPHIC FACTORS IN CULTIVATED AND NON-CULTIVATED PLOTS AT KHARDAH, NORTH 24-PARGANAS, WEST BENGAL - A PRELIMINARY STUDY

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INTRODUCTION

Soil is a decomposition product, the solid phase of which has two main constituents, one is the mineral material and the other is the organic material. The vegetation growing in the soil provides the organic material that remains closely associated with the mineral part of the soil. The soil microarthropods which are dominant and most important biotic component of soil ecosystem, play a major role in decomposition of the organic matter (Wallwork, 1970). Considering the great role played by various groups of arthropods, many researchers in India had taken up the studies on soil arthropods in different vegetation sites and agricultural fields. A good number of workers also conducted studies to understand the relationship between soil microarthropods and different edaphic factors.

The earliest work on soil fauna was done by Diem (1903). Cameron (1913) first carried out the survey of soil insects. Later in 1917 he first pointed out the environmental condition may cause differences in the faunal make-up in two types of grasslands. Buckle (1921) said that growth of vegetation affects the growth of fauna. Thomson (1924) while working on a piece of grassland observed that collembola and acarina were the dominant groups among other soil fauna with maximum population in winter months. Frenzell (1936) found that the soil moisture had a direct role on the fluctuation of the faunal population. He recorded maximum population of soil organisms in early winter and early spring while the minimum in mid winter and mid summer.

Hammer (1944, 1953) observed soil faunal population was negatively correlated with the soil moisture. Macfadyen (1952) found the population to be maximum

in winter and that too in the upper layer of the soil. Davis and Murphy (1961) observed that soil factors like pH, organic carbon and moisture could exert a triggering effect on soil animals. Edwards and Lofty (1969) observed that more drastic population fluctuation of soil microarthropods could be expected from effects of cultivation and addition of organic manure. Edwards and Lofty (1974) while studying the impact of organic manure and the other factors on the invertebrate fauna of grassland, observed that the total collembolan population was little affected by the level of nitrogen. In their opinion Collembola as a whole was influenced by soil pH than mites.

Notable researches have been done by several workers in West Bengal. Choudhuri and Banerjee (1975, 1977) reported a strong positive correlation between the collembolan population and moisture content of soil. According to Singh and Pillai (1975) the Oribatid mites were predominant in the soil with a higher content of organic matter while Prostigmatid mites were dominant in the soil deficient in organic matter. The study of soil mesofauna in a grassland ecosystem by Pillai and Singh (1977) revealed the occurrence of two population peaks of mesofauna, one in the rainy season and the other in the winter season. According to them the contents of moisture and organic matter in the soil played significant role on the population fluctuation of microarthropods. Bhattacharya and Joy (1978), Bhattacharya and Roychowdhury (1979), Bhattacharya *et al.* (1980), Ghatak and Roy (1981), Sanyal (1981, 1982, 1994), Hazra and Sanyal (1989), Sengupta and Sanyal (1991), Sanyal and Sarkar (1993), Sanyal *et al.* (1999), Roy *et al.* (2004) reported their observations on soil arthropod population in uncultivated and cultivated lands in West Bengal.

In the present study an attempt has been made to investigate soil microarthropod population and seasonal fluctuations and their relationship with soil moisture, temperature and pH in two sites, one uncultivated and another cultivated having different crops in different seasons.

SITE DESCRIPTION

Two sites, one cultivated and the other non-cultivated were selected in this study. Both the sites were located at Khardah, North 24-Parganas, West Bengal (Map – 1). The Barrackpore Trunk road runs about ¼ km away from the site on eastern side and the river Ganges runs very near on the western side. Soils of both the sites were gangetic alluvial in nature, blackish grey in colour and clay-loam in texture.

I. Non-cultivated site (P1)

The sampling site was non-cultivated and undisturbed. A dumping ground of household wastes was present a little away from the site. It included two sampling plots each 10 meters square in size.

The site was covered with grasses such as *Cynodon dactylon* and *Brachiaria* sp. Some seasonal herbs like *Lantana* sp., *Urinea* sp., *Clerodendron* sp., *Amaranthas* sp., *Solanum* sp., *Ipomoea* sp. and *Croton* sp. were also found at this site. The plot also contained fallen leaves and twigs of trees. Soil was rich in humus content. Shade was found to prevail there in some parts of the day (Fig. 1 & 2).

II. Cultivated site (P2)

The site situated near the first one was separated by a brick wall. During the study, the site contained cultivated plants like coriander, mustard (*Brassica* sp.), potato, tomato, etc. Besides these vegetations some garden flower plants like ganda, dhalia, astar, cosmos, etc. were also present in the field. The site was manured by cow-dung only. Insecticides were not used on the vegetation. Plots were watered frequently particularly in winter and summer months. The site was covered with grasses and some wild plants; cut grasses and bamboo logs were also found dumped here and there in the site. The site was divided into two sampling plots each 10 meters square in size (Fig. 3).

MATERIALS AND METHODS

A. Collection of Soil sample :

A total number of 120 soil samples were drawn from 4 plots in 2 sampling sites at monthly interval over a period of six months that is from November 2007 to April 2007 @ 5 samples/month/plot. The undisturbed

soil samples were drawn at random using stainless steel cores with an internal diameter of 5cm. Each soil core was 25 square cm in surface area and 10 cm in depth.

B. Extraction of soil arthropods :

The extraction of soil samples was done by Tullgren funnel apparatus as modified by Macfadyen (1953). The soil samples were kept under extraction for 72 hours. The extracted soil arthropods were then sorted out into different groups under stereoscopic binocular microscope and counted. The adult and comparatively large sized arthropods were collected by hand picking method. All the collected specimens were preserved in separate glass vials containing 70% alcohol for further study.

C. Recording and analysis of soil factors :

Soil thermometer was used to record the temperature of the soil. pH of the soil was determined by the electronic pH meter. Moisture of the soil sample was measured by the "Oven dry method" (Dowdeswell, 1959) and expressed in percentage of weight difference before and after the soil samples were dried for 4 hours at 105° C.

RESULTS

I. Analysis of Edaphic factors : a) pH

Site P1 (Non-cultivated site)

Soil pH (Table-1) ranged from 5.3 to 6.9. It was maximum in the month of January (6.9) and gradually reduced in the months of March (5.5) and April (5.3).

Site P2 (Cultivated site)

Soil pH (Table-2) ranged from 5.2 to 6.2. There were records of 6.1 to 6.2 in the months of January and February but decreased to 5.7 and 5.2 in March and April respectively.

The pH was observed slightly low in the cultivated site.

b) Moisture

Site P1 (Non-cultivated site)

Soil moisture content (Table-1) ranged from 29.70% to 21.50%. The value was maximum in February 29.70%, nearly 26.70% to 27.80% in the months of January and November. The value gradually reduced in the months of March (23.40%) and April (21.50%).

Site P2 (Cultivated site)

Soil moisture content (Table-2) ranged from 29.40% to 24.4%. Maximum amount of moisture content was recorded in the month of February and almost similar concentrations were recorded in November (27.70%),

Table-1 : Showing mean no. of individuals group of arthropod/month and their percentage/month at sampling site P1 (undisturbed and non-cultivated plots) from November 2007-April 2008

Sl. No.	Arthropods and soil factors	November	December	January	February	March	April
		Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)
1.	Acarina	34 (12.27)	42 (15.16)	66 (23.82)	72 (25.99)	35 (12.63)	28 (10.10)
2.	Collembola	57 (11.72)	101 (20.78)	112 (23.04)	121 (24.89)	53 (10.90)	42 (8.64)
3.	Hymenoptera	12 (9.67)	15 (12.09)	26 (20.96)	30 (24.79)	21 (16.93)	20 (16.12)
4.	Coleoptera	15 (12.93)	16 (13.79)	22 (18.96)	31 (26.72)	18 (16.51)	14 (12.06)
5.	Diptera	2 (2.2)	3 (3.3)	4 (4.4)	22 (24.44)	27 (30)	32 (35.55)
6.	Insect larvae	20 (13.42)	26 (17.44)	37 (24.83)	42 (28.18)	11 (7.38)	13 (8.72)
7.	Others	7 (3.19)	11 (26.82)	9 (21.95)	7 (17.07)	5 (12.19)	2 (4.87)
8.	pH	6.3	6.2	6.9	6.8	5.5	5.3
9.	Moisture (%)	27.80	24.30	26.70	29.70	23.50	21.50
10.	Temperature (°C)	28.00	22.30	21.50	24.60	33.50	34.00

January (27.20%) and March (27.30%) with minimum in the month of April i.e. 25.00%.

The percentage of soil moisture content was recorded as slightly high in cultivated site (P2).

c) Temperature

Site P1 (Non-cultivated site)

Soil temperature (Table-1) ranged from 21.5°C to 34.0°C. Maximum temperature was recorded in the months of March and April and minimum in January (21.5°C).

Site P2 (Cultivated site)

Soil temperature (Table-2) ranged from 22°C (January) to 33.7°C. The months of March (32.5°C) and April (33.0°C) showed nearly same temperature.

The result indicated more or less similar range of temperature in the two sites.

II. Faunal make-up :

A total number of 1283 arthropods belonging to 9 different groups namely Acarina, Collembola,

Hymenoptera, Coleoptera, Diptera, Psocoptera, Hemiptera, Diplura and Isoptera were collected. As the number of specimen of Psocoptera, Hemiptera, Diplura and Isoptera was low, these 4 groups were jointly considered here as 'others'. The quantitative difference in arthropod population showed that site P1 was rich (1283) in fauna than P2 (796) (Tables 1, 2). Collembola was recorded as most dominant group (P1= 486 and P2 = 374) in both the sites. They contained 37.87% and 46.98% of the total arthropod population recorded from sites P1 and P2 respectively. The other faunal groups like Acarina (21.59%), Hymenoptera (9.66%), Coleoptera (9.04%) and Diptera (7.01%) were found to occupy second, third, fourth and fifth position repetitively in P1 site. In P2 site Hymenoptera (26.13%), Acarina (12.06%), Coleoptera (5.65%) and Diptera (2.51%) were found to occupy second, third, fourth and fifth position repetitively. The ants were the main components of Hymenopteran insects recovered in the P1 and P2 sites. Different insect larvae collected in P1 and P2 sites were 11.61% and 3.76% respectively.

Table-2 : Showing mean no. of individuals group of arthropod/month and their percentage/month at sampling site P2 (disturbed and cultivated plots) from November 2007-April 2008

Sl. No.	Arthropods and soil factors	November	December	January	February	March	April
		Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)	Arthropod/month Mean no. (%)
1.	Acarina	19 (19.79)	16 (16.66)	27 (28.12)	22 (22.9)	9 (9.3)	3 (3.12)
2.	Collembola	55 (14.70)	67 (17.91)	92 (24.59)	96 (25.66)	33 (8.82)	31 (8.28)
3.	Hymenoptera	21 (10.09)	26 (12.50)	37 (17.78)	49 (23.55)	33 (15.86)	42 (20.14)
4.	Coleoptera	5 (11.11)	4 (8.88)	11 (24.44)	12 (26.66)	7 (15.55)	6 (13.33)
5.	Diptera	4 (20)	2 (10)	1 (5)	3 (15)	4 (20)	6 (30)
6.	Insect larvae	5 (16.66)	4 (13.33)	9 (30)	5 (16.66)	3 (10)	4 (13.33)
7.	Others	2 (8.69)	4 (17.39)	6 (26.08)	6 (26.08)	2 (8.69)	3 (13.04)
8.	pH	6.1	5.9	6.1	6.2	5.7	5.2
9.	Moisture (%)	27.7	24.4	27.2	29.4	27.3	25
10.	Temperature (°C)	27.50	24	22	24.20	32.50	33.70

Table 3 : Showing individuals group of arthropods and their monthly population (%) at sampling site P1 (non-cultivated and undisturbed) and P2 (disturbed and cultivated) at Khardah from November 2007-April 2008

	Group of Arthropods													
	Acarina		Collembola		Hymenoptera		Coleoptera		Diptera		Insect larvae		Others	
Months	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
November	23.12	17.11	38.77	49.54	8.16	18.91	10.20	4.50	1.36	3.60	13.60	4.50	4.76	1.80
December	19.62	13	47.19	54.47	7	21.13	7.47	3.25	1.40	1.62	12.14	3.25	5.14	3.25
January	23.91	14.75	40.57	50.27	9.42	20.21	7.97	6.01	1.44	0.54	13.40	4.91	3.26	3.27
February	22.15	11.39	37.23	49.74	9.23	25.38	9.58	6.21	6.76	1.55	12.92	2.59	2.15	3.10
March	20.58	9.80	31.17	36.26	12.35	36.26	10.58	7.69	15.88	4.39	6.47	3.29	2.94	2.19
April	18.54	3.15	27.81	32.63	13.24	44.24	9.27	6.31	21.19	6.31	8.60	4.21	4.32	3.15

III. Population fluctuation :

In comparing the faunal composition in two sites, it was found that percentage (46.98 %) of collembolan population in P2 site was higher compared to (37.87 %)

P1 site. Similarly Hymenopteran population was more in percentage in P2 site (26.13 %) than P1 site (9.66 %). In all other groups like Acarina, Diptera, Coleoptera and Insect larvae the percentage of population



Figs. 1. Non Cultivated Site.



Figs. 2. Non Cultivated Site.



Fig. 3. Cultivated Site.

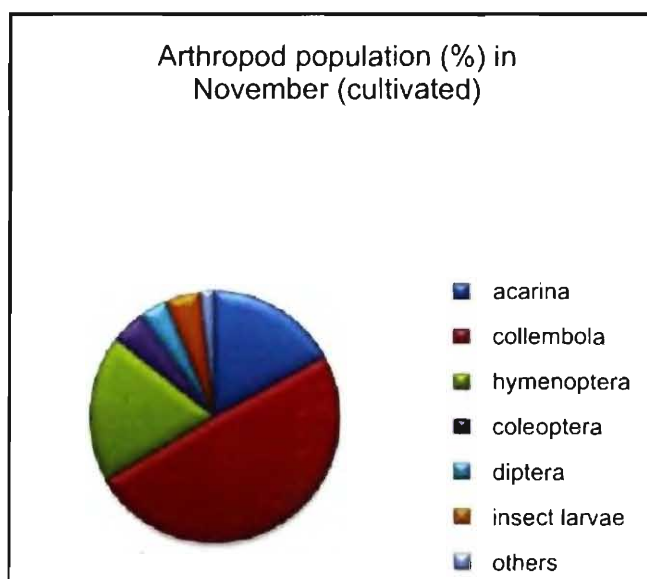
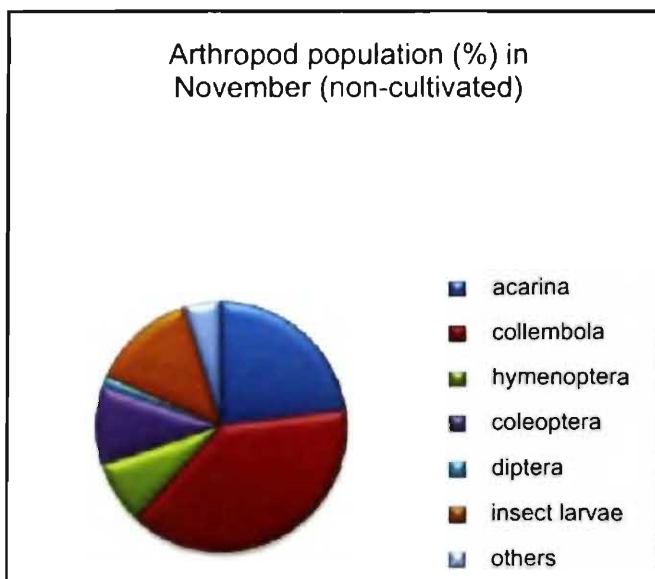


Fig. 4 Pie chart depicting Arthropod population (%) in November in Cultivated and Non-Cultivated plots.

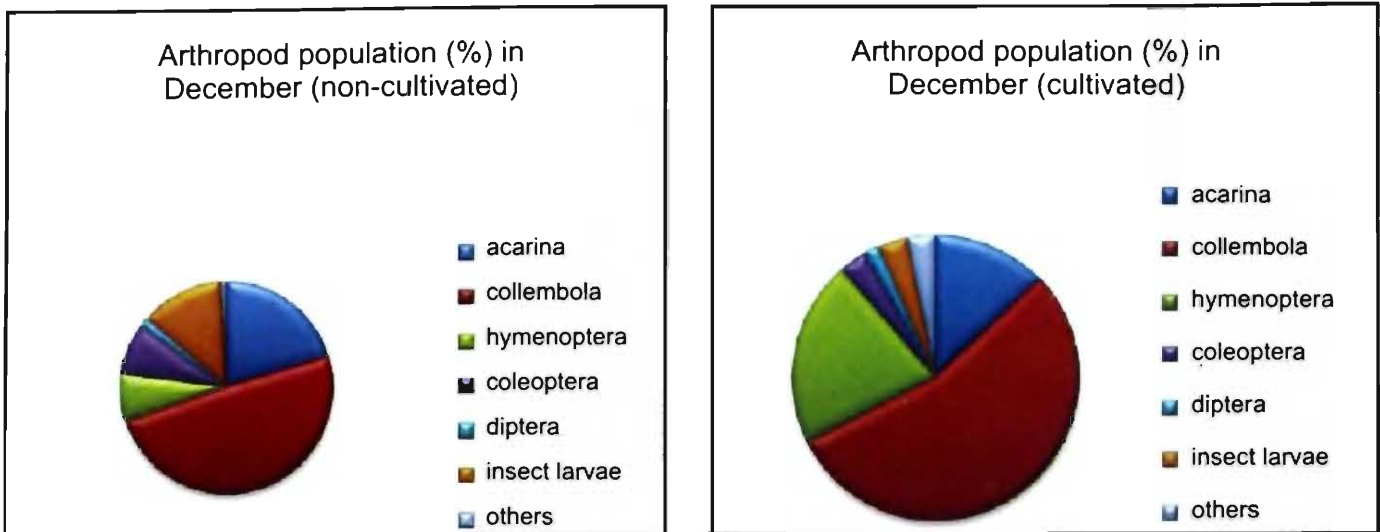


Fig. 5 Pie chart showing Arthropod population (&) in December in Cultivated and Non-Cultivated plots.

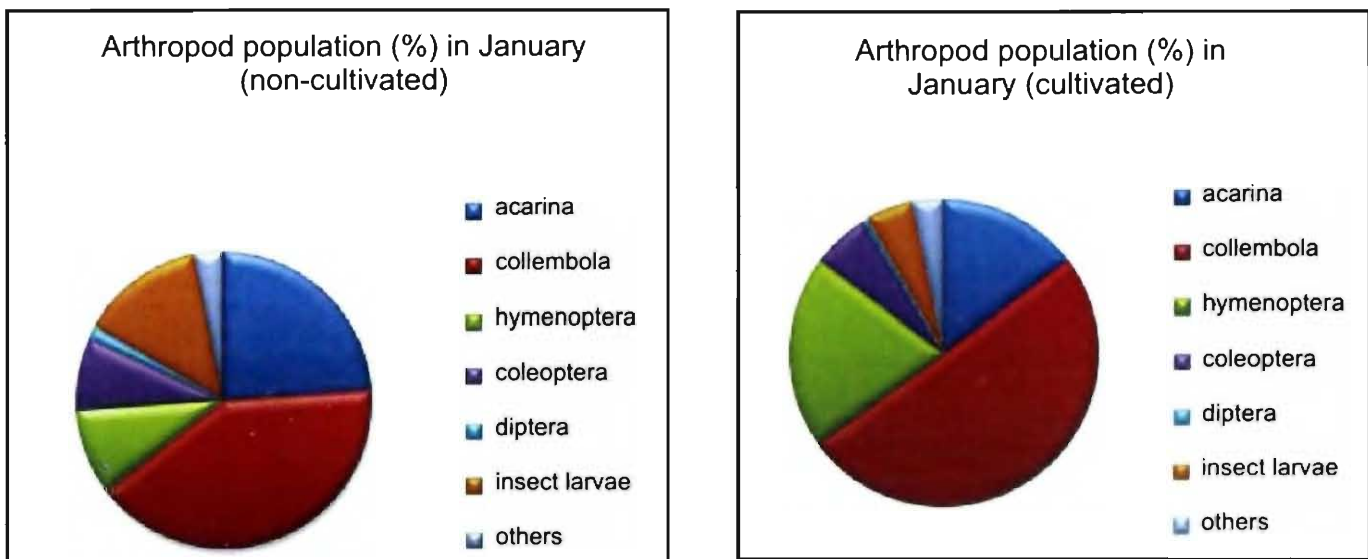


Fig. 6 Pic chart showing Arthropod population (&) in January between Cultivated and Non-Cultivated plots

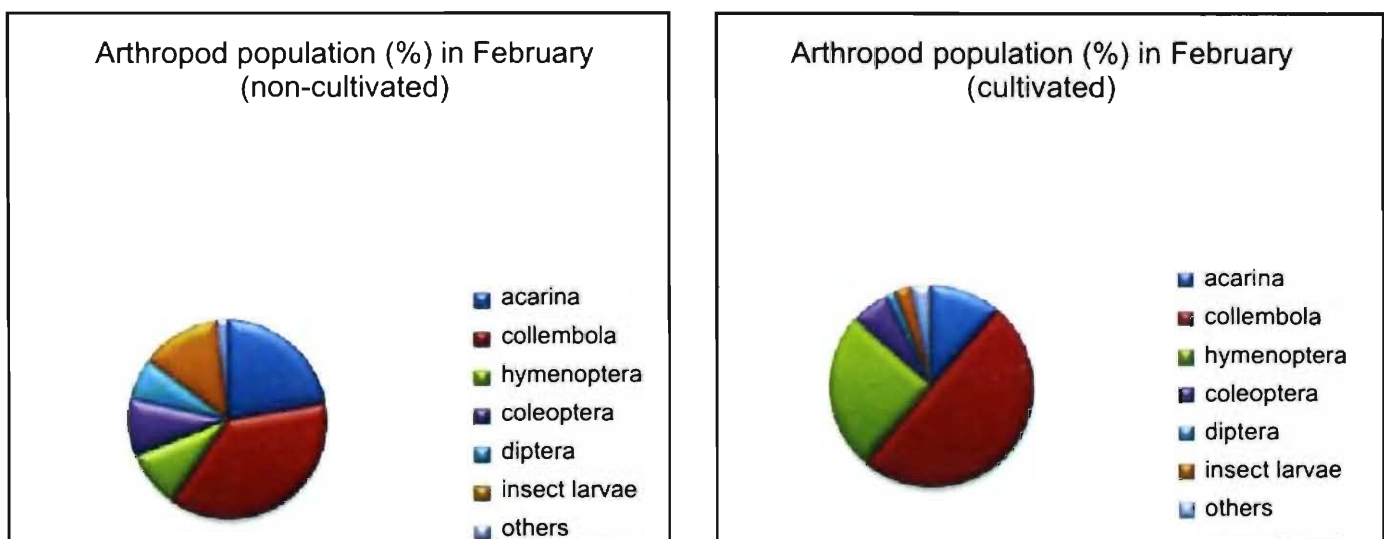


Fig. 7 Pie chart showing Arthropod population (%) in February between Cultivated and Non-Cultivated plots.

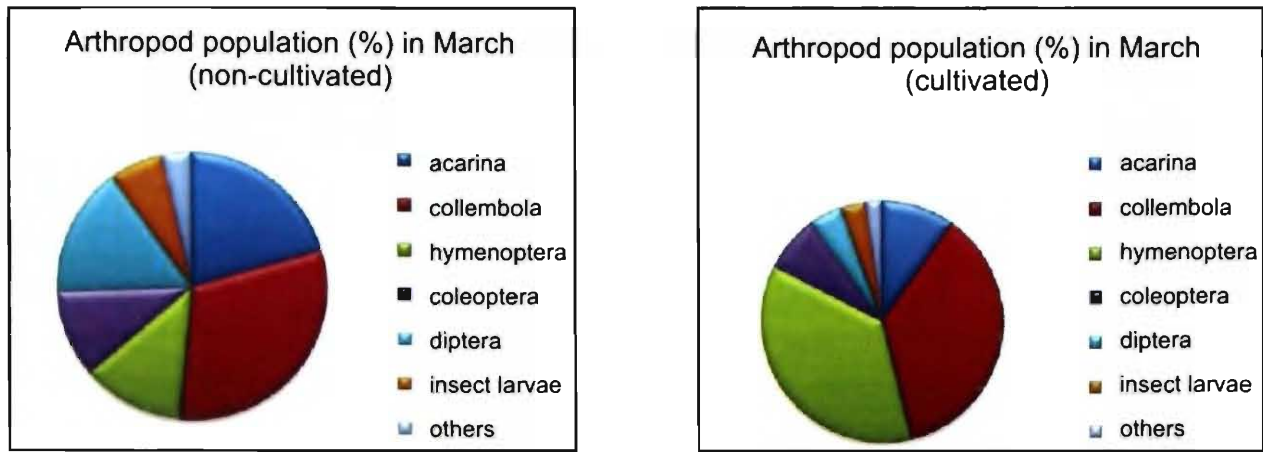


Fig. 8 Pie chart showing Arthropod population (%) in March in Cultivated and Non-Cultivated plots.

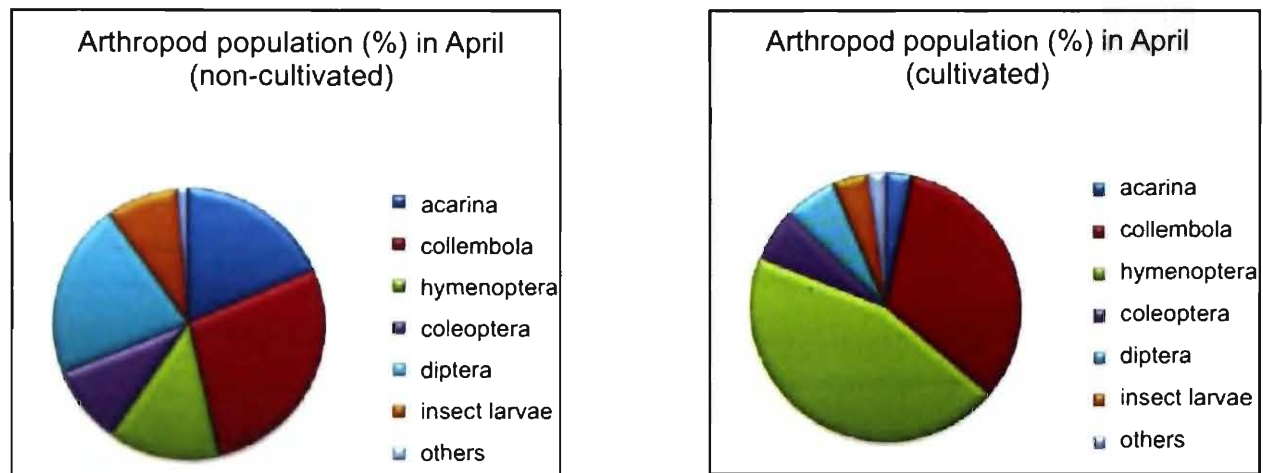


Fig. 9 Pie chart showing Arthropod population (%) in April in Cultivated and Non-Cultivated plots.

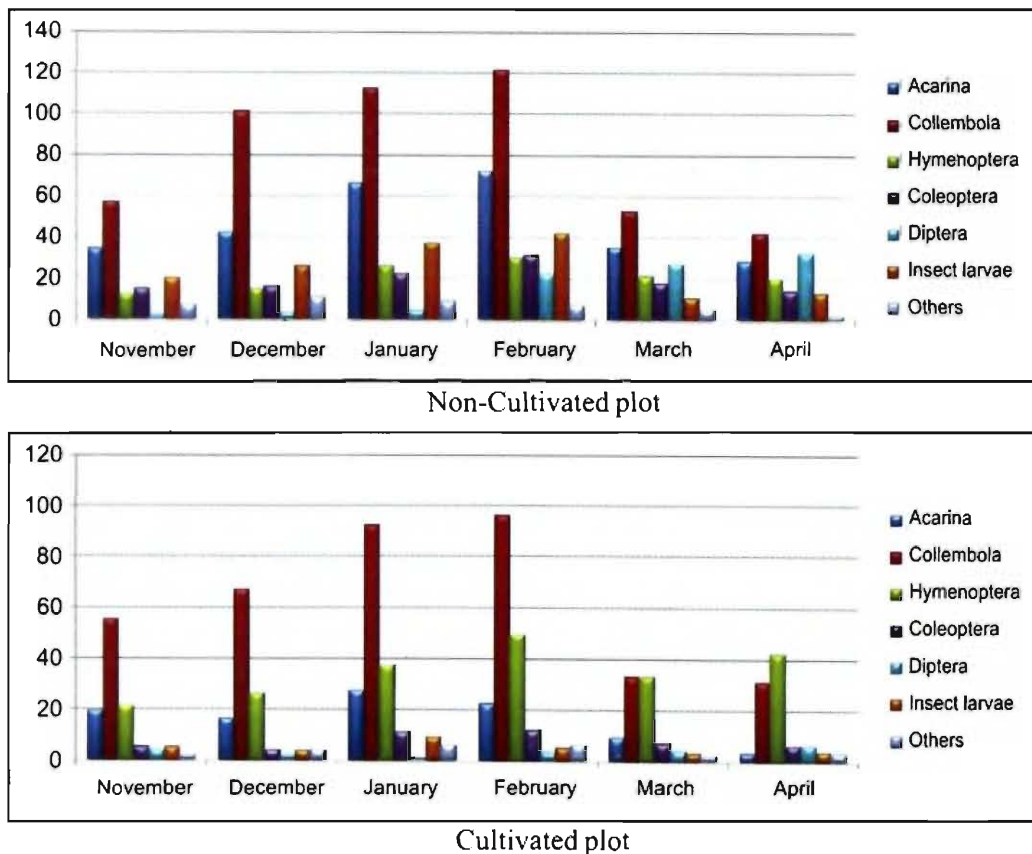
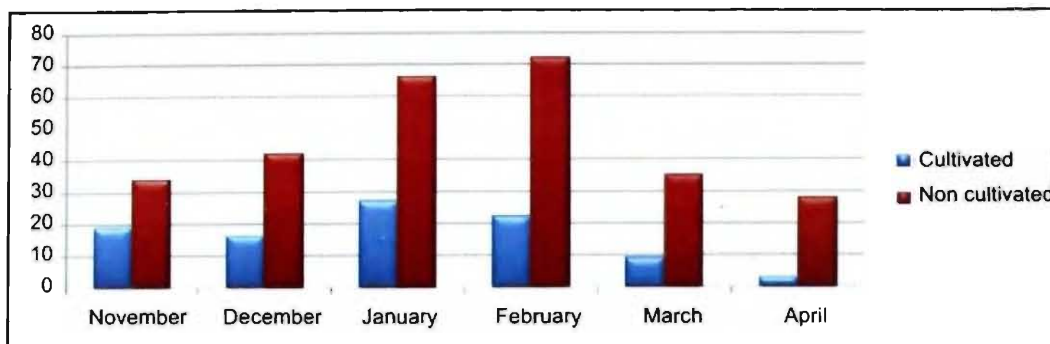
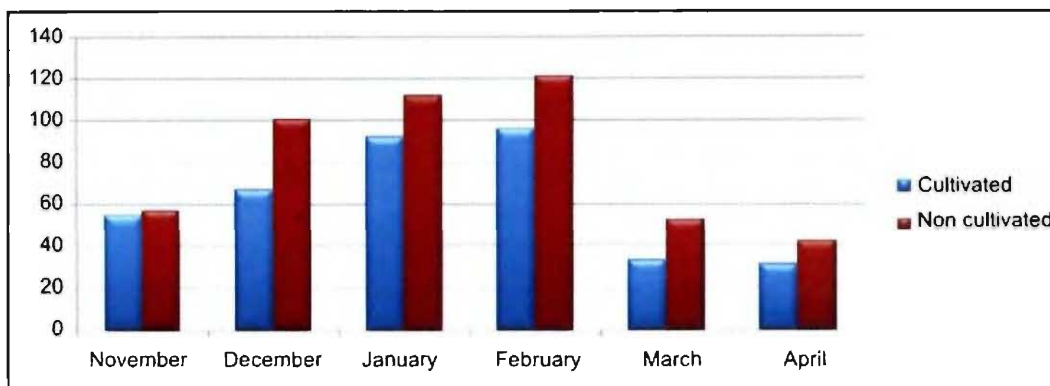


Fig. 10 Comparative study of arthropods in Cultivated (P2) and Non-Cultivated (P1) plots from November to April

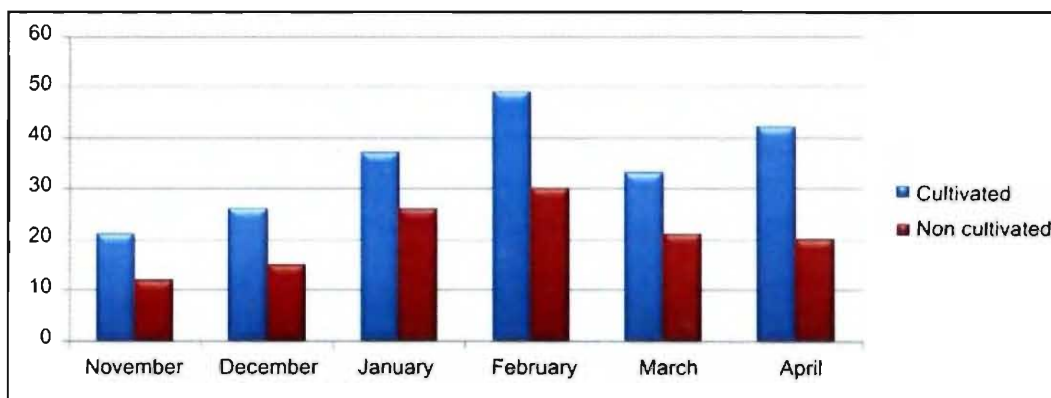


Comparative study of Acarian

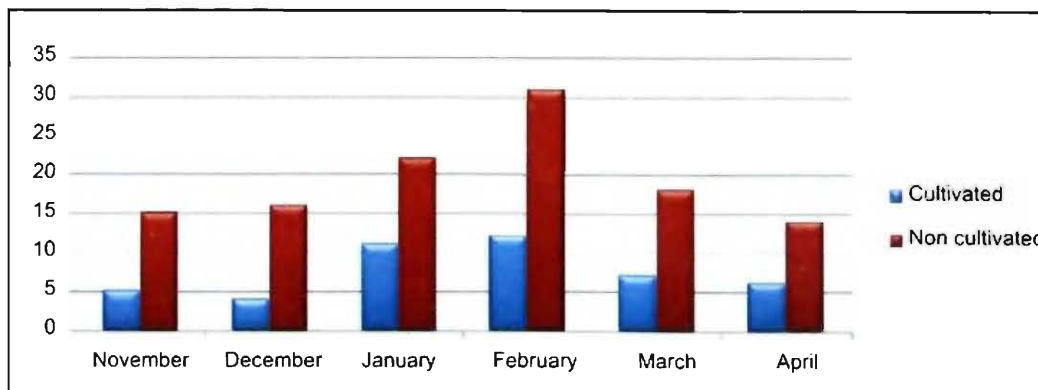


Comparative study of Collembola

Fig. 11 Comparative study of Acarian and Collembola between Cultivated (P2) and Non-Cultivated (P1) plots from November to April

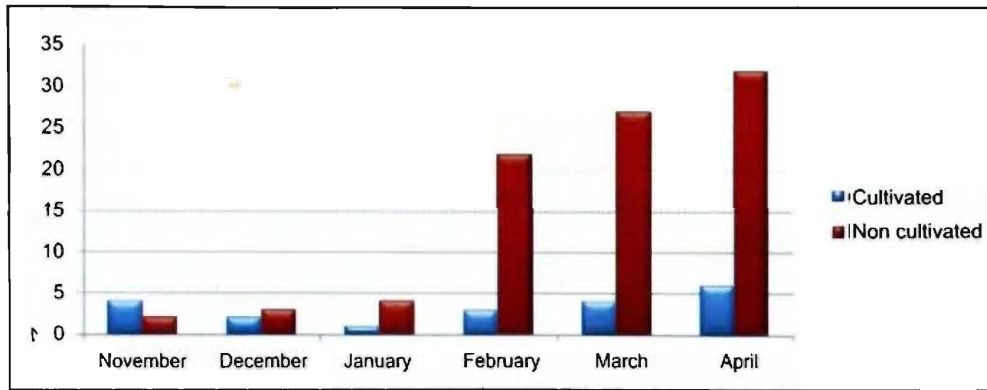


Comparative study of Hymenoptera

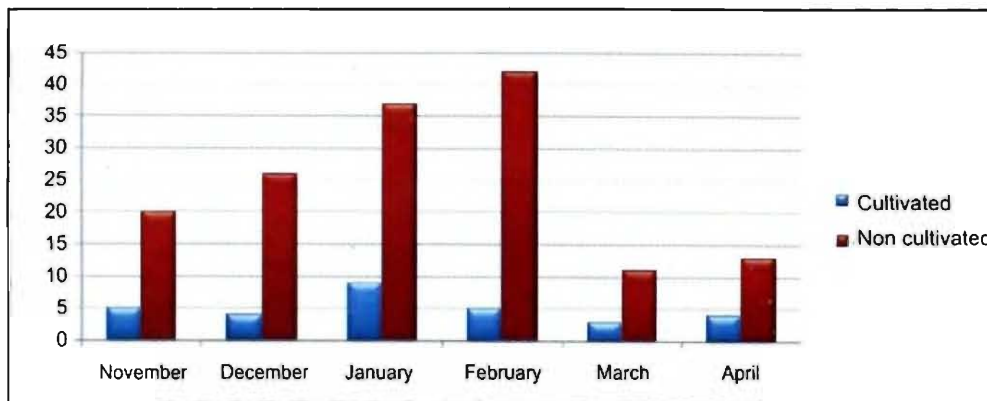


Comparative study of Coleoptera

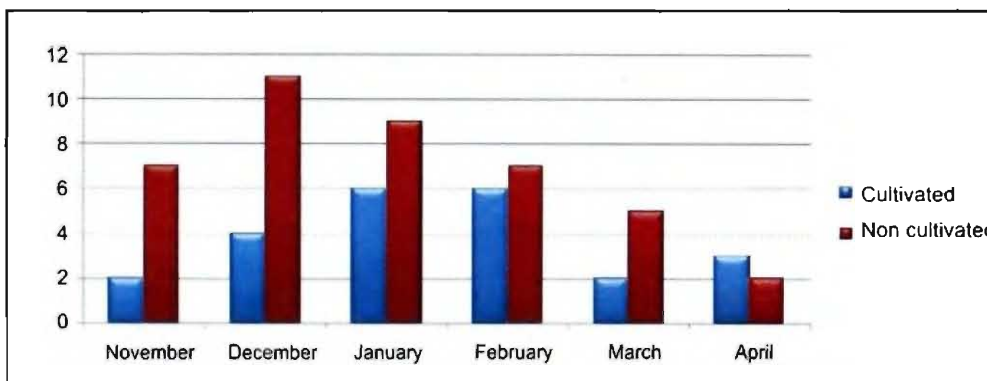
Fig. 12 Comparative study of Hymenoptera and Coleoptera between Cultivated (P2) and Non-Cultivated (P1) plots from November to April



Comparative study of Diptera



Comparative study of Insect Larvae



Comparative study of Anthropods

Fig. 13 Comparative study of Diptera, Insect Larvae and others between Cultivated (P2) and Non-Cultivated (P1) plots from November to April

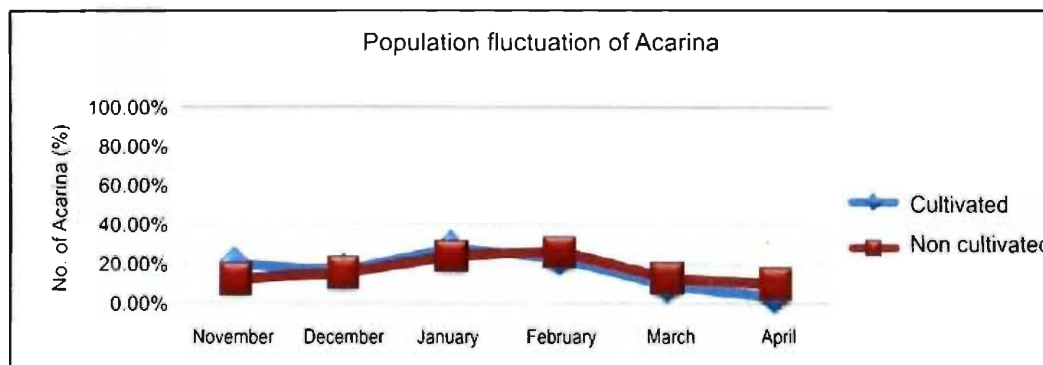


Fig. 14 Population function of Acarina.

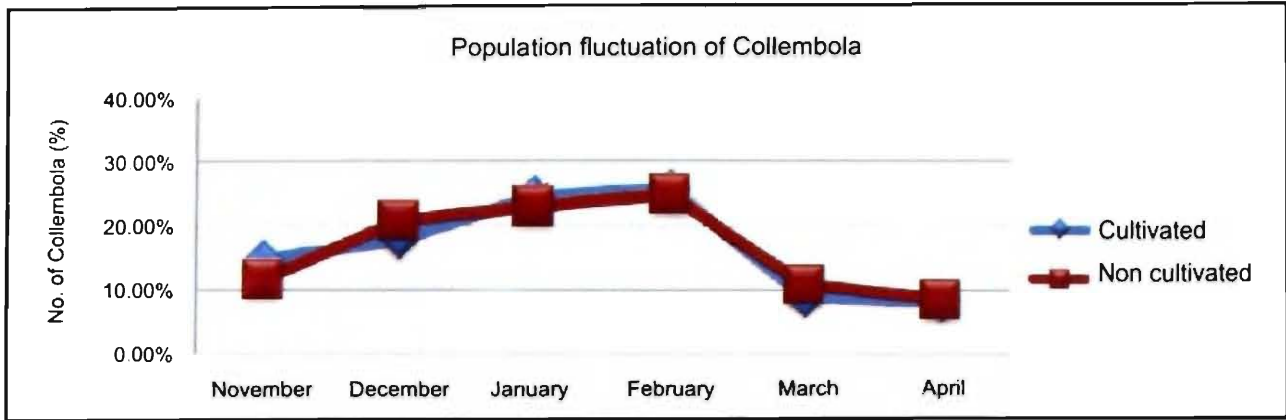


Fig. 15 Population function of Collembola.

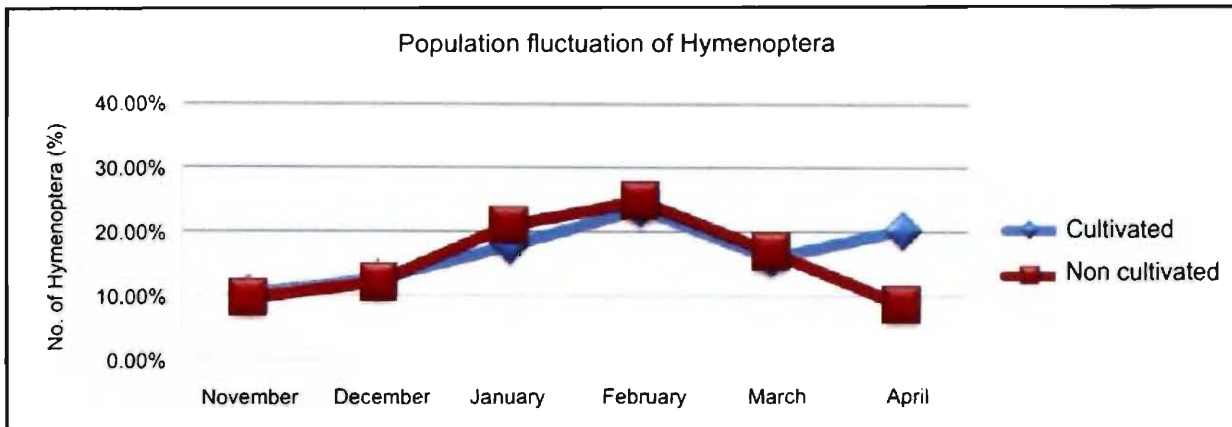


Fig. 16 Population function of Hymenoptera.

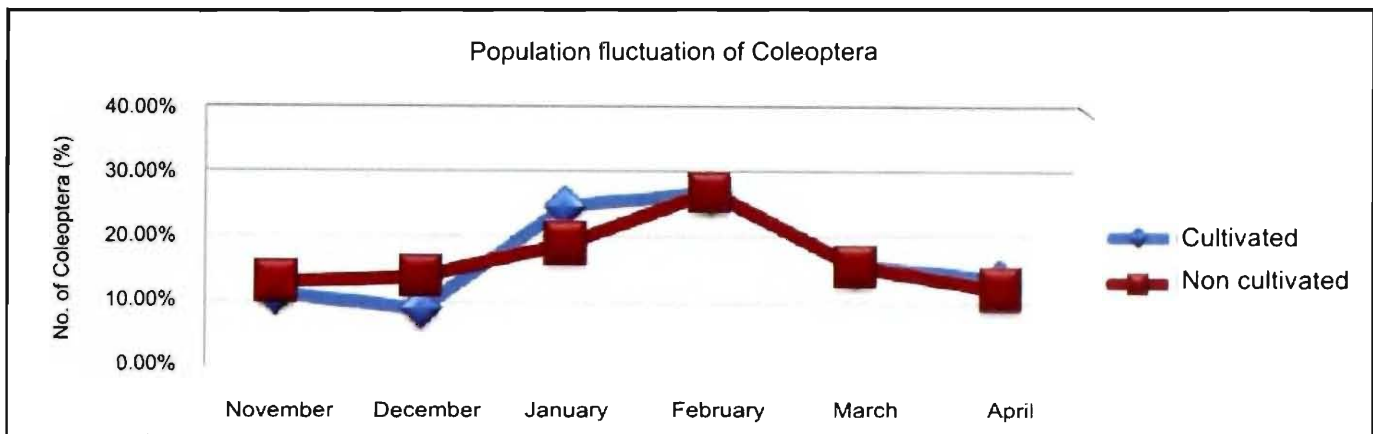


Fig. 17 Population function of Coleoptera.

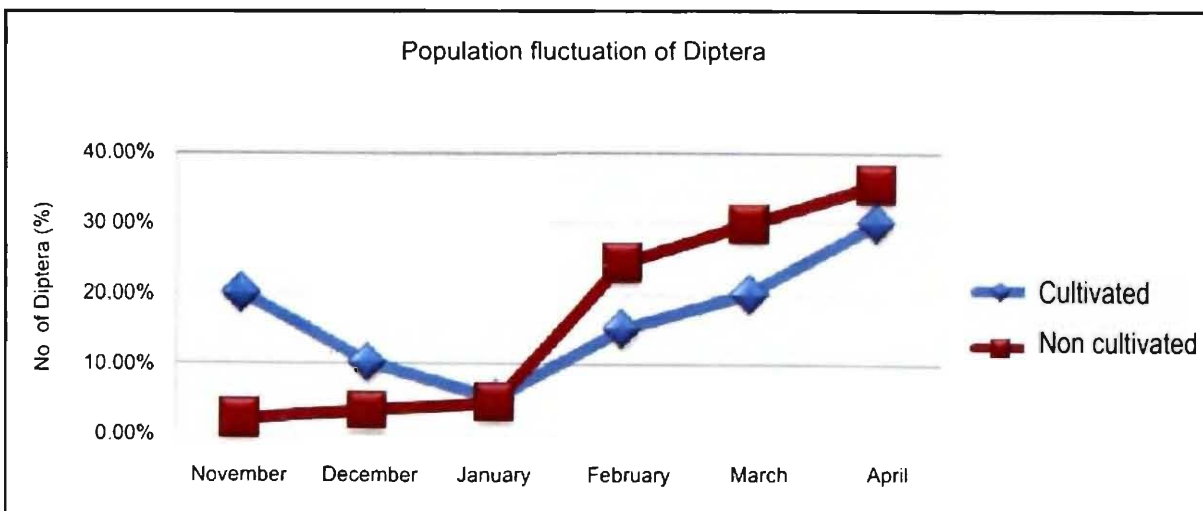


Fig. 18 Population function of Diptera.

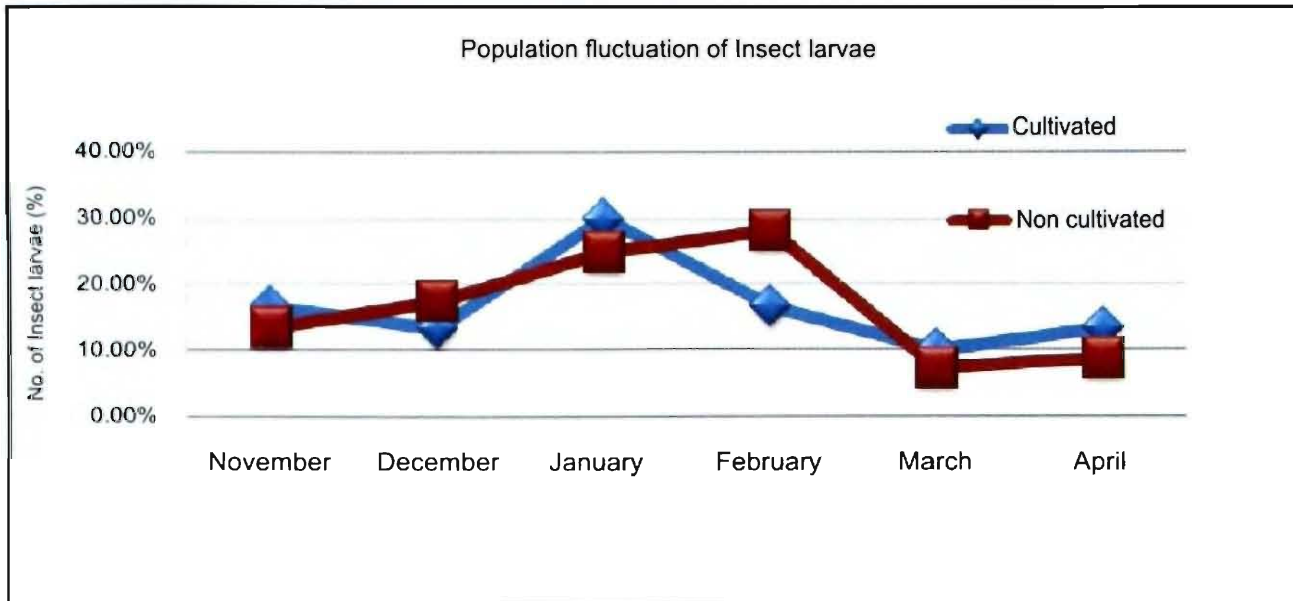


Fig. 19 Population function of Insect Larvae.

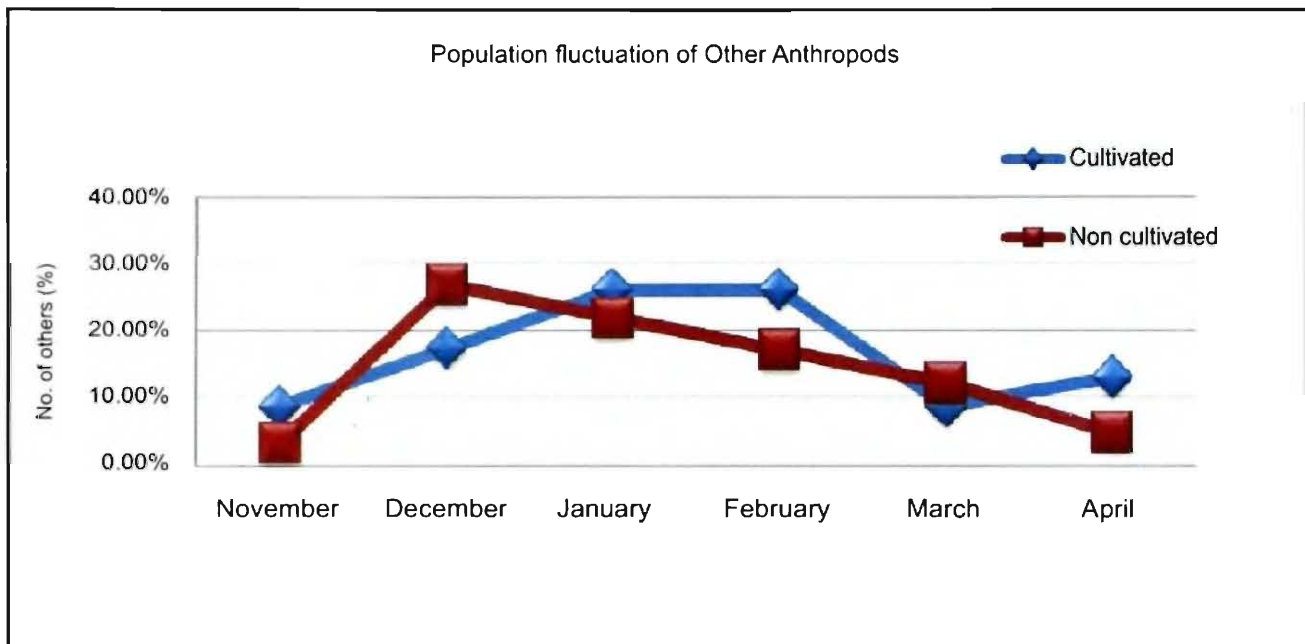


Fig. 20 Population function of Anthropods.

Table 4 : List of Species of different Arthropods collected from soil samples of P1 and P2 plots at Khardah, North 24 Parganas from November 2007 to April 2008

Sl. No.	Name of species	Order	Family
ACARINA			
1.	1. <i>Scheloribates albialatus</i>	Cryptostigmata	Oribatulidae
2.	2. <i>Oppia yodae</i>	Cryptostigmata	Oribatulidae
3.	3. <i>Tectocephus vitatus</i>	Cryptostigmata	Oribatulidae
4.	4. <i>Trichonropoda asaki</i>	Mesostigmata	Uropodidae
5.	5. <i>Pachylaelaps dorsalis</i>	Mesostigmata	Pachylaelapidae
COLLEMBOLA			
6.	1. <i>Entomobrya</i> sp.	Collembola	Entomobryidae
7.	2. <i>Lepidocyrtus</i> sp.	Collembola	Entomobryidae
8.	3. <i>Isotomurus</i> sp.	Collembola	Isotomidae
9.	4. <i>Cryptopygus</i> sp.	Collembola	Isotomidae
HYMENOPTERA			
10.	1. <i>Solenopsis geminate</i>	Hymenoptera	Formicidae
11.	2. <i>Oligomyrmex</i> sp.	Hymenoptera	Formicidae
12.	3. <i>Pheiddogeton</i> sp.	Hymenoptera	Formicidae
13.	4. <i>Monomorium</i> sp.	Hymenoptera	Formicidae
14.	5. <i>Cerapachys</i> sp.	Hymenoptera	Formicidae
15.	6. <i>Pachycondyla</i> sp.	Hymenoptera	Formicidae
16.	7. Sp. X1	Hymenoptera	Eulophidae
17.	8. Sp. X2	Hymenoptera	Eulophidae
COLEOPTERA			
18.	1. <i>Cryptophilus</i> sp.	Coleoptera	Langureidae
19.	2. <i>Silvanoprus scuticollis</i>	Coleoptera	Silvanidae
20.	3. <i>Stilicus pygmacus</i>	Coleoptera	Staphylinidae
21.	4. <i>Leptocimus gracilis</i>	Coleoptera	Staphylinidae
22.	5. <i>Lathobuim</i> sp.	Coleoptera	Staphylinidae
23.	6. <i>Leptocimus</i> sp.	Coleoptera	Staphylinidae
24.	7. <i>Lobochilus fortepunctatus</i>	Coleoptera	Staphylinidae
25.	8. <i>Platylomalus oceanitis</i>	Coleoptera	Histeridae
26.	9. Sp. 1	Coleoptera	Tenebrionidae
27.	10. Sp. 2	Coleoptera	Carabidae
28.	11. Sp. 3	Coleoptera	Dermestidae
DIPTERA			
29.	1. <i>Lestremia</i> sp.	Diptera	Ceidomyidae
30.	2. <i>Sciara</i> sp.	Diptera	Sciaridae

decreased in P2 plots compared to P1 plots. In month wise observations on populations of different groups of arthropod, it was found that Acarina, Collembola, Hymenoptera, Coleoptera and Insect larvae were maximum in number in the month of February and slightly less in January and minimum in April (Table-3, Figs. 4-9).

There was a tendency of gradual increase in population of different groups of arthropods from

November to February and conversely there was gradual decrease from March to April in P1 site. On the contrary, dipteran population in P1 site was maximum in April and minimum in November. There was a tendency of gradual increase in population from November to April (Figs. 10-13).

In P2 plots, monthly observations showed that maximum number of mite specimens and insect larvae were recovered in January where as maximum number

of collembolan, hymenopteran and coleopteran insects were found to occur in February. Dipteran population was more or less constant in November, March and April but decreased in December and January. Maximum number of coleopterans was found in the month of January and February (Figs. 14-20).

DISCUSSION

The similarity in faunal composition in two sites may be attributed to the fact that two sites were located very close to each other and in the same eco-geographical area. The dissimilarity in population fluctuation in two sites may be due to difference in nature of vegetation, agricultural practices like tillage and intermittent organic manuring by cow dung in the cultivated site.

Choudhuri and Roy (1972) and Hazra and Choudhuri (1983) reported an indirect influence of vegetation on collembolan population with the resultant increase in moisture holding capacity of soil. They also recorded high population of *Collembola* in P1 site in February may be due to rich humus and high moisture content (Edwards and Loftly, 1969, Sanyal, 1993).

The total population of arthropods as obtained from two sampling sites P1 and P2 under the preview of the study when considered together showed numerical variation with change of three seasons like prewinter (November), winter (December and January) and premonsoon (February- April). In the present study the population of *Collembola* became maximum in January and February and minimum in April as was observed by Macfadyen (1952), Choudhuri and Roy (1972), Sanyal and Bhaduri (1982). The winter peak of population of Acarina, Coleoptera, Hymenoptera and *Collembola* might be due to population spurt in winter in non-cultivated (P1) plots. Such peaks were also observed in India by Choudhuri and Roy (1972), Pillai and Singh (1977), Sanyal (1981, 1988, 1991) and Sanyal and Sarkar (1993). The soil arthropod species collected from two sites showed maximum number of species in coleoptera followed by hymenoptera, acarina, collembola and diptera (Table-4).

The pattern of month-wise variation appeared to be different in different orders which perhaps indicated the existence of different breeding periods. In both P1

and P2 sites the dominant microarthropod groups like Acarina, Coleoptera, Hymenoptera and *Collembola* showed their maximum peak in February (Hazra and Choudhuri, 1990). Such observation of spring peak might be due to presence of high humus concentration in P1 plots and high organic manure like cow dung concentration in P2 plots and their decomposition due to increased soil moisture content and low soil temperature. Further, high Hymenopteran concentration in spring (February and March) and presummer month (April) in P2 plots was presumed to be due to their peak breeding period and their tolerance to high temperature (33.7°C) and low moisture content due to evaporation (Ghosh *et al.*, 1999).

Summer peak of dipterans in P1 plots was due to optimum temperature and moisture for their breeding in humus rich soil. Maximum number of maggots was available near the decomposition sites (Hazra and Choudhuri, 1981, Joy and Bhattacharya, 1981, Mitra *et al.*, 1983, Ghatak and Roy, 1991, Sanyal, 1996). Gradual decrease in population concentrations of acarines, collemboles and coleopterans in P1 plots in March and April was due to high rate of evaporation of soil moisture combined with low rainfall which led to a considerable reduction in number possibly through increased mortality of delicate and susceptible live forms. Information regarding population fluctuation and population concentration should always be recorded through over the years. So from the present preliminary study no definite conclusion on population fluctuation of soil microarthropods and their correlation with edaphic factors could be made. A clear picture could only be depicted after the work is completed.

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Rec. zool. Surv. India : 111(Part-2) : 23-28, 2011

ACRIDOIDEA (ORTHOPTERA : INSECTA) DIVERSITY OF SUR SAROVAR BIRD SANCTUARY, KEETHAM, AGRA (UTTAR PRADESH, INDIA)

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INTRODUCTION

Sur Sarovar Bird Sanctuary is named after the famous poet Surdas. Declared as Bird Sanctuary by the Uttar Pradesh government in 1991, the sanctuary is spread over 713 hectares. A lake having an area of 300 hectares is present in the middle of the sanctuary. The depth of the lake ranges between 5-8 meters. Sur Sarovar Bird Sanctuary is situated on the Agra-Mathura-Delhi National Highway (No. 2), at a distance of 20 kms. from the famous historical city, Agra. This bird sanctuary is situated on the bank of river Yamuna. The sanctuary is located between 77°-26'E to 78°-51'E longitudes and 26°-43'N to 27°-26' N latitudes. The temperature varies from 5°-48° C and the rainfall varies from 517mm to 750 mm. The sanctuary supports 105 species of birds. The vegetation of this zone comprises of grasses, *Eucalyptus*, *Zizypus*, *Delbergia*, *Lantana* etc.

Short-horned grasshoppers are included in the Superfamily Acridoidea. They are moderate in size, but range from less than 10 mm to 65 mm. The form of body shape, head and thorax are diverse; antennae are filiform but sometimes ensiform; tarsi three segmented; hind femora long, slender and thick towards base and adapted for leaping; wings are either fully developed or reduced or absent; forewings in the form of leathery tegmina; hind wings fan like; male external genitalia complex, symmetrical and concealed, when not in use, by the enlarged ninth abdominal sternum (Subgenital plate).

The most notable work on Indian grasshoppers was made by Kirby (1914). He wrote "Fauna of British India, including Ceylon and Burma" Later on Bolivar (1914, 1918), Uvarov (1921, 1923, 1925, 1927, 1929, 1940, 1940a, 1940b, 1942,) have also studied the Orthoptera of Indian subcontinent. Willemese (1955) has studied the

Orthoptera of Indo-Malayan region. Later on Dirsh (1954, 1956, 1958), Dirsh & Uvarov (1953, Banerjee & Kevan (1960), Hollis (1965, 1968, 1971, 1975) Mason (1973) and Ritchie (1981, 1982) have taxonomically revised several genera. Tandon and Shishodia (1969, 1976, 1989) and Shishodia and Tandon (2004) have studied Indian grasshoppers from different states.

The present paper deals with 17 species belonging to 2 families and 17 genera. All the species are reported from the sanctuary for the first time. Three species have been recorded from Uttar Pradesh for the first time. Classification followed here is according to Uvarov (1966) and Shishodia *et. al.* (2010).

ABBREVIATIONS USED

Coll.– Name of the Collector.

SYSTEMATIC ACCOUNT

Order ORTHOPTERA

Superfamily ACRIDOIDEA

Family 1 PYRGOMORPHIDAE

Subfamily ORTHACRIDINAE

Genus 1. *Chrotogonus* Serville, 1839

1. *Chrotogonus (Chr.) trachypterus trachypterus* (Blanchard)

1836. *Ommexechea trachypterus* Blanchard, *Annl. Soc. Ent. France*, 5 : 618.

1959. *Chrotogonus (Chr.) trachypterus trachypterus* : Kevan, *Publcoes cult. Co. Diam, Angola*, No. 43 : 147.

Material examined : Near Sanctuary Main gate, 1 ♂, 5 ♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1 ♂, 1 ♀, 4.ix.2005 (Coll. N. Sharma & party); Surdas House, 2 ♂, 5.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujrat, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhaya Pradesh, Maharashtra,

Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Bangladesh, Iran, Nepal, Pakistan.

Remarks : This species is the pest of various types of crops and generally found in dry condition on a bare sandy ground.

Genus 2. *Atractomorpha* Saussure, 1861

2. *Atractomorpha crenulata* (Fabricius)

1793. *Truxalis crenulatus* Fabricius, *Ent. Syst.*, 2 : 28.

1969. *Atractomorpha crenulata*: Kevan and Chen, *Zool. J. Linn. Soc.*, 48 : 187.

Material examined : Surdas House, 2♂, 5.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 1♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 2♂, 1♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujrat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Lakshadweep Islands, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Cambodia, Malaya, Myanmar, Nepal, Pakistan, Sri Lanka, Sumatra, Thailand, Vietnam.

Family 2 ACRIDIDAE

Subfamily ACRIDINAE

Genus 3 *Acrida* Linnaeus, 1758

3. *Acrida exaltata* (Walker)

1859. *Truxalis exaltata* Walker, *Ann. Mag. nat. Hist.*, (3) 4 : 222.

1954. *Acrida exaltata* : Dirsh, *Bull. Soc. Fouad Ent.*, 38 : 149.

Material examined : Surdas House; 2♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 2♂, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere : Afghanistan, Bangladesh, Iran, Pakistan, Saudi Arabia, South East Tibet, Sri Lanka, Yemen and West Aden.

Genus 4. *Phlaeoba* Stål, 1860

4. *Phlaeoba infumata* Brunner

1893. *Phlaeoba infumata* Brunner, *Annali Mus. civ. Stor. Nat. Giacomo Doria*, 33 : 124.

1914. *Phlaeoba ifumata* : Kirby, *Fauna Brit. India. Orthopt.*, : 103.

Material examined : Near Sanctuary Main gate, 1♂, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1♂, 1♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, East Nepal, Hainan Islands, Myanmar, S. China, South and North Malacca, Tennasserim, Yunnan.

Subfamily OEDIPODINAE

Genus 5. *Aiolopus* Fieber, 1853

5. *Aiolopus thalassinus tamulus* (Fabricius)

1798. *Gryllus tamulus* Fabricius, *Ent. Syst., Suppl.* : 195.

1968. *Aiolopus thalassinus tamulus* : Hollis, *Bull. Brit. Mus. nat. Hist. (Ent.)*, 22 (7) : 347.

Material examined : Surdas House, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 2♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1♂, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal.

Elsewhere : Australia, Bangladesh, Borneo, Celebes, China, Hainan, Hong Kong, Indonesia, Japan, Java, Lombok, Malaysia, Myanmar, New Guinea, Pakistan, Papua, Philippines, Singapore, Sri Lanka, Sumatra, Taiwan, Thailand and Timor.

Genus 6. *Oedaleus* Fieber, 1853

6. *Oedaleus abruptus* (Thunberg)

1815. *Gryllus abruptus* Thunberg, *Mem. Acad. Sci. St.-Petersb.*, 5 : 233.

1981. *Oedaleus abruptus* : Ritchie, *Bull. Brit. Mus. nat. Hist. (Ent.)*, 42(3) : 104-107.

Material examined : Near Sanctuary Main gate, 1♂, 5.ix.2005 (Coll. N. Sharma & party); Surdas House, 1♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1♂, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Pondicherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Bangladesh, China, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, Thailand and Vietnam.

Genus 7. *Trilophidia* Stål, 1873

7. *Trilophidia annulata* (Thunberg)

1815. *Gryllus annulatus* Thunberg, *Mem. Acad. Sci. St.-Petersb.*, **5** : 234.

1965. *Trilophidia annulata* : Hollis, *Trans. R. ent. Soc. London*, **117**(8) : 251.

Material examined : Near Keetham Lake, 2♂, 4.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 1♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Surdas House, 2♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Bangladesh, Borneo, South China, Japan, Hong Kong, Japan, Java, Korea, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sarawak, Singapore, Sri Lanka, Sumatra, Taiwan, Thailand, Vietnam.

Subfamily HEMIACRIDINAE

Genus 8. *Hieroglyphus* Krauss, 1877

8. *Hieroglyphus nigrorepletus* (Bolivar)

1912. *Hieroglyphus nigrorepletus* Bolivar, *Trab. Mus. Cienc. nat. Madr.*, no. **6** : 56.

1973. *Hieroglyphus nigrorepletus* : Mason, *Bull. Brit. Mus. nat. Hist. (Ent.)*, **28**(7) : 340.

Material examined : Near Sanctuary Main gate, 2♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Surdas House, 1♂, 2♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Assam, Bihar, Delhi, Jammu & Kashmir, Karnataka, Madhya Pradesh,

Maharashtra, Orissa, Punjab, Rajasthan, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh and Pakistan.

Subfamily SPATHOSTERNINAE

Genus 9. *Spathosternum* Krauss, 1877

9. *Spathosternum prasiniferum prasiniferum* (Walker)

1871. *Heteracris* (?) *prasinifera* Walker, *Cat. Derm. Salt. Brit. Mus.*, **5** Suppl. : 65.

1936. *Spathosternum prasiniferum prasiniferum* : Tinkham, *Lingman. Sci. Journ. Canton*, **15** : 51.

Material examined : Surdas House, 3♂, 2♀, 5.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 2♂, 3♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 2♂, 2♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Bangladesh, Hainan, Myanmar, Nepal, Pakistan, South East China, Sri Lanka, Thailand, Vietnam and West Malaysia.

Subfamily OXYINAE

Genus 10. *Oxya* Serville, 1831

10. *Oxya fuscovittata* (Marschall)

1836. *Gryllus fuscovittatus* Marschall, *Ann. Wien. Mus. Naturg.*, **1** : 211.

1971. *Oxya fuscovittata* : Hollis, *Bull. Brit. Mus. nat. Hist. (Ent.)*, **26**(7) : 289.

Material examined : Near Sanctuary Main gate, 1♂, 2♀, 5.ix.2005 (Coll. N. Sharma & party); Surdas House, 1♂, 1♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 2♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Bangladesh, Nepal, Pakistan and USSR.

Subfamily CALLIPTAMINAE

Genus 11. *Acorypha* Krauss, 1877

11. *Acorypha glaucopsis* (Walker)

1870. *Caloptenus glaucopsis*, Walker, *Cat. Derm. Salt. B.M.* **iv** : 702.

2009. *Acorypha glaucopsis*. Hemp, *Jour. Orth. Res.*, **18**(2) : 197.

Material examined : Near Sanctuary Main gate, 2♂, 5.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttarakhand.

Elsewhere : Iran and Saudi Arabia.

Remarks : This species is rare and has been recorded for the first time from Uttar Pradesh.

Subfamily EYEPREPOCNEMIDINAE

Genus 12. *Heteracris* Walker, 1870

12. *Heteracris pulchra* (Bolivar)

1902. *Euprepocnemis pulchra* Bolivar, *Annl. Soc. ent. France*, **70** : 630.

1958. *Heteracris pulchra* : Dirsh, *Tijdschr. Ent.*, **101** : 54.

Material examined : Near Sanctuary Main gate, 2♂, 3♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1♂, 1♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Bihar, Delhi, Orissa, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere: Sri Lanka.

Remarks : The species has been recorded for the first time from Uttar Pradesh.

Genus 13. *Eyprepocnemis* Fieber, 1853

13. *Eyprepocnemis alacris alacris* (Serville)

1839. *Acridium alacre* Serville, *Hist. Nat. Ins. Orth.*, : 682.

1958. *Eyprepocnemis alacris alacris* : Dirsh, *Proc. R. ent. Soc. London*, (B) **27**(3-4) : 40.

Material examined : Near Keetham Lake, 1♂, 2♀, 4.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 1♀, 5.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Haryana, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Bangladesh, Iran, Iraq, Pakistan and Sri Lanka.

Subfamily CATANTOPINAE

Genus 14. *Choreodocus* Bolivar, 1914

14. *Choreodocus robustus* (Serville)

1839. *Acridium robustus* Serville, *Ins. Orth.*, 647.

1921. *Choreodocus robustus* : Uvarov, *Trans. ent. Soc. Lond.* (69) : 109.

Material examined : Surdas House, 1♂, 2♀, 5.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 1♂, 2♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 2♂, 1♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Arunachal Pradesh, Andhra Pradesh, Assam, Himachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, Tripura and West Bengal.

Elsewhere : Bangladesh.

Genus 15. *Paraconophyma* Uvarov, 1921

15. *Paraconophyma scabra* (Walker)

1870. *Caloptemus scaber* Walker, *Cat. Derm. Salt. Brit. Mus.*, **4** : 707.

1921. *Paraconophyma scabra* : Uvarov, *Ann. Mag. nat. Hist.*, (9) **7** : 500, 501.

Material examined : Near Keetham Lake, 2♂, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Bihar, Delhi, Himachal Pradesh, Jammu and Kashmir, Karnataka, Manipur, Rajasthan, Tamil Nadu, Uttarakhand and West Bengal.

Remarks : The species is a rare species in Uttar Pradesh.

Genus 16. *Diabolocatantops* Jago, 1984

16. *Diabolocatantops innotabilis* (Walker)

1870. *Acridium innotabile* Walker, *Cat. Derm. Salt. Brit. Mus.*, **4** : 629.

1953. *Catantops pinguis innotabilis* : Dirsh and Uvarov, *Tijdsch. Ent.*, **96**(3) : 233.

1984. *Diabolocatantops innotabilis*, Jago, *Trans. Amer. Entomol. Soc.*, **110**(3) : 371.

Material examined : Surdas House, 1♂, 5.ix.2005 (Coll. N. Sharma & party); Near Sanctuary Main gate, 1♂, 2♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 2♀, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Haryana, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Lakshadweep Island, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh and West Bengal.

Elsewhere : Afghanistan, Bangladesh, Borneo, Cambodia, China, Hong Kong, Indo-China, Japan, Java, Korea, Malaysia, Myanmar, Nepal, New Guinea, Pakistan, Philippines, Sri Lanka, Sumatra, Tibet and Thailand.

Genus 17. *Xenocatantops* Dirsh and Uvarov, 1953

17. *Xenocatantops karnyi* (Kirby)

1910. *Catantops karnyi* Kirby, *Syn. Cat. Orthopt.*, **3** : 483.

1982. *Xenocatantops karnyi* : Jago, *Trans. Am. ent. Soc.*, **108**(3) : 455.

Material examined : Near Sanctuary Main gate, 2 ♀, 5.ix.2005 (Coll. N. Sharma & party); Near Keetham Lake, 1 ♂, 4.ix.2005 (Coll. N. Sharma & party).

Distribution : India : Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Himachal Pradesh, Maharashtra, Orissa, Tamil Nadu, Tripura, Uttarakhand and Uttar Pradesh.

Elsewhere : Nepal.

Remarks : The species has been recorded for the first time from Uttar Pradesh.

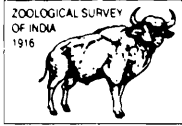
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ON A COLLECTION OF CHALCIDOID WASPS (HYMENOPTERA : CHALCIDOIDEA) FROM MELGHAT WILDLIFE SANCTUARY OF MAHARASHTRA, INDIA

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INTRODUCTION

Melghat Wildlife Sanctuary is a part of Melghat Tiger Reserve which is located in the northern part of Amravathi district of Maharashtra state in India. It forms an integral part of the Satpura- Maikal Ranges, where land folds and unfolds creating a distinctive and mystifying landscape of high hills and deep valleys. The forest is tropical dry deciduous in nature and dominated by teak plants. It occupies an area of 788.78 sq. km and located on longitude 21°21'N, latitude 77°22'E. The Zoological Survey of India (ZSI) has initiated programmes for survey and collection of insects (and other animals) from protected areas such as Wildlife sanctuaries, National Parks, etc. Under this programme, scientists of ZSI made surveys and collection of chalcidoid wasps from the Melghat Wildlife Sanctuary (MWS). There is no study of chalcidoid Hymenoptera from the MWS, except for recent descriptions of three pteromalid species by Narendran & Girish Kumar (2009). In this paper we record 20 species of chalcidoids (10 species of Eulophidae, 2 species of Eupelmidae and 8 species of Pteromalidae) from MWS. The collections were made from such areas as Semodah, Makhala and Kolkaz. All the specimens are deposited at the 'National Zoological Collections' of the Hymenoptera section, Zoological Survey of India, Kolkata (NZSI).

MATERIAL AND METHODS

The collected specimens were card-mounted and curated using the methods mentioned by Narendran

(2001). The specimens were studied under Leica M6 stereozoom microscope (Switzerland) and the photos were taken by using Samsung PL50 digital camera (China) with 10.2 mega pixels.

The following abbreviations are used in the text :
F1-F3 = Funicular segments 1 to 3; MS = Malar sulcus; MV = Marginal vein; OOL = Ocellocular line; POL = Postocellar line; SMV = Submarginal vein; STV = Stigmal vein; T1-T3 = Gastral tergites 1 to 3.

Abbreviations for the Depositories : BMNH = The Natural History Museum, London, SW7 5BD, England; DEI = Institute fur pflanzenschutz fur Schung, Germany; FRI = Forest Research Institute, Dehradun; NMP = Norodni Museum v Praze, Prague, Czech Republic; NZSI = National Zoological Collections of the Hymenoptera section, Zoological survey of India, Kolkata; QMB = Queensland Museum, Brisbane, Australia; SEA = School of Entomology, St. John's College, Agra, India; UMO = University Museum, Oxford, England; USNM = United States National Museum, Washington DC, USA; ZSIK = Western Ghats Regional Centre, Zoological Survey of India, Kozhikode, Kerala, India.

RESULTS AND DISCUSSION

A total of 20 species were identified of which 10 species belongs to the family Eulophidae, 2 species belongs to the family Eupelmidae and 8 species belongs to the family Pteromalidae. Of these 20 species, 3 species of pteromalids were recently described. The informations on chalcidoid fauna of Maharashtra is very

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scanty and fragmentary. 187 species are recorded from the state so far (Noyes, 2003 last updated October, 2010). In this paper, 15 species are found out to be the new records from Maharashtra state. It is extremely important to explore the faunal diversity of Sanctuaries and other protected areas like MWS to find out more and more number of described and undescribed species.

SYSTEMATIC ACCOUNT

Order HYMENOPTERA

Superfamily CHALCIDOIDEA

Family EULOPHIDAE

1. *Aprostocetus microcosmus* (Girault)

(Plate I-1)

1888. *Aprostocetus granulatus* Ashmead, 105, Syntype Female, USA : Florida (USNM).
 1917. *Tetrastichus microcosmus* Girault, 316. Replacement name for *granulatus* Ashmead.
 1981. *Tetrastichus asperculus* Graham, 2, Holotype Female, Madeira (UMO).
 2002. *Aprostocetus microcosmus* (Girault) : Zhu *et al.*, 598.
 2007. *Aprostocetus granulatus* Ashmead : Narendran, 59.

Diagnosis : Female. Body black, antenna brown, legs honey yellow except at apical tarsal segments brown, wings hyaline; mesosoma moderately arched dorsally, with propodeum slopping at 45° to 50°; midlobe of mesoscutum very slightly longer than broad; dull with moderately fine, slightly raised reticulations; scutellum slightly more than half as long as mesoscutum, reticulations like that of mesoscutum but finer; gaster lanceolate, about 3.5x as long as broad, nearly half as long as head plus mesosoma but slightly narrower than mesosoma, strongly acute, slightly acuminate, longest setae of each circus 2x length of next one, sinuate.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10519/H3). 1 Female, same data except the collection locality is Kolkaz (NZSI, Regd. No. 10520/H3).

Host : *Hyparrhenia hirta* (Linnaeus) (Family : Poaceae) (Narendran, 2007).

Distribution : India : Jharkhand, Karnataka, Kerala, Maharashtra (new record), Tamil Nadu.

Elsewhere : Australia, Canary Islands, Cape Verde Islands, China, Europe, Madeira, USA, Trinidad and Tobago.

2. *Aprostocetus kuriani* (Husain & Khan)

(Plate I-2)

1954. *Syntomosphyrum israeli* Kurian, 131, Male, Female,

India : Cuttak (SEA?). Preoccupied by Mani & Kurian (1953).

1986. *Tetrastichus kuriani* Husain & Khan, 239. Replacement name for *S. israeli* Kurian.
 2003. *Aprostocetus kuriani* (Husain & Khan) : Noyes, Universal Chalcidoidea Database.
 2007. *Aprostocetus kuriani* (Husain & Khan) : Narendran, 71.

Diagnosis : Female. Body reddish brown to black with metallic greenish blue luster; legs yellowish brown with hind coxa dorsally black; antenna with 1 anellus; postocellar line 1.5x ocellocular line; forewing 2.4x as long as broad; MV 3.05x as long as STV; hind femur 1.25x as long as wide; gaster 1.5x as long as mesosoma, laterally compressed; ovipositor long exerted from ventrally far ahead of abdominal tip.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10521/H3). 1 Female, same data except locality is Makhala (NZSI, Regd. No. 10522/H3). 12 Females, same data except locality is Kolkaz (NZSI, Regd. Nos. 10523/H3 to 10534/H3).

Host : Eggs of the moth *Schoenobius* sp. (Lepidoptera : Crambidae) (Narendran, 2007).

Distribution : India : Orissa, Maharashtra (new record).

3. *Aprostocetus vatiata* Narendran

(Plate I-3)

2007. *Aprostocetus vatiata* Narendran, 103, Holotype Female, India : Aligarh (NZSI).

Diagnosis : Female. Body dark brown with lower frons, mesopleuron, metapleuron, coxae, gastral tergites light brown; legs (except dark brown coxae) pale yellow with fourth tarsal segment and pretarsi brown; antenna with 2 anelli; mesoscutum with 3 adnotaular setae on either side; SMV with 3 dorsal setae; MV 2.83x as long as STV.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary; Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10535/H3).

Host : Coccids (Scale insects) on *Euphorbia* sp. (Family : Euphorbiaceae) (Narendran, 2007).

Distribution : India : Kerala, Maharashtra (new record), Uttar Pradesh, West Bengal.

4. *Neotrichoporoides arunima* Narendran

(Plate I-4)

2007. *Neotrichoporoides arunima* Narendran, 146, Holotype Female, India : Aligarh (NZSI).

Diagnosis : Female. Head and mesosoma mostly brilliant metallic green, gaster dark metallic green; scape not exceeding above level of vertex; pedicellus 3x as long as broad; fovea of malar sulcus not reaching half length of malar sulcus; midlobe of mesoscutum with one row of 3 adnotaular setae on either side; scutellum with 3 pairs of setae; SMV with 5 dorsal setae; MV 8.5x as long as STV; hypopygium not reaching middle of gaster.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Kolkaz, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10536/H3). 3 Females, same data except locality is Semodah. (NZSI, Regd. Nos. 10537/H3 to 10539/H3).

Host : Unknown.

Distribution : India : Kerala, Maharashtra (new record), Uttar Pradesh.

5. *Neotrichoporoides beonus* Narendran (Plate I-5)

2006. *Neotrichoporoides beonus* Narendran, in Narendran *et al.*, 5. Holotype Female, India : Kohinoor (near Calicut University Campus) (NZSI).

Diagnosis : Female. Upper half of head dark brown with metallic green reflections; a line adjacent to eye brownish yellow; lower half of frons, gena and temples brownish yellow; antenna dark brown with scape and under side of pedicel pale yellow; pronotum, mesoscutum, scutellum and propodeum metallic green; pronotal panel, meso and metapleuron pale brownish yellow; axilla pale brownish yellow with middle part metallic green; sides of lateral lines of scutellum pale brownish yellow; legs pale yellow with hind coxa and basal half of mid coxa pale yellowish brown and hind femur with pale brownish tinge medially; pretarsi and fourth tarsal segment of all legs dark brown; gaster black with base yellow; wings hyaline; midlobe of mesoscutum with 2 rows of adnotaular setae, outer row of 6 and inner row of 3 setae; forewing (excluding fringe) about 3.7x as long as wide.

Material examined : 4 Females, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary; Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. Nos. 10540/H3 to 10543/H3).

Host : Unknown.

Distribution : India : Delhi, Kerala, Maharashtra (new record), Tamil Nadu.

6. *Neotrichoporoides doproides* Narendran (Plate I-6)

2007. *Neotrichoporoides doproides* Narendran, 153, Holotype Female, India : Siruvani forest (NZSI).

Diagnosis : Female. Brown with the following parts otherwise : head, lower frons, gena, posterior half of dorsum of pronotum, sides of pronotum, tegula, legs, base of gaster pale yellow, mesosomal dorsum with slight metallic green reflections on some parts; scape not exceeding vertex; clava distinctly longer than F1; F1 1.5-1.83x as long as pedicellus; midlobe of mesoscutum with 3 adnotaular setae on either side, middle seta being a little inside of other setae; posterior pair slightly longer than others; forewing 2.5x as long as broad; SMV with 5 dorsal setae; speculum relatively small.

Material examined : 2 Females, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary; Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. Nos. 10544/H3 and 10545/H3).

Host : Unknown.

Distribution : India : Kerala, Maharashtra (new record), Tamil Nadu.

7. *Tetrastichus epilachnae* (Giard) (Plate I-7)

1896. *Lygellus epilachnae* Giard, 839, Syntypes, France : Saint-Roch, near Valenciennes (not located).

1940. *Tetrastichus jablonowskii* Szelenyi, 86, Holotype Female, Hungary: Budapest, Harmashatarhegy, (Synonymised with *epilachnae* by Domenichini (1966), 92.

2007. *Tetrastichus epilachnae* (Giard) : Narendran, 256.

Diagnosis : Female. Body black with weak bluish or greenish tinge; antenna with 1 anellus; F2 1.4-1.43x as long as broad; clava about as long as F2 and F3 combined; mesoscutum with distinct median line; SMV with single dorsal seta; costal cell of forewing very narrow, more than 10x as long as broad.

Material examined : 3 Females, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Makhala, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. Nos. 10546/H3 to 10548/H3). 6 Females, same data except locality is Semodah (NZSI, Regd. Nos. 10549/H3 to 10554/H3).

Host : *Simmondsius pakistanensis* Ahmad & Ghani (Coleoptera: Coccinellidae), *Epilachna* beetles (Coleoptera: Coccinellidae) (Narendran, 2007).

Distribution : India : Assam, Karnataka, Kerala, Maharashtra (new record), Tamil Nadu, West Bengal.

Elsewhere : Bulgaria, Croatia, Europe, France, Hungary, Iran, Italy, Macedonia, Morocco, Netherlands, Pakistan, Slovakia, Sweden, Old USSR, Yugoslavia.

8. *Tetrastichus taprobanensis* Ranaweera
(Plate I-8)

1950. *Tetrastichus taprobanensis* Ranaweera, (1947). 10. Holotype Female, Sri Lanka (FRI).

2007. *Tetrastichus taprobanensis* Ranaweera : Narendran. 290.

Diagnosis : Female. Body metallic blue with green reflections; legs pale cream colored with coxae and major part of femora concolorous with mesosoma; head as broad as mesosoma; ocelli surrounded by a groove which extends on sides to the eye; antennal scape reaching front ocellus, more than 2x as long as broad; funicular segments subequal in length; mesoscutum with complete median line.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Makhala, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10555/H3).

Host : *Darna nararia* Moore (Lepidoptera : Limacodidae) on tea plant *Camellia sinensis* (Linnaeus) (Family : Theaceae) (Narendran, 2007).

Distribution : India : Kerala, Maharashtra (new record).

Elsewhere : Sri Lanka.

9. *Tetrastichus tunicus* Narendran
(Plate I-9)

2007. *Tetrastichus tunicus* Narendran, 293, Holotype Female, India: Calicut University Campus (ZSIK).

Diagnosis : Female. Head, mesosoma and gaster black with metallic blue reflections; antenna with 1 anellus; F1 shorter than F2; mesoscutum with distinct median line, 4 adnotaular setae on each side; costal cell a little shorter than MV; SMV with single dorsal seta; gaster distinctly longer than mesosoma.

Material examined : 1 Female, India: Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10556/H3).

Host : Eggs of Cockroaches ? (Narendran, 2007).

Distribution : India : Kerala, Maharashtra (new record).

10. *Elasmus viridiscutellatus* Verma & Hayat
(Plate I-10)

2002. *Elasmus viridiscutellatus* Verma & Hayat, in Verma *et al.*, 270, Holotype Female, India : Mumbai (BMNH).

2008. *Elasmus viridiscutellatus* Verma & Hayat : Narendran *et al.*, 3.

Diagnosis : Female. Body blackish with greenish blue reflection on frontovertex, pronotum and

mesoscutum, more intense on scutellum. propodeum less bluish; pleura black with greenish reflections, tegula metallic dark; posterior extension of metanotum hyaline except at base yellowish; flagellum dark brown covered with short black setae; mid coxa and femur largely yellow; hind femur yellowish with blackish margins; gaster blackish dorsally with bluish green reflections at base of T1 and with narrow, dusky yellow stripes at apices of tergites 1-4; wings hyaline; pedicel slightly shorter than F1.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary; Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10557/H3).

Host : The larvae of the Rice Leaf Roller, *Cnaphalocrosis medinalis* (Guenee) (Lepidoptera : Crambidae) (Verma *et al.*, 2002).

Distribution : India : Andhra Pradesh, Bihar, Maharashtra, Tamil Nadu, West Bengal.

Family EUPELMIDAE

11. *Eupelmus (Eupelmus) testaceiventris*
(Motschulsky)
(Plate II-11)

1863. *Callimome ceylonica* Motschulsky, 47, Syntypes, Sri Lanka.

1863. *Roprocercus testaceiventris* Motschulsky, 49, Syntypes, Sri Lanka.

1965a. *Eupelmus testaceiventris* (Motschulsky) : Boucek, 543-554.

2000. *Eupelmus (Eupelmus) testaceiventris* (Motschulsky) : Askew & Nieves-Aldrey, 55-56.

Diagnosis : Female. Macropterous; antenna black; head and thorax metallic green; gaster yellow; legs yellow except forecoxa concolorous with thorax; ovipositor dark brown at base and apex, pale yellow in middle; metanotum with posterior margin produced into plical depression of propodeum; forewing without lineal clava; ovipositor length 0.70x length of gaster.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Makhala, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10628/H3). 19 Females, same data except locality is Kolkaz (NZSI, Regd. Nos. 10629/H3 to 10647/H3).

Host : The Sorghum midge *Contarinia sorghicola* (Coquil-lett) (Diptera : Cecidomyiidae) and the mango leaf gall midge *Procontarinia matteiana* Kieffer & Ceconi (Diptera : Cecidomyiidae) (Noyes, 2003).

Distribution : India : Maharashtra (new record), West Bengal.

One report of this species from India without mentioning the state in CIBC Annual Report 1984-1985 : 30, Commonwealth Agricultural Bureaux, Slough, U.K.

Elsewhere : Afrotropical, Australia, Canary Islands, Croatia, Cyprus, Oman, Spain, Sri Lanka.

12. *Neanastatus cinctiventris* Girault

(Plate II-12)

1913. *Neanastatus cinctiventris* Girault, 35, Syntype Female, Australia (QMB).

1926. *Metaplopoda grillaria* Masi, 276. Female, Taiwan (DEI) (Boucek, 1988 synonymised).

Diagnosis : Body black; head metallic green; mesoscutum medially, pronotum often medially, fore coxa, middle leg except apical three tarsal segments, apical half of hind coxa, hind femur at its base and apex, pale or white yellow; antenna, mandible, apical four tarsal segments dark brown, rest of foreleg pale brownish yellow; hind basitarsi white; forewing with an infuscation starting before STV; gaster longer than mesosoma; T1-T3 with posterior margin medially incised; last tergite narrow conical; ovipositor sheath slightly exerted.

Material examined : 1 Male, India : Maharashtra; Amravathi dist., Melghat Wildlife Sanctuary, Makhala, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10648/H3).

Host : The rice gall midge *Orseolia oryzae* (Wood-Mason) (Diptera: Cecidomyiidae) (Noyes, 2003).

Distribution : India : Andhra Pradesh, Madhya Pradesh, Maharashtra (new record), Orissa, Tamil Nadu.

Elsewhere : Australia, China, Sri Lanka, Taiwan, Thailand.

Family PTEROMALIDAE

13. *Chlorocyclus amaravathicus* Narendran &

Girish Kumar

(Plate II-13)

2009. *Chlorocyclus amaravathicus* Narendran & Girish Kumar, 33, Holotype Female, India : Melghat Wildlife Sanctuary (NZSI).

Diagnosis : Female. Bright metallic green; antennal funicle dark brown; anelli, pedicel and scape brownish yellow; all coxae metallic green, remainder of legs pale yellow except brown last tarsal segment and pretarsi; wings hyaline; scape slightly exceeding level of vertex; propodeal plicae absent; forewing with speculum open below; relative lengths of SMV = 23, MV = 17, PMV = 11.3, STV = 5.6; metasomal length subequal to head plus mesosoma combined; hypopygium reaching middle of gaster.

Material examined : Holotype : Female, India : Maharashtra; Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 12362/H3). 2 Female, Paratypes of same data (NZSI, Regd. Nos. 12363/H3 & 12364/H3).

Host : Unknown.

Distribution : India : Maharashtra.

14. *Colotrechnus melghaticus* Narendran &

Girish Kumar

(Plate II-14)

2009. *Colotrechnus melghaticus* Narendran & Girish Kumar, 29, Holotype Female, India : Melghat Wildlife Sanctuary (NZSI).

Diagnosis : Female. Dark metallic blue; antenna black with scape pale yellow, all coxae black with slight metallic bluish green tinge and with apex slightly pale; all femora brownish black with apices pale yellow; all tibiae blackish brown with bases and apices pale yellow; all tarsi pale white with pretarsi dark brown; wings hyaline; scape 2.55x as long as F1; head width in anterior view 1.56x distance between front ocellus and lower clypeal margin; pronotum as long as half length of mesoscutum in dorsal view; forewing 2.39x as long as broad; PMV 1.46x as long as STV; MV 2.75x as long as PMV; hind femur 1.5x as long as hind coxa; metasoma 1.77x as long as mesosoma; ovipositor sheath exerted, 0.64x as long as last tergite.

Material examined : Holotype : Female, India : Maharashtra; Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 12365/H3).

Host : Unknown.

Distribution : India : Maharashtra.

15. *Homoporus maharashtriensis*

Narendran & Girish Kumar

(Plate II-15)

2009. *Homoporus maharashtriensis* Narendran & Girish Kumar, 30, Holotype Female, India : Melghat Wildlife Sanctuary (NZSI).

Diagnosis : Female. Head and mesosoma black; gaster yellow, with brown marking on sides and faint marking on middle; ovipositor sheath black; antenna brownish yellow with scape and pedicel more yellowish; fore coxa black; mid and hind coxae completely yellow; fore femur black with base and apex yellow; mid and hind femora, all tibiae and tarsi yellow; pretarsi brown; wings hyaline; lower margin of clypeus weakly emarginated; scape distinctly longer than eye length; clava 3.25x as long as preceding segment; POL 1.25x

OOL; propodeum without median carina; prepectus with two or three small pits, not smooth; MV 1.58x as long as PMV; PMV 1.9x as long as STV; metasoma elongate, ovate with a very short petiole visible dorsally; gaster longer than mesosoma; hind margin of all tergites straight; ovipositor sheath slightly protruding out; hypopygium reaching middle of gaster.

Material examined : Holotype : Female, India : Maharashtra; Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 12366/H3). Paratype: One female of the same data of holotype (NZSI, Regd. No. 12367/H3).

Host : Unknown.

Distribution : India : Maharashtra.

16. *Mesopolobus harithus* Sureshan & Narendran
(Plate II-16)

2002. *Mesopolobus harithus* Sureshan & Narendran, 84, Holotype Female, India: Silent Valley National Park (ZSIK).

Diagnosis : Female. Head and mesosoma metallic green with golden reflections; gaster darker; antenna pale brown; legs with coxae concolorous with mesosoma, remainder testaceous with tips of tarsi brown; femora darker; tegulae brown; wings hyaline; scape reaching median ocellus, temple length 0.6x eye length; metasoma little longer than head plus mesosoma; hypopygium reaching little beyond half length of gaster.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10649/H3). 1 Female, same data except the collection locality which is Makhala (NZSI, Regd. No. 10650/H3).

Host : Unknown.

Distribution : India : Kerala, Maharashtra (new record).

17. *Propicroscytus mirificus* (Girault)
(Plate II-17)

1915. *Arthrolysis mirificus* Girault, 191, Female, Australia (QMB).

1941. *Propicroscytus mirificus* (Girault) : Szelenyi, 123.

Diagnosis : Head and mesosoma black with metallic green reflections; gaster yellow with one median and two lateral longitudinal brownish lines; antenna yellow except funicular segments yellowish brown; legs yellow except fore coxae and fore femora yellowish brown; wings hyaline; antenna with two anelli; male antenna with funicular segments long and with erect hairs; propodeum uniformly convex and finely reticulate punctate; hind margin of second tergite truncate.

Material examined : 1 Female & 2 Males. India : Maharashtra, Amravathi dist.; Melghat Wildlife Sanctuary, Makhala, 22.ix.2007, Coll. Girish Kumar, P. (NZSI, Regd. Nos. 10651/H3 to 10653/H3).

Host : The rice gall midges (Diptera : Cecidomyiidae) such as *Orseolia mnesitheae* Gagne, *Orseolia oryzae* (Wood-Mason), *Orseoliella javanica* (Kieffer & Docters van Leeuwen-Reijnvaan) and *Pachydiplosis oryzae* (Wood-Mason). The yellow rice stem borer *Scirpophaga incertulas* (Walker) (Lepidoptera : Pyralidae) (Noyes, 2003).

Distribution : India : Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Uttar Pradesh, West Bengal.

Elsewhere : Australia, Indonesia, Malaysia, China, Sri Lanka.

18. *Sphegigaster anamudiensis*
Sureshan & Narendran
(Plate II-18)

1997. *Sphegigaster anamudiensis* Sureshan & Narendran, 194, Holotype Female, India : Eravikulam National Park (ZSIK).

Diagnosis : Female. Body bluish green with slight golden reflections on head and mesosoma; metasoma almost black; antenna dark brown except scape testaceous; legs with coxae concolorous with mesosoma, remainder testaceous with tips of tarsi brown; tegulae brown; wings hyaline; antenna inserted little below middle of face; pedicel almost 2x as long as broad; head moderately reticulate; forewing with PMV much shorter than MV; STV only about 0.3x MV; gaster 1.2x as long as thorax; petiole 0.3x as long as gaster.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10654/H3).

Host : Unknown.

Distribution : India : Kerala, Maharashtra (new record).

19. *Sphegigaster reticulata* Sureshan & Narendran
(Plate II-19)

1997. *Sphegigaster reticulata* Sureshan & Narendran, 195, Holotype Female, India : Parambikulam (ZSIK).

Diagnosis : Female. Head, thorax and petiole bluish black; gaster black; antennae yellow; all coxae concolorous with thorax, remainder of legs brownish yellow with tips of tarsi brown; tegulae testaceous; POL 1.6x OOL; pronotum with lateral angles of collar without teeth; mesoscutum, scutellum and propodeum moderately reticulate; MV 2.9x STV and 1.4x that of

PMV; petiole moderately reticulate; gaster elongate, ovate; T1 occupying almost one third length of gaster, hind margin straight; T2 occupying more than half of gaster.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10655/H3).

Host : Unknown.

Distribution : India : Kerala, Maharashtra (new record).

20. *Sphegigaster stepicola* Boucek
(Plate II-20)

1965b. *Sphegigaster stepicola* Boucek, 12, Holotype Female, Czechoslovakia (NMP).

1971. *Acroclisis melanagromyzae* Mani, 591.

Diagnosis : Female. Body slender, shiny black; legs relatively dark; tibiae more or less infuscate; antenna with all funicle segments transverse; F1 shorter than pedicel; gaster oval, shorter than thorax; petiole 3x as long as wide; hind margin of T1 with its middle portion truncate.

Material examined : 1 Female, India : Maharashtra, Amravathi dist., Melghat Wildlife Sanctuary, Semodah, 22.ix.2007, coll. Girish Kumar, P. (NZSI, Regd. No. 10656/H3).

Host : *Melanogromyza* sp. and *Phytomyza* sp. (Diptera: Agromyzidae) (Noyes, 2003).

Distribution : India : Bihar, Delhi, Karnataka, Kerala, Maharashtra (new record), Uttar Pradesh.

Elsewhere : Widely distributed.

SUMMARY

In this paper, twenty species of chalcidoid wasps are identified and reported from Melghat Wildlife Sanctuary of which 9 species of Eulophidae, viz., *Aprostocetus microcosmus* (Girault), *A. kuriani* (Husain & Khan), *A. vatiata* Narendran, *Neotrichoporoides arunima* Narendran, *N. beonus* Narendran, *N. doproides* Narendran, *Tetrastichus epilachnae* (Giard), *T. taprobanensis* Ranaweera and *T. tunicus* Narendran, 2 species of Eupelmidae, viz., *Eupelmus (Eupelmus) testaceiventris* (Motschulsky) and *Neanastatus cinctiventris* Girault and 4 species of Pteromalidae, viz., *Mesopolobus harithus* Sureshan & Narendran, *Sphegigaster anamudiensis* Sureshan & Narendran, *S. reticulata* Sureshan & Narendran and *S. stepicola* Boucek are reported here for the first time from Maharashtra state.

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PLATE I



1. *Aprostocetus microcosmus* (Girault). Female.



2. *Aprostocetus kuriani* (Husain & Khan). Female.



3. *Aprostocetus variata* Narendran. Female.



4. *Neotrichoporoides arunima* Narendran. Female.



5. *Neotrichoporoides beonus* Narendran. Female.



6. *Neotrichoporoides doproides* Narendran. Female.



7. *Tetrastichus epilachnae* (Giard). Female.



8. *Tetrastichus taprobanensis* Ranaweera. Female.



9. *Tetrastichus tunicus* Narendran. Female.



10. *Elasmus viridiscutellatus* Verma & Hayat. Female.

PLATE II



11. *Eupelmus (Eupelmus) testaceiventris* (Motschulsky). Female.



12. *Neanastatus cinctiventris* Girault. Male.



13. *Chlorocyttus amaravathicus* Narendran & Girish Kumar. Female.



14. *Colotrechnus melghaticus* Narendran & Girish Kumar. Female.



15. *Homoporus maharashtriensis* Narendran & Girish Kumar. Female.



16. *Mesopolobus harithus* Sureshan & Narendran. Female.



17. *Propicroscyttus mirificus* (Girault). Female.



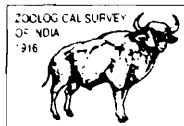
18. *Sphegigaster anamudiensis* Sureshan & Narendran. Female.



19. *Sphegigaster reticulata* Sureshan & Narendran. Female.



20. *Sphegigaster stepicola* Boucek. Female.



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ON A COLLECTION OF INSECTA : HYMENOPTERA : FORMICIDAE FROM UTTARAKHAND

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INTRODUCTION

Uttarakhand is a state located in the northern part of India (in Hindi -'Uttara' means 'North' and 'Khand' means 'Section'). On 9TH November 2000 a state was carved out of Himalayan and the adjoining districts of Uttar Pradesh as the 27TH state of the Republic of India under the name of the Uttaranchal. In January, 2007 the name of the state was officially changed from Uttaranchal to Uttarakhand.

The state shares an international boundary with China in the north and with Nepal in the east; and the state boundary with Himachal Pradesh in the west and Uttar Pradesh in the south. Geographically, the state is situated between latitudes 28° 43'- 31° 28'N and longitudes 77° 34'- 81° 03' E. The state has an area of 53,566 km² of which 93% is mountainous.

The state Uttarakhand has been divided into the following districts :

(1) Almora; (2) Bageshwar; (3) Chamoli; (4) Champawat; (5) Dehra Dun; (6) Haridwar; (7) Nainital; (8) Pauri Garhwal; (9) Pithoragarh; (10) Rudraprayag; (11) Tehri Garhwal; (12) Udham Singh Nagar; (13) Uttarkashi.

Among all the wide variety of insect life on the earth, ants are one of the few forms universally recognised. This is because they are found in all terrestrial habitats from swamp to harsh desert, from sea coast to great altitude and from deep in the soil to the tips of the highest trees. Ants have the most highly organised social life among all the insects. The major factor responsible for their ecological success is division of labour, performing different biological functions. Ants live in highly organised and integrated units the societies or colonies.

Bingham's (1903) fauna is the main source of knowledge on ants. Rothney (1889) published an

extensive note on ants of Bengal whereas Wroughton (1892) provided a good account on Formicidae mainly from Maharashtra. Chapman and Capco (1951) published a checklist of the ants of Asia. Roonwal (1975) discussed the plant pest status of *Dorylus orientalis*. Chhotani and Ray (1976) described the hymenopterous fauna of Rajasthan. Mukherji (1925), Chhotani and Maiti (1977) worked on the ants of Andaman Islands. Pajni and Suri (1978) reported the Formicid Fauna of Chandigarh. Mathew (1980, 1983, 1984, 2000) dealt with the ants of North-east India. Sharma (1981) gave a short note on the ants of desert area. Gadagkar (1983) gave the Species richness and diversity of Western Ghats, Karnataka. Ali (1991, 1992) reported the ants fauna of Karnataka. Tiwari (1994, 1997, 1998, 2002, 2003) has worked on ants of South India, Delhi, Orissa, West Bengal and Sikkim. Sunil Kumar (1997) worked the ant species richness of Bangalore whereas Rastogi (1997) gave the observations on behaviour of ants in Bangalore. Bharti (2001, 2002) has given a Checklist of ants of Northwest India. Tak (1995, 1996, 2000, 2004) has dealt with the ants of Gujarat and Rajasthan. Varghese (2003) has studied the ants of Indian Institute of Science Campus, Bangalore. Ghosh (2005) has worked out the ants of Rabindra Sarovar, Kolkata. Bolton (1995) has dealt with taxonomic and zoogeographical census of the extant ant taxa (Hymenoptera : Formicidae).

SYSTEMATICS

Order HYMENOPTERA

Family FORMICIDAE

Subfamily DORYLINAE Leach

Tribe DORYLINI Fabricius

Dorylus (Typhlopone) labiatus Shuckard

Dorylus (Typhlopone) labiatus Shuckard

Subfamily AENICTINAE

- Tribe ECITONINI Forel
Aenictus (Aenictus) brevicornis Mayr
 Subfamily DOLICHODERINAE Forel
 Tribe TAPINOMINI EMERY
Tapinoma (Micromyrma) melanocephalum Fabricius
 Subfamily PSEUDOMYRMECINAE Emery
 Tribe PSEUDOMYRMECINI Forel
Tetraoponera (Tetraoponera) rufonigra Jerdon
 Subfamily MYRMICINAE Lapeletier
 Tribe CREMATOGASTERINI Emery
Crematogaster (Acrocoelia) brunnea var. *contemta*
 Mayr
Crematogaster (Acrocoelia) rothneyi Mayr
Crematogaster subnuda Mayr
Crematogaster (Orthocrema) walshi Forel
 Tribe MERONOPLINI Emery
Meranoplus bicolor Guerin
 Tribe SOLENOPLINI Forel
Monomorium (Monomorium) pharaonis Linne
Monomorium (Monomorium) wroughtoni Forel
Monomorium (Parholcomyrme) destructor Jerdon
Monomorium (Xeromyrmex) salomonis indicum Forel
Monomorium monomorium Bolton
Monomorium sagei Forel
 Tribe PHEIDOLINI Emery
Messor baabarus sub sp. *himalayana* Forel
Recurvidris recurvispinosa Forel
 Tribe TETRAMORINI Emery
Tetramorium salvatum Forel
Tetramorium walshi Forel
 Subfamily FORMICINAE
 Tribe COMPONOTINI Forel
Camponotus (Tanaemyrmex) compressus Fabricius
Camponotus (Tanaemyrmex) invidus Forel
Camponotus (Orthonotomyrmex) sericeus Fabricius
Camponotus dichrous Forel
Camponotus dolendus Forel
 Tribe OECOPHYLLINI Forel
Oecophylla smaragdina Fabricius
 Tribe PRENOLEPIDINI Forel
Paratrechina longicornis Latreille
 Tribe PLAGIOLEPIDINI Forel
Acantholepis frauenfeldi Emery

Ants are polymorphic social insects having three distinct forms—the perfect and fertile female, the male and worker (major or minor). The largest forms are

soldiers. Identification of ants is mainly based on the worker caste of ants.

IDENTIFICATION KEY IS BASED ON THE WORKER CASTE OF AN ANT

KEY TO THE SUBFAMILIES OF FAMILY FORMICIDAE

- I. Petiole of the abdomen one or two jointed.
 1. Opening at posterior end of gaster (acidopore) slit like.
 - A. Eyes never present, blind.
 - a. Petiole one jointed subfamily DORYLINAE
 - b. Petiole two jointed subfamily AENICTINAE
 - B. Eyes always present. Petiole one jointed subfamily DOLICHODERINAE
 2. Opening at posterior end of gaster (acidopore) terminal, circular and usually surrounded by a fringe of hairs. Petiole one jointed subfamily FORMICINAE.
- II. Petiole of the abdomen two jointed
 1. Petiole remarkably elongate, generally the anterior node is elongated petiolate, sometimes the posterior node is also petiolate, giving flexibility to the abdomen subfamily PSEUDOMYRMICINAE.
 2. Petiole not so elongate, the anterior node with a long petiole anteriorly and a short petiole posteriorly subfamily MYRMICINAE

Family FORMICIDAE

Subfamily DORYLINAE Leach

Tribe DORYLINI Forel

Genus *Dorylus* Fabricius

Dorylus (Typhlopone) labiatus Shuckard

1940. *Dorylus (Typhlopone) labiatus* Shuckard, *Ann. Mag. Nat. Hist.*, 5 : 319, Male.

Diagnostic characters : Length worker maj. 6-8 mm; worker min. 3.5. Worker (maj) : Castaneous yellow, polished smooth, shining and blind. Head rectangular, longer than its breadth, broader in front than posteriorly. No longitudinally impressed line on the head. Mandible with two teeth. Antennae worker maj. 11 and worker min. 10 jointed. Alitrunk rectangular depressed slightly constricted at the pro-mesonotal suture. Node of petiole longer than its breadth.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Chandigarh, Karnataka, Punjab, Delhi, West Bengal, Orissa, Sikkim, Manipur, Uttar Pradesh, Himachal Pradesh.

Elsewhere : Myanmar, Countries East Bay of Bengal.

Subfamily DORYLINAЕ Leach

Tribe DORYLINI Forel

Genus *Dorylus* Fabricius

Dorylus (Alaopone) orientalis Westwood

1985. *Dorylus (Alaopone) orientalis* Westwood, *Proc. Zool. Soc. Lond.*, **3** : 72, Male.

Diagnostic characters : Length worker maj. : 5.5 mm.; worker min. : 2.5-3 mm.

Worker (maj) : Castaneous brown with the abdomen generally lighter in colour than the head and alitrunk. Head rectangular occiput deeply emarginate, the head slightly wider anteriorly than posteriorly. A deeply impressed medial line present on the head. Alitrunk elongate, rounded anteriorly depressed and flat above, constricted at the pro-mesonotal suture. Node of the petiole broader than long, united with the abdomen.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, West Bengal, Uttar Pradesh, Assam, Karnataka Kerala, Tamil-Nadu, Chandigarh, Orissa, Punjab, Meghalaya, Delhi, Sikkim.

Elsewhere : Sri Lanka, Nepal, China, Malay-Peninsula, Myanmar, Indonesia.

Subfamily AENICTINAЕ

Tribe ECITONINI Forel

Genus *Aenictus* Shuckard Mayr

Aenictus (Aenictus) brevicornis Mayr

1878. *Aenictus (Aenictus) brevicornis* Mayr (*Typhlatta*) *Verh. zool.-bot. Ges. Wien*, **28** : 668 & 669.

1901. Forel, *J. Bombay nat. Hist. Soc.*, **13** : 446, worker.

Diagnostic Characters : Length worker : 2.5-3 mm.

Worker : Reddish yellow, head smooth and shining, thorax sculptured. Head rectangular very broad posteriorly, mandibles with three distinct teeth. Antennae very short and massive. Scape of the antennae about half length of the head. Alitrunk narrower than the head, pronotum convex smooth and shining, basal portion of the metanotum passing by a gradual curve with sloping apical portion. Nodes of petiole rounded shining. Abdomen elongate oval.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Chandigarh, Karnataka, Kerala, West Bengal, Uttar Pradesh, Meghalaya, Tamil-Nadu, Assam, N. W. Provinces.

Subfamily DOLICHODERINAЕ Forel

Tribe TAPINOMINI Emery

Genus *Tapinoma* Forster

Tapinoma (Micromyrma) melanocephalum Fabricius

1793. *Tapinoma (Micromyrma) melanocephalum* Fabricius, *Ent. Syst.*, **2** : 353, (*Fornica melanocephala*).

Diagnostic characters : Length worker : 1.5 mm.

Worker : Head and thorax dark brown in colour, abdomen yellowish white. Head longer than broad, oval, not emarginate, rounded posteriorly. Mandibles triangular broad with the masticatory margin equal to the outer margin and armed with minute teeth. Clypeus evenly convex, broader than high, its anterior margin slightly arched. Antennae thick, the scape extending beyond the top of the head. The joints of the flagellum longer than broad. Alitrunk viewed from the side not emarginate, the pro-meso and meso-metanotal sutures distinct slightly constricted at the latter suture. Petiole with a distinct node. Base of the abdomen overhanging the pedicel.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Meghalaya, Tripura, Chandigarh, Karnataka, Tamil-Nadu, West Bengal, Orissa.

Elsewhere : Spread through both the hemispheres, S. America.

Subfamily PSEUDOMYRMECINAЕ Emery

Tribe PSEUDOMYRMECINI Forel

Genus *Tetraponera* Smith

Tetraponera (Tetraponera) rufonigra Jerdon

1851. *Tetraponera (Tetraponera) rufonigra* Jerdon, *Madras Jour. Lit. Sc.*, **12** : 111, Worker (*Eciton rufonigrum*).

Diagnostic characters : Length worker : 12 mm.

Worker : Head, 2nd joint of petiole black, the mandibles, antennae, thorax and 1st joint of the petiole more or less red. Head rectangular, a little longer than broad and slightly narrow in front then posteriorly. Mandibles with six teeth. Clypeus transverse, narrow raised in the middle which is slightly produced, giving the anterior margin a bisinuate appearance. Antennae short and stout, 12 segmented. Ocelli present. Alitrunk elongate, the pronotum broad, its anterior lateral angles dentate, a medial, small longitudinal tubercle at its posterior margin, small longitudinal tubercle at its posterior margin, promesonotal suture arched to the front, mesonotum small flat, a deep emargination at the meso-metanotal suture. Metanotum longer than the pro and meso together. Petiole elongate, the 1st node oval with a long petiole, 2nd node conical with a short petiole.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Tripura, Chandigarh, Karnataka, Tamil Nadu, Kerala, Punjab, Haryana, Uttar Pradesh, Himachal Pradesh, Meghalaya, West Bengal, Orissa, Manipur.

Elsewhere : Myanmar, Sri Lanka, China, Singapore, Indonesia, Cambodia, Java, Sumatra.

Subfamily MYRMICINAE

Key to genera of subfamily MYRMICINAE

- A. Antennae with less than 12 joints.
- i) Antennae 11 jointed. Metanotum armed with two spines. Petiole attached to dorsal surface of abdomen *Crematogaster*
- ii) Antennae 9-jointed. Pronotum and metanotum armed with two teeth. Petiole attached to the middle of abdomen *Meranoplus*
- B. Antennae 12-jointed
- i) Clypeus bicarinate *Monomorium*
- ii) Clypeus not bicarinate *Tetramorium*

Subfamily MYRMICINAE Lepeletier

Tribe CREMATOGASTERINI Emery

Genus *Crematogaster* Lund*Crematogaster (Acrocoelia) brunnea* var. *contempta* Mayr

1878. *Crematogaster (Acrocoelia) brunnea* var. *contempta* Mayr, *Verh. zool.-bot. Ges. Wien*, **28** : 681, Worker.

Diagnostic characters : Length worker : 3.5-4 mm.

Worker : Shining chestnut red, abdomen darkening posteriorly into dark brown, the base being chestnut red. Head very highly polished and shining, very globose and strongly convex in front, thick and narrow longitudinally striate at base, the masticatory margin with generally 4 teeth. Antennae 11 jointed the club formed of the apical three joint, Alitrunk – the pronotum convex anteriorly with the lateral angles very prominent, mesonotum slightly oblique, longer than broad, meso-metanotal suture broad and very well marked, basal portion of metanotum slightly oblique, steeply sloped, metanotal spines short acute, curved a little downward and inwards and placed on the sides a little down the oblique sloping portion of the metanotum. Petiole the 1st joint widened transversely concave and with a small rounded tubercle at apex above; 2nd joint short, longitudinally furrowed, the furrow widening posteriorly. Abdomen smooth slightly shining.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, West Bengal, Uttar Pradesh, Himachal Pradesh, Chandigarh, Haryana, Punjab.

Elsewhere : Sri Lanka, Myanmar.

Subfamily MYRMICINAE Lepeletier

Tribe CREMATOGASTERINI Emery

Genus *Crematogaster* Lund*Crematogaster (Acrocoelia) rothneyi* Mayr

1878. *Crematogaster (Acrocoelia) rothneyi* Mayr, *Verh. zool.-bot. Ges. Wien*, **28** : 681, worker.

Diagnostic Characters : Length Worker–3-3.5 mm. Worker–Rufo–feruginous, abdomen fuscous brown to black, pilosity fairly abundant. Head longitudinally striate, a little longer than broad. Mandibles finely striate with 4 teeth. Antennae slender but short, the scape not quite reaching the top of the head, the club of the flagellum formed of apical three joints. Alitrunk pronotum flat above, rounded anteriorly, mesonotum slightly, concave meso-metanotal suture very distinct, basal portion of the metanotum transversely rectangular, longitudinally striate, metanotal spines very thick at base, apex directed backwards and inwards. Petiole two-jointed 1st joint broad, flat above; broader in front than posteriorly, the sides rounded, 2nd joint seen from above trituberculate on upper side, the tubercles rounded, the anterior one small, the other two larger side by side, subequal, abdomen broadly cordate.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Tamil-Nadu, Sikkim, West Bengal, Punjab, Haryana, Himachal Pradesh, Meghalaya, Orissa, Uttar Pradesh.

Subfamily MYRMICINAE Lepeletier

Tribe CREMATOGASTERINI Emery

Genus *Crematogaster* Lund*Crematogaster subnuda* Mayr

1878. *Crematogaster subnuda* Mayr *Verh. Zool.-bot. Ges. Wien*, **28** : 680 & 682, Worker.

Diagnostic characters : Length worker : 3-3.5 mm.

Worker : Dark chestnut red, abdomen darkening posteriorly to fuscous brown. Head smooth, square, angles rounded. Mandibles strong, thick and narrow, the masticatory margin with 4 teeth. Antennae 11 jointed the club formed of the apical three joint, Alitrunk–the pronotum larger, rounded in front, subangular at the sides; pro-mesonotal distinct, the mesonotum small, slightly sloping posteriorly, mesometanotal suture well marked, the basal portion of metanotum rectangular sloping posteriorly, metanotal spines short and acute. Petiole the 1st joint flat above not very wide, semicircular in front with the lateral angles obtuse, 2nd joint above longitudinally grooved forming two rounded tubercles with a transverse rounded tubercle at the apex. Abdomen broadly cordate.

Distribution : India : Uttarakhand, Gujarat, West Bengal, Uttar Pradesh, Himachal Pradesh, Chandigarh, Haryana, Punjab, Tamil-Nadu, Maharashtra, Karnataka, Assam.

Subfamily MYRMICINAE Lepeletier

Tribe CREMATOGASTERINI Emery

Genus *Crematogaster* Lund

Crematogaster (Orthocrema) walshi Forel

1902. *Crematogaster (Orthocrema) walshi* Forel, *Rev. Suisse Zool.*, **10** : 15, Worker.

Diagnostic Characters : Length Worker–3-3.5 mm. Worker: Dark piceous, smooth and shining, the basal portion of the metanotum longitudinally striate, pilosity fairly abundant and pale yellowish in colour. Head rectangular, slightly longer than broad. Mandibles longitudinally strait with 4 teeth. Antennae short and thick, the scape not extending to the posterior margin of the head, the club formed of the apical three joints, but somewhat indistinct. Alitrunk raised in front and a little compressed, pro-mesonotal suture obsolete, meso-pro-mesonotal suture deep. Basal portion of metanotum sculptured, metanotal spines very short, triangular, not divergent. Petiole two jointed 1st joint slightly broadened, flat anteriorly and narrowed posteriorly, 2nd joint with a rounded, slightly raised node divided longitudinally by a broad groove. Abdomen short and broad.

Distribution : India : Uttarakhand, Rajasthan, Chandigarh, Punjab, Haryana, Uttar Pradesh, Meghalaya, Orissa, Sikkim, Himachal Pradesh, West Bengal.

Subfamily MYRMICINAE Lepeletier

Tribe MERANOPLINI Emery

Genus *Meranoplus* Fred Smith

Meranoplus bicolor Guerin

1845. *Meranoplus bicolor* Guerin, *Inconogr Regne Anim Insect.* **7** : 425 (*Cryptocerus*).

Diagnostic Characters : Length worker : 4-5 mm.

Worker : Head, alitrunk, legs and petiole of the abdomen bright ferruginous red. Abdomen black. Pilosity very long, soft, abundant and of a grey colour. Head a little longer than broad, broader posteriorly than the front. Mandibles narrow armed with 4 teeth. Clypeus convex in the middle, inclined downwards. Alitrunk–the pro-mesonotal shield about as broad as long, with the anterior angles prominent and acute, the sides posteriorly with a small incision and beyond that produced, backwards into a long laminate spine on each side overhanging the metanotum, the latter, vertical, slightly convex with a carina on each side ending above in an acute spine, Petiole the 1st node smooth, triangular 2nd node globose, Abdomen cordate.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Manipur, Tripura, Chandigarh, Karnataka, Kerala, Tamil Nadu, Punjab, West Bengal, Delhi, Orissa, Uttar Pradesh.

Elsewhere : Nepal, Myanmar, Indonesia, Sri Lanka, Pakistan, Bhutan, Thailand, China, Singapore, Malaysia.

Subfamily MYRMICINAE Lepeletier

Tribe SOLENOPSISINI Forel

Genus *Monomorium* Mayr

Monomorium (Monomorium) pharaonis Linne

1758. *Monomorium (Monomorium) pharaonis* Linne, *Syst. Nat.*, **1** : 586, Worker.

Diagnostic characters : Length worker : 2.5-3 mm.

Worker : Reddish yellow, posterior two thirds of the abdomen black, shining. Head half as long again as broad, the sides slightly convex; the posterior margin transverse. Mandibles narrow, linear, slightly broadened at the masticatory margin with 3-4 teeth. Antennae long and thick, scape reaching nearly up to posterior margin of the head. Alitrunk–pro-mesonotum convex rounded in front and at the sides narrowing posteriorly, mesometanotal suture very distinct, slightly emarginate, metanotum seen from above rectangular, somewhat flat, the posterior lateral angles of the basal portion scarcely tuberculate. Petiole 1st node little thick and rounded at the top, anteriorly with a long petiole, 2nd node from above globose, slightly broader than long and broader than the 1st node. Abdomen oval, truncate anteriorly.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Punjab, Haryana, West Bengal, Uttar Pradesh, Himachal Pradesh, Meghalaya.

Elsewhere : Spread over the tropical region of both the hemispheres.

Subfamily MYRMICINAE Lepeletier

Tribe SOLENOPSISINI Forel

Genus *Monomorium* Mayr

Monomorium (Monomorium) wroughtoni Forel

1902. *Monomorium (Monomorium) wroughtoni* Forel, *Rev. Suisse Zool.*, **10** : 209, Worker.

Diagnostic characters : Length worker : 2.0 mm.

Worker : Blackish brown with the abdomen dark brown. Abdomen opaque except at the base which is smooth and shining. Head longer than broad, narrow posteriorly, slightly emarginate Mandibles narrow armed with 4 teeth. Antennae moderately long, the scape nearly reaching the top of the head. Alitrunk depressed sub-margined, the meso-metanotal suture distinct, basal portion of metanotum rectangular, apex truncate. Petiole

1st node conical, rounded above, anteriorly petiolate, the petiole thickening and sloping posteriorly, 2nd node globose, broader than the 1st node. Abdomen broadly oval, truncate anteriorly, acute posteriorly.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Karnataka.

Subfamily MYRMICINAE

Tribe SOLENOPSIDINI Forel

Genus *Monomorium* Mayr

Monomorium (Parholcomyrmex) destructor Jerdon

1851. *Monomorium (Parholcomyrmex) destructor* Jerdon, *Madras Jour. Lit. Sc.*, **17** : 105, Worker (*Atta*).

Diagnostic Characters : Length worker : 1.8-2.3 mm.

Worker : Reddish yellow, apical three-fourth of abdomen from chestnut brown to dark brown. Head rectangular, slightly emarginate posteriorly. Mandibles narrow armed with 4 teeth; the apical longest and acute. Antennae 12 jointed, the scape just reaching the top of the head. Alitrunk-elongate anteriorly as broad as the back of the head, the pro-metanotum convex, meso-metanotal suture deeply impressed, basal portion of metanotum narrow passing by the rounded curve into the apical portion. Petiole elongate the 1st node squamiform, anteriorly petiolate 2nd node globose, a little broader than long, not as high as the 1st node. Abdomen oval.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, West Bengal, Karnataka.

Elsewhere : Torrid regions of both hemispheres.

Subfamily MYRMICINAE

Tribe SOLENOPSIDINI Forel

Genus *Monomorium* Mayr

Monomorium (Xeromyrmex) salomonis indicum Forel

1902. *Monomorium salomonis* Linn., *race indicum* Forel *Rev. Suisse Zool.*, **10** : 213.

Diagnostic Characters : Length worker : 3-3.5 mm.

Worker : Ferruginous red with abdomen dark brown. Head opaque almost as broad as long, broader anteriorly than posteriorly. Mandibles narrow with three to four teeth, when closed partially concealed under the projecting margin of the clypeus. Antennae moderately long, the scape not quite reaching the posterior margin of the clypeus. Alitrunk anteriorly rounded, moderately broad, the meso-metanotal suture distinct, the basal portion of the metanotum broadening posteriorly, Petiole

the nodes seen from above equal. The rounded 1st node higher than and 2nd node and petiolate anteriorly. Abdomen oval.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Chandigarh, Karnataka, Punjab, West Bengal, Andhra Pradesh, Tamil Nadu.

Elsewhere : Myanmar.

Subfamily MYRMICINAE Lepeletier

Tribe SOLENOPSIDINI Forel

Genus *Monomorium* Mayr

Monomorium monomorium Bolton

1995. *Monomorium monomorium* Bolton, *A New Genl. Cat. Ants World.*, : 264.

Diagnostic Characters : Length worker : 1.5-2 mm.

Worker : Head and alitrunk dark brown, abdomen black, smooth, polished and shining; pilosity very sparse. Head rectangular, posteriorly transverse. Mandibles narrow with 4 teeth on masticatory margin. Clypeus very convex, anteriorly rounded. Scape of antennae 12-segmented nearly reaching upto the top of the head; eyes comparatively large, placed in the middle of the head. Pro-mesonotum convex; meso-metanotal suture distinct and emarginate; metanotum compressed, basal portion rectangular, apical portion truncate. Petiole rounded, 2nd node broader than long. Abdomen oval.

India : Uttarakhand, Karnataka, West Bengal.

Elsewhere : Africa, North America, Southern Europe.

Subfamily MYRMICINAE Lepeletier

Tribe SOLENOPSIDINI Forel

Genus *Monomorium* Mayr

Monomorium sagei Forel

1902. *Monomorium sagei* Forel, *Rev. Suisse Zool.*, **X** : 211.

Diagnostic characters : Length Worker 2.2-2.5mm. Pale yellow, smooth and shining. Mandible narrow with four acute teeth, Antennae 12-jointed, scape extending beyond the top of head, flagellum with a distinct club. Alitrunk convex above, not submargined, thorax seen in profile deeply emarginate at the meso-metanotal suture. Petiole—the 1st node squamiform, anteriorly petiolate, 2nd node from above circular, smoothly rounded a little broader in front than posteriorly, abdomen more than twice as long as broad.

Distribution : India : Uttarakhand, Rajasthan, Karnataka, North-West Himalayas.

Subfamily MYRMICINAE Lepeletier

Tribe PHEIDOLINI Emery

Genus *Messor* Forel

***Messor barbarus* subsp. *himalayana* Forel**

1902. *Messor barbarus* subsp. *himalayana* Forel, *Rev. Suisse Zool.*, **10** : 220, Worker, Female, Male (*Stennama*).

Diagnostic characters : Length : Worker-4-10 mm.

Worker : Black shining, the mandibles reddish brown, the flagellum of the antennae and legs castaneous, the scape brown. Head without the mandibles square longitudinally striate, masticatory margin of mandibles dentate. Alitrunk narrower than the head, the posterior lateral angles of the metanotum dentate, 1st node of the petiole conical, rounded above with a long petiole anteriorly, 2nd node broader, rounded above, about as broad as its length. Abdomen oval.

Distribution : India : Uttarakhand, Rajasthan Punjab, Chandigarh, N.W. Himalayas, Himachal Pradesh.

Subfamily MYRMICINAE Lepeletier

Tribe CARINI Emery

Genus *Recurvidris recurvispinosa* (Forel)

***Recurvidris recurvispinosa* (Forel)**

1890. *Trigonogaster recurvispinosa* Forel, *Ann. Soc. Ent. Belg., C.R.*, **34** : 109 Worker.

1992. *Recurvidris recurvispinosa* Bolton, *Psyche*, **99** : 46.

Diagnostic characters : Length Worker 2.2-2.5 mm.

Worker : Orange yellow, eyes black, mandibles brown; pubescence almost absent; erect sparse hairs on head, alitrunk and abdomen. Head elongate, rectangular, anteriorly truncate; narrow mandibles with 4 teeth; vertical clypeus medially bicardinate, anterior margin complete and arched. Antennae 11-segmented, scape extending up to the top of head. Alitrunk elongate, broad anteriorly. Pro-mesonotum forming a single convexity; pro-mesonotal suture absent; meso-metanotal suture deep, emarginate; metanotum dorsally flat, strong spines curved upwards and forwards from their bases. Petiole with long peduncle in front with an acute ventral spine, 1st node low and conical, 2nd node reduced, shallow in profile. Basal segment of the abdomen dorsally flat, strongly convex ventrally.

Distribution : India : Uttarakhand, West Bengal, Karnataka, Tamil Nadu Assam, Kerala.

Elsewhere : China, Hongkong, Japan, Myanmar, Nepal.

Subfamily MYRMICINAE Lepeletier

Tribe TETRAMORINI Emery

Genus *Tetramorium* Mayr

***Tetramorium salvatum* Forel**

1902. *Tetramorium salvatum* Forel, *Rev. Suisse Zool.*, **10** : 235, Worker.

Diagnostic characters : Length : 2.3-2.4 mm.

Worker : Reddish yellow in colour, abdomen dark brown Head rectangular, a little broader posteriorly than in front, the sides convex. Mandibles armed with 7 teeth. The eyes are large and more convex., Antennae 11 jointed. Alitrunk–Pronotum broad anteriorly, not emarginate at the meso-metanotal suture. Metanotal spines as long as about two-thirds of the space between them. First node of petiole as broad as long, second node narrowed anteriorly, broadened posteriorly. Abdomen convex.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Western India, N. W. Himalayas.

Subfamily MYRMICINAE Lepeletier

Tribe TETRAMORINI Emery

Genus *Tetramorium* Forel

***Tetramorium walshi* Forel**

1890. *Triglyphotherix walshi* Forel, *Ann. Soc. Ent. Belg.*, **34** : 107, Worker, Female.

Diagnostic characters : Length Worker 2.2-2.5 mm.

Worker : Dull brown, abdomen black. Pilosity very dense and woolly, whitish in colour and somewhat concealing the sculpture. Head narrowed anteriorly. Posterior margin of clypeus produced between the basis of antennae. Mandibles broad with 5-7 teeth. Antennae 12-jointed, short, the scape not reaching the top of the head. Thorax short and broad, curved and convex above, pronotum unarmed, the metanotal spine sub-triangular and acute at apex pointing obliquely back, Erect hairs on body trifid. First node of pedicel distinctly transverse, much broader than long. Petiole of 1st node nearly as long as node.

Distribution : India : Uttarakhand, Rajasthan, Karnataka, Kerala, Tamil Nadu, Meghalaya, Arunachal Pradesh, Orissa, West Bengal, Himachal Pradesh.

Elsewhere : Sri Lanka.

Subfamily FORMICINAE

Key to genera of subfamily FORMICINAE

A. Antennae 12 jointed.

A(i) Maxillary pulpi 6 jointed.

1. Antennae inserted at perceptible distance from posterior margin of clypeus.

i) Alitrunk and node of petiole not spinous, basal two abdominal segment equal in length
..... **Camponotus**

2. Antennae inserted immediately above posterior margin of clypeus, almost touching it.

i) Antennal and clypeus hollows not confluent, distinct **Paratrechina**

a A(ii)Antennae 12 jointed, maxillary palpi 5 jointed
Oecophylla

B. Antennae 11 jointed, maxillary palpi 6 jointed.

i) **Acantholepis**

Subfamily FORMICINAE Lapeletier

Tribe CAMPONOTINI Forel

Genus **Camponotus** Mayr

Camponotus (Tanaemyrmex) compressus Fabricius

1787. *Camponotus (Tanaemyrmex) compressus* Fabricius, *Mant. Insect.*, 1 : 307, Worker, (*Formica*).

Diagnostic characters : Length worker : 13 mm

Worker : Black opaque. Head sub triangular, very broad posteriorly. Mandibles triangular with seven teeth. Clypeus medially vertically carinate. Alitrunk narrower than the head, anteriorly produced into a collar. Node of the petiole oval, transverse convex in front, flat posteriorly. Tibia of the legs prismatic. Abdomen broad and massive.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Tripura, Andamans, Chandigarh, Karnataka, Tamil Nadu, Assam, West Bengal, Meghalaya, Punjab, Orissa, Sikkim, Manipur.

Elsewhere : Sri Lanka, Myanmar, Russia, Arabia, Africa, Borneo, Philippines, Nepal, Malayan subregion.

Subfamily FORMICINAE Lapeletier

Tribe CAMPONOTINI Forel

Genus **Camponotus** Mayr

Camponotus (Tanaemyrmex) invidus Forel

1892. *Camponotus (Tanacemyrmex) invidus* Forel, *J. Bombay nat. Hist. Soc.*, 7 : 235, fig.2, Worker, Soldier.

Diagnostic Characters : Length worker : 5-6 m.m.

Worker :- Head, alitrunk and abdomen entirely pale yellow with sparse erect yellowish pubescent. Head more or less elongate, sides of the head straight not convex. Mandibles with 6 teeth; clypeus comparatively broad. Antennae 12 segmented, comparatively long and thick. Alitrunk convex anteriorly, strongly laterally compressed posteriorly, with the pro-meso and metanotum more strongly curved. Legs stout, tibia cylindrical. Petiole one jointed, node low, convex in

front, flat posteriorly, abdomen comparatively long and massive.

Distribution : India : Uttarakhand, Rajasthan, Orissa, Himachal Pradesh, Sikkim, West Bengal, Delhi.

Subfamily FORMICINAE Lapeletier

Tribe CAMPONOTINI Forel

Genus **Camponotus** Mayr

Camponotus (Orthonotomyrmex) sericeus Fabricius

1798. *Camponotus (Orthonotomyrmex) sericeus* Fabricius, *Suppl. Ent. Syst.*, : 279, Worker (*Formica*).

Diagnostic characters : Length worker maj. 10 mm.

Worker : Black with the head blood red in colour. Abdomen with a dense silky golden pubescence hiding the sculpture. Head very broad, emarginate posteriorly, mandibles with 5 teeth. The anterior border of clypeus emarginate in the middle. Alitrunk broad in front, strongly compressed posteriorly, emarginate at the meso-metanotal suture, the basal face of the metanotum horizontal, flat the sides margined posterior face excavate. Node of petiole rounded knob like. Abdomen very broad globose.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Chandigarh, Karnataka, Tamil Nadu, West Bengal, Meghalaya, Punjab, Orissa, Manipur, Delhi.

Elsewhere : Myanmar, Sri Lanka, Africa, Arabia, Egypt, Indo-China.

Subfamily FORMICINAE Lapeletier

Tribe CAMPONOTINI Forel

Genus **Camponotus** Mayr

Camponotus dichrous Forel

1897. *Camponotus dichrous* Forel, *Bull. Soc. Vaud. Sc. Nat.*, 16 : 63. Worker.

Diagnostic Characters : Worker : 9-11 mm.

Worker : Head and 3rd and following segments of the abdomen pitch-black, basal two segments yellow, the alitrunk brown. Head triangular, much broader posteriorly than in front, the lateral occipital angles very prominent, mandibles with teeth, clypeus carinate with a median anteriorly produced rectangular lobe. Scape of antennae cylindrical. Tibia compressed and spined beneath. Alitrunk anteriorly narrowed into a collar, seen from side forming a regular arch. Petiole one jointed and node of petiole convex in front, flat posteriorly. Abdomen oval not broader than the head.

Distribution : India : Uttarakhand, Rajasthan, Punjab, Uttar Pradesh, West Bengal, Himalayas.

Subfamily FORMICINAE Lepeletier

Tribe CAMPONOTINI Forel

Genus *Camponotus* Mayr

Camponotus dolendus Forel

1892. *Camponotus rufoglaucus* (Jerdon) race *dolendus* Forel, *J. Bombay nat. Hist. Soc.*, 7 : 227 & 238, Worker.

Diagnostic Characters : Worker : 7-9 mm.

Worker : Black, mandibles, antennae, legs and posterior margins of abdominal segments testaceous; pubescence entirely wanting. Head subtriangular, sides convex; carinate clypeus with median lobe distinctly rectangularly produced. Mandibles with 7 teeth. Alitrunk short and broad; legs with tibiae compressed and with scattered spines on undersides. Petiole broad and flat with silky pilosity. Abdomen broadly oval.

Distribution : India : Uttarakhand, North West Himalayas, Tamil Nadu, Sikkim, Andaman and Nicobar Islands, West Bengal.

Subfamily FORMICINAE Lepeletier

Tribe OECOPHYLLINI Forel

Genus *Oecophylla* Smith

Oecophylla smaragdina Fabricius

1793. *Oecophylla smaragdina* Fabricius, *Hafniae Ent. Syst.* 3 : 350, Worker.

Diagnostic characters : Length worker maj. 9.5-11 mm. Worker min. 7-8 mm.

Worker : Rusty red. Head of maj. and min relatively the same size, roundly quadrangular, posteriorly not emarginate and slightly broader than in front. Mandibles long with masticatory margin very broad in proportion to length, dentate, the apical tooth acute and curved, clypeus strongly convex about two third as high as broad, its anterior margin strongly arched. Antennae 12-jointed, originating from the anterior margin of the clypeus. Alitrunk elongate, pronotum convex, anteriorly narrowed into a collar, mesonotum constricted, narrow, saddle shaped. Metanotum rounded above, gibbous. Petiole elongate, incrassate in the middle scarcely nodiform. Abdomen short oval.

Distribution : India : Uttarakhand, Rajasthan, Gujarat, Maharashtra, Uttar Pradesh, Sikkim, Uttranchal, Assam, Chandigarh, Meghalaya, Orissa, Tamil Nadu, Karnataka, Kerala, Andamans, N.W. Himalayas.

Elsewhere : Myanmar, Sri Lanka, S. China, Malaya, New Guinea, Australia, Java.

Subfamily FORMICINAE Lepeletier

Tribe PRENOLEPIDINI Forel

Genus *Paratrechina* Motschoulsky

Paratrechina longicornis Latreille

1802. *Nylanderia longicornis* Latreille, *Hist. Nat. Fourmis* : 113, (*Formica longicornis*).

Diagnostic characters : Length : Worker : 2.5-3 mm. Dull coppery brown in colour, with fairly abundant, long, erect, somewhat coarse hairs. Head oval as broad in front as posteriorly. Mandible small with 5-6 teeth. Antennae 12 jointed, scape of antennae remarkably long, extending beyond the top of the head by more than half its length. Alitrunk elongate, rounded above viewed from side lightly emarginate at the mesonotum, not constricted at the mesometanotal suture. Node of the petiole not so broad as high. Abdomen anteriorly gibbous oval and massive.

Distribution : India : Uttarakhand, Rajasthan, Western India, Maharashtra, Orissa, West Bengal, Uttar Pradesh, Tamil Nadu.

Elsewhere : All tropical countries (Europe).

Subfamily FORMICINAE Lepeletier

Tribe PLAGIOLEPIDINI Forel

Genus *Acantholepis* Mayr

Acantholepis frauenfeldi Emery

1925. *Acantholepis frauenfeldi* Emery, *C. Gen. Insect. Fasc.*, 183 : 23, 25.

Diagnostic Characters : Length worker : 3.5 mm.

Worker : Head brown, mandibles, antennae thorax, legs and node of petiole brownish yellow abdomen dark brown, Head distinctly longer than broad, rounded above, mandibles narrow, curved with the apical tooth long and acute, clypeus strongly convex. Scape of antennae remarkably long extending for more than half its length beyond the top of the head. Alitrunk the pronotum in front above appears circular, the mesonotum strongly constricted in front forming a cylindrical neck, widening posteriorly, the metanotal teeth thick and broad at base, the meso-metanotal suture deep and distinct. Node of petiole pentagonal the upper border slightly emarginate. Abdomen oval.

Distribution : India : Uttarakhand, Rajasthan, Maharashtra, Chandigarh, Punjab, Andhra Pradesh, Meghalaya, West Bengal, Karnataka.

Elsewhere : Southern Europe, N. Africa.

SUMMARY

The manuscript deals with 28 ant species distributed under 13 genera of the family Formicidae. The family

comprises 6 sub-families namely Dorylinae with 1 genera and 2 species. Aenictinae with 1 genera and 1 species. Dolichoderinae with 1 genera and 1 species. Pseudomyrmecinae with 1 genera and 1 species. Myrmecinae with 5 genera and 15 species and Formicinae with 4 genera and 8 species.

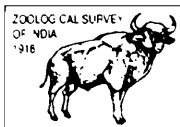
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POLYPHENISM—GENETIC OR EPIGENETIC?

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INTRODUCTION

In the post-Darwinian period genes have been considered as of prime importance in the development of the phenotype. But now again the role of genes along side that of the environment is being discussed, and some authors have even turned to Lamarckism. But one desirable aspect of this change, as pointed out by West-Eberhard (2006), is that the current discussion in this area has helped identifying “an important shortcoming of mainstream evolutionary thought, namely neglect of environmentally induced variation, and its importance for evolution by natural selection”

In the present context by ‘genetic’ is meant accountable by the Synthetic Theory of Evolution, which attributes all phenomena of inheritance and evolution to three factors, mutation, selection, and isolation. “ ‘Epigenetics’ is the study of heritable changes in a gene expression and function that cannot be explained by changes in DNA sequence” (Bossdorf *et al.*, 2008).

“ ‘Phenotypic plasticity’ refers to the ability of genetically identical organisms to alter their phenotype in response to an environmental change” (Anonymous, 2005) Some species exhibit more of phenotypic plasticity than others.

At present evidence in support of the genetic mechanism of phenotypic plasticity is dominant and overwhelming, and that supporting the epigenetic side is scanty. But significance of an open minded approach in this discussion cannot be over-emphasized.

GENETIC CONTROL OF PHENOTYPIC PLASTICITY

(i) Polyphenism in tobacco hornworm

A significant paper on a case of polyphenism is by Suzuki & Nijhout (2006). The larvae of the tobacco hornworm (*Manduca sexta*) are monophenic and green in colour. The larvae of a closely related species, the tomato hornworm (*Manduca quinquemaculata*) are polyphenic; they may be green, black and with intermediate body colours. The larvae of this species are black, if developed at 20° C, and green at 28° C.

Suzuki & Nijhout (*loc. cit.*) have concentrated on *Manduca sexta*, and have found that, if the larvae of this species are heat-shocked, i.e. by exposure to heat for 6 hours just before start of the moult between the 4th and the 5th instars, a range of body colours are produced, from black to the original green. As Verma (2007) has described, Suzuki and Nijhout performed the following experiment; “ Among the larvae obtained in this manner (i.e. after the heat shock treatment), selection was done along two lines—a monophenic line by selecting black larvae in each generation to obtain the next generation, and a polyphenic line by selection of normal green larvae. In each generation nearly 3000 larvae were reared, and subjected to heat-shock. Of these, 60 larvae were then chosen, following the above mentioned body colour criteria, to get the next generation. A control line was also maintained; these were subjected to heat-shock in each generation, and the next generation was reared without any selection. The monophenic line lost its response to heat treatment after about the seventh generation, i.e. now heat treatment led to the production of only black larvae. In

Key words : tobacco hornworm, bruchids, Y chromosome, yeast, polyploidy, cavefishes, Baldwin Effect

the polyphenic line the body colour remained green even at 28° C. In the control line the body colour showed continuous variation between the black colour.... and the nearly complete green colour....” The observation in the control line suggests a polygenic control of development of body colour, and that the repeated heat treatment environment did not alter the polygenic response. Obviously the polyphenism in *M. sexta* is under genetic control.

(ii) Polyphenism in bruchids

Several workers have studied polyphenism in stored legume bruchids. In *Callosobruchus maculatus* F. and *C. analis* F. there are ‘flightless’ form (referred to as ‘A’ phase by Tiwary and Verma, 1989, a, b, and c) and George and Verma (1994, 1997, and 1999), and ‘flight’ phase (called ‘B’ phase by Tiwary and Verma, *loc. Cit.*, and as ‘B’ ‘X’ and ‘Y’ by George and Verma, *loc. cit.*). The ‘B’ individuals are highly melanic and are active flyers and ‘A’ are light coloured and less active. In between the two phases are a series of intermediate forms. Crowding or a high density population in a culture increases the proportion of melanic form (Tiwary and Verma, 1989c). That crowding has this effect has been observed also by Utida (1965). George and Verma (1999) reared *C. maculatus* in laboratory in medium density cultures, some at >40° C and high humidity (RH >90%), and some at 32± 2° C and RH 70 -75%. They noted a significant increase in the proportion of the melanic phase under conditions of high temperature and high humidity. It is believed that larval crowding in a legume store produces both a rise in temperature and in humidity.

Tiwary and Verma (1989c) did selection in high density cultures of *C. analis* for 10 generations, in 3 lines in favour of ‘B’ or highly melanic phase, and in 3 lines in favour of ‘A’ phase or lightly melanic phase. After the 10th generation in each line the bruchids were left to them-selves, i.e. without any further selection. In cultures, in which selection had been done for ‘B’ in the second post-selection generation all individuals were ‘B’ and in the cultures, in which selection had been in favour of ‘A’, out of 150 individuals, examined, all, except 2, were ‘A’. Occurrence of intermediate forms between ‘A’ and ‘B’ in an unselected culture suggests a polygenic control in the phase development in the two bruchid species. Tiwary and Verma (1989d), from their experiments, have inferred that the significance of the ‘B’ phase of *C. analis* is that the individuals in this phase, being more active flyers, help in reaching new stores, when the original store has become too

crowded. Presumably on reaching a new store ‘B’ individuals breed and eventually produce a mixed phase population with ‘A’ dominating. This suggests that the effect of the environment in the original store is not inherited by the progeny in the new store. Obvious inference is that the control of polyphenism in bruchids is genetic.

(iii) Polyphenism in a pierid butterfly

Karisson (2008) has recorded in a pierid butterfly that “summer generation adults have a higher dispersal capacity measured as flight duration at five different temperatures” These summer adults have a larger thorax. About reproductive output, the summer females lay fewer eggs than spring females. Thus there is a trade-off between flight ability and fecundity. A similar trade-off has been noted in bruchids *Callosobruchus analis* (Tiwary and Verma, 1989a) and in *C. maculatus* (George and Verma, 1994). The ‘flight’ or ‘B’ phase females of the two bruchid species, though more active, have reduced ovaries and lower fecundity than ‘A’ or ‘flightless’ females.

Both in the stored legume bruchids and in the pierid butterfly there are shifts in the frequency of the phases with changes in the environmental conditions, because of cost of plasticity (Crispo, 2007). Such cases of polyphenism do not support the epigenetic concept.

(iv) Y-induced polyphenism

Lemos *et al.* (2008) have experimentally investigated the role of the Y chromosome induced polyphenism in *Drosophila melanogaster* flies. Thermal tolerance differs among different populations of the fly. Among *Drosophila* species “thermal heat sterility thresholds differ across species from 23° C in heat sensitive species upto 31° C in heat tolerant species” The thermal sterility in the fly results from disturbed spermatogenesis. For these experiments the authors have developed specially prepared strains of *D. melanogaster*, some with the Y chromosome from temperate climate (Ymass), and some with Y chromosome from tropical climate (Ycongo). (Ymass refers to the Y chromosome derived from flies collected in Massachusetts, USA, and Ycongo to the Y chromosome derived from flies in Congo, Africa). In these strains the rest of the genotype or extra-Y genotype was homogenic. Flies of these strains were reared at 16° C and at 25° C. In either of the two strains some genes were up-regulated and some down-regulated at the two temperatures. “We (the authors) found that the Ycongo line showed about twice as many genes up-regulated at 16° C relative to Ymass, whereas the Ymass line showed about twice as many genes up-

regulated at 25° C relative to Ycongo....” From their studies the authors have concluded, “Our findings provide a mechanism for adaptive phenotypic variation associated with the Y chromosome”

(v) Chirality in snails

In most snail species individuals have dextral shells, and sinistrality of shells is rare. But the west Asian snail *Amphidromus* shows the two enantiomorphs in considerable proportions, the frequencies of the two varying in different populations, proportion of sinistral individuals reaching even 90% in some cases. Schilthuizen *et al.* (2007) have studied this snail, and have found the reasons for the high frequency of sinistrality. The reasons are: (1) Interchiral matings (i.e. matings between dextrals and sinistrals) occur in *Amphidromus*, whereas such matings are not known in other snails, and (2) Such interchiral matings result in greater fecundity, which means selective advantage for such matings. In this instance the shell dimorphism is obviously genetic.

(vi) Cavefishes

Borowski (2008) has experimentally studied the blind cavefish, *Astyanax mexicanus* in 29 different caves in north-eastern Mexico. This fish with normal vision occurs in surface waters too. From various experimental crosses the author has inferred that the loss of vision has been due to mutation at different loci in the cavefish populations in different caves. Twelve such loci have been identified (Niven, 2008). On crossing a surface fish and a cavefish, in the resulting F1 generation the fishes have been found to have smaller eye than in the surface fish, but fully visual. F1 hybrids, from a cross between a cavefish from the Tinaja cave and a fish from the Molino cave, have been found to have 39% vision. It has been estimated that the fishes reached the caves in mid-Pleistocene, i.e. about 1,000,000 years back.

Main inferences arrived at in Borowski’s study :

(1) Loss of vision in the fish in the dark environment of the caves evolved independently in different cave populations through convergence,

(2) The loss of vision has been through mutation at multiple loci.

(3) It is likely that the reduction of eyes has been through genetic drift in the absence of selection pressure to maintain eye function.

Though Lamarckists, like R. Jeannel, have often cited the example of blind cavefishes in support of their notion, in the study of the Mexican cavefishes by

Borowski (*loc. cit.*) there is little to support either Lamarckism or epigenetics.

(vii) *Heliconius*, a markedly plastic butterfly

Butterflies of the Neotropical genus *Heliconius* present a remarkable example of phenotypic plasticity (Kronfrost and Gilbert, 2007). They present “hundreds of distinct mimetic wing patterns at both population and species level” *Heliconius erato* and *H. melpomene* are an instance of a pair of mimetic species with nearly identical wing pattern, and sympatric in distribution. How has this sympatric diversity evolved? To explain this the authors have hypothesized that *Heliconius* species have subpopulations within the range of a population. Within a subpopulation genetic diversity arises followed by the Sewall-Wright effect or local genetic drift. As a result of the drift certain mutant genes start increasing in frequency. When in frequency they reach a threshold value and are of defensive significance, they get “protected” by which the authors seem to mean through natural selection.

The ‘subpopulation’ part of the hypothesis has been confirmed by Kronfrost *et al.* (*loc. cit.*) by taking to mark-recapture method. They have inferred that the butterfly shows a small home range behaviour; hence isolated subpopulations.

To confirm the ‘genetic drift’ part of the hypothesis Kronfrost *et al.* have done DNA analysis. From such studies they have inferred “local genetic drift over very limited spatial scales” Thus polyphenism in *Heliconius* butterflies is essentially a genetic phenomenon.

(viii) A case of *Chrysochus* leaf beetles

Dahlhoff and Rank (2007) have studied a case of physiological polyphenism in the mountainous leaf beetle *Chrysochus aeneicollis* in three different areas in Sierra Nevada, California. The three areas have named as BC, BPC, and RC. RC is at the highest elevation and BPC at the lowest, while BC is at a middle elevation. Mean summer temperature is lowest at RC, and highest at BPC. The authors, in their study, have concentrated on the enzyme locus phosphoglucose isomerase (PGI). This enzyme is involved in temperature tolerance. Two alleles of the enzyme locus have been identified, PGI-1 and PGI-4. In the beetles in the area RC PGI-1 dominates, and PGI-4 is only small in proportion. In BC PGI-1 is more, but PGI-4 is more in frequency than in RC. In BPC PGI-4 dominates. The authors have studied the frequency of PGI alleles in 1988 and in 1996. They have found that “During that time the frequency of PGI-1 increased by 11% in BC, while PGI-4 decreased. These directional shifts did not occur at other polymorphic

enzyme loci, suggesting that changes at PGI resulted from natural selection favoring PGI-1 allele” Role of genetic mechanism in this case of physiological polyphenism is obvious.

(ix) Gorilla polyphenism

Anthony *et al.* (2007) have studied mtDNA variation among different gorilla populations, and have found that the results support the view that the genetic variability among the populations has resulted from their distribution among the patches, formed by the Pleistocene fragmentation of the forest, providing refugia to forest dwelling species, and from river barriers. They point out, “Admixture is also evident along the borders between refugial populations” Morphological and behavioural polyphenism among gorilla populations in such border areas is obviously genetic in origin.

(x) Polyphenic yeast

It has been known for quite sometime that some strains of yeast are phenotypically more plastic with environmental changes than others. Some 6000 genes in yeast have been studied as to their response to variety of stressful environments. It has been found that that genes vary enormously in their response to varying conditions, extent of response varying considerably from gene to gene Promislow (as cited by Anonymous, 2005, according to whom the paper by Promislow was due to be published in the May 2005 of the American Scientist) has studied the regulatory genes, regulating the expression of other genes. He has discovered that “the more regulators a gene has, the more plastic the gene” Smith and Kruglyak (2008) have extensively studied gene-environment interaction in yeast, and have discovered “how the effects of different classes of regulatory variants are modulated by the environment” However, in these communications there is no mention of changed/modified gene expression as becoming heritable.

(xi) Plastic behaviour of the great tit

Nussey *et al.* (2005) made observations on a Dutch population of the bird *Parus major* (the great tit). They kept in view the theoretical inference that phenotype plasticity may evolve to stability through selection. This notion has received support from some laboratory studies. The authors wanted to confirm this notion through observations on a wild population, and they chose the great tit population. They noted that in the chosen population there was plasticity with regard timing of reproduction. Some individual birds showed

mismatch between the breeding time and the time when caterpillars, which were the prey for the bird, were available in good numbers. During the period of 32 years of their study Nussey *et al.* (*loc. cit.*) noted that there was a gradual evolution of the breeding time so as to remove the mismatch. Obviously the behavioural plasticity was being replaced by fixity.

Charmantier *et al.* (2008) have studied a wild population the great tit (*Parus major*) in United Kingdom for 47 years. They noted that the individuals in the population were “markedly invariant in their response to environmental variation, suggesting that the current response may be fixed in this population” Presumably this fixity has been reached through selection, the progress of which has been observed by Nussey *et al.* (2005) in a Dutch population of this bird.

These observations are within the realm of the Synthetic Theory.

(xii) Death Valley pupfish

The Death Valley in Colorado, USA is a very dry, hot, and depressed area, 86 metres below the sea level, with temperature reaching 49° C in summer.

In the floor of the valley there are number of water bodies, large and small, isolated from each other like islands of an archipelago, and with varying environmental conditions, such as water temperature, food availability, and population density of the pupfish (*Cyprinodon nevadensis*). Populations of the pupfish in different water bodies in the valley present different phenotypes, i.e. exhibit phenotypic plasticity.

Lema (2008), with his coworkers, has studied the phenotypic variability in the pupfish.

One water body in the valley has been named as the Devil’s Hole. It is 14 metres deep in a rock fissure, quite warm, and poor in food supply. The pupfishes in this water hole have small body size, large head, and flatter body. Some other water bodies, like the Big Spring, have cooler water, and with more abundant food. In such water bodies the pupfishes have a smaller head, and deeper body. Some pupfishes from the Devil’s Hole were transferred to cooler waters and better food supply, and they, after only 5 years, showed smaller head and deeper body. There is an obvious relationship between environment and the structural phenotype. A behavioural plasticity has also been observed. While males, in cooler waters with better food supply, defend their reproductive territory actively and aggressively, the males in the Devil’s Hole are not so active and aggressive in this respect.

The experimental studies by Lema (*loc. cit.*) and his associates show that thyroid hormone deficiency produces morphological features like those in the fishes in the Devil's Hole. The aggressive behaviour of the male fish is induced by a neurohormone, arginine vasotocin (AVT), which is secreted by some neurosecretory cells in the preoptic region of the hypothalamus. The neurosecretory cells could be identified by using an antibody to AVT. Lema and associates experimented with pupfishes from Amargosa River, reared under conditions of the Devil's Hole from the hatchling stage. The river fishes had larger neurosecretory neurons than the same sex individuals in the Big Spring with cooler water and more abundant food than the Devil's Hole. Next the Lema team injected exogenous AVT into a male from (wild population in) the Amargosa River. This resulted in the male becoming less aggressive.

Lema and his associates kept pupfishes from the Amargosa River and from the Big Spring in captivity, and have exposed them to different values of temperature and salinity. They found that the AVT systems of the fishes from the two wild populations responded differently to these environmental changes. This shows that the two populations have “evolved differences” in their proclivity to respond to these environmental variations.

Lema (*loc. cit.*) says, “Recently....accumulating evidence has established that plasticity itself has a genetic basis. Although the phenotypes generated by plasticity are induced by the environment, the phenotypic responses are produced by changes in the gene expression”

(xiii) A case of Darwin's finches

Hendry *et al.* (2008) have studied distribution of beak size in a Darwin's finch (*Geospiza fortis*) in El Garrapatero and Santa Cruz islands of the Galapagos archipelago. The distribution is bimodal, medium beak size being comparatively rare. The larger and the smaller beak sizes differ, besides in size, in the bite force capacity. This plasticity seems related to availability of small/soft and large/hard seeds. Between the two modes there seems to be some reproductive isolation, as song structure differs in birds of the two modes, and they “respond differently to each other's song” However, limited gene flow between the two modes could be inferred from analysis of DNA of microsatellites. The bimodality was being maintained in the study period due to “selective loss of birds with intermediate beak sizes” which may be due to relatively few intermediate

size seeds or to the large and small beak size birds sharing the availability of middle sized seeds.

Between 2004 and 2006 the large beak size mode was becoming taller, and the small beak mode smaller. Were the two modes on way of speciation? May be this selection in favour of the larger beak was operative during droughts, and it was not there during wet years. Besides the history of selection has been variable. “At one site (Academy Bay) bimodality was historically strong but now weak. At a second site (El Garrapatero) bimodality is currently strong. At a third site (Borrero Bay) bimodality has not been documented in the past nor the present” (Hendry *et al. loc. cit.*). Besides there are temporal fluctuations in the distribution of the two modes, and thus, a tug of war seems to be going on between the two directions of selection, or there are intraspecific evolutionary fluctuations, and thus the phenotypic plasticity in the bird species is currently being maintained.

EPIGENETIC EFFECT IN PHENOTYPIC PLASTICITY

While there is a massive support for genetic control of phenotypic plasticity, some evidence has recently surfaced inferring epigenetic involvement in this.

Epigenetics, as it is commonly understood at present, has been defined in the ‘Introduction’ part of this review. Waddington (1953) defined epigenesis in a different way. He regarded epigenesis as genetic assimilation of acquired characters. His concept is outdated, and has been replaced now (Bossdorf *et al.*, 2008).

Epigenesis works by the environment interfering with gene function. The interference includes “molecular forces that can activate, reduce or completely disable the activity of particular genes....” (Bossdorf *et al., loc. cit.*). The changes in genes include “(i) methylation of cytosine residues in the DNA, (ii) remodelling of chromatin structure through chemical modification, in particular acetylation or methylation of histone proteins and (iii) regulatory processes mediated by small RNA molecules” (Bossdorf *et al.*). Cytosine followed by guanine or the CpG sites are in many cases clustered in regulatory regions of certain genes. Such clusters may be referred to as CpG islands. Methylation of such islands generally results in reduced activity of the associated genes. Bossdorf *et al.* opine that several types of plasticity are due to epigenesis.

Bossdorf *et al. (loc. cit.)* further point out that examples of epigenesis, through such environmentally

induced changes in the genome, pose a challenge to the notion that evolution occurs only through random mutations and selection. But, they say, "Yet, how serious this challenge really is we currently cannot even guess, because there is dearth of studies that addressed epigenetic questions in a real world context"

Robinson *et al.* (2008) have pointed out that social responses may be controlled by long lasting epigenetic changes in the genome. This was first noted in rats (*Rattus norvegicus*). Mother rats lick and groom their pups. If they do these motherly activities more extensively, the offspring become less responsive to stresses and more responsive to their progeny. On the other hand those rats, which have received less attention from their mother, are more easily stressed and are less responsive and less care taking to their own pups. These social responses are passed on from generation to generation. This has been found to be due to at least two epigenetic changes in DNA methylation on mother-pup extensive contacts. Thus affected DNA regions include the glucocorticoid receptor gene (which is related to formation of glucocorticoid stress hormones). In addition it includes the alb region of DNA. Further the authors point out that upto the present epigenetic changes associated with social behaviour have been studied for only a few genetic loci, but may be more genetic loci are affected this way.

Kronauer (2008) has discussed parental imprinting of DNA in social Hymenoptera. He says that recent studies have shown that the parental imprinting occurs through DNA methylation in the honey bee and other social Hymenoptera (ants, wasps, and other bees). It has been demonstrated that in the honey bee methylation imparts information that decides whether a larva will develop into a queen or a worker. The author, however cautions that we have to await results of future empirical studies for proper interpretation of such epigenetic changes in context of the development and behaviour of these social insects.

Crespi (2008), in his review, has pointed out that the role of genomic imprinting in development of various psychotic disorders in humans has been inferred from a number of studies. It has been shown that "psychotic spectrum conditions have been mediated in part by alteration of imprinted genes in the brain" While some psychotic disorders are due to imprinted genes of maternal origin, some others are connected with imprinted genes from the male parent. Perhaps

this epigenetic gene imprinting in such cases involves DNA methylation.

Leitch and Leitch (2008) have discussed genomic plasticity in polyploid plants. They point out that polyploidy results from non-disjunction of chromosomes in the germ line. Angiosperms have a remarkable capacity of tolerating the genomic impact of polyploidy, much more than in animals, including humans. Polyploid angiosperms differ in their responses to the environment, and may invade new niches. The genomic plasticity, shown by polyploid plants, may be due to a sequence rearrangement in DNA, silencing of certain sequences, and epigenetic changes through methylation.

THE BALDWIN EFFECT

In 1896 James Mark Baldwin, an American psychologist, described a new factor in evolution. Subsequently his concept came to be known as the Baldwin Effect. The Baldwin Effect, as discussed and interpreted by Crispo (2007), accepts neo-Darwinism, and the Baldwin's contribution may be taken as a supplement to the Darwinian theory. Baldwin believed that small variations in a population were not enough to address the needs arising out of a changing environment. Hence environmental changes induced new variations, on basis of which selection occurred. He referred to such selection as 'organic selection' Baldwin rejected neo-Lamarckism, as it was supported by little or no evidence.

C.H. Waddington, between 1905 and 1975, proposed a similar concept, which is often confused with the Baldwin Effect. According to Waddington changed environment produces a new phenotypic response, which through selection, gets assimilated in the genotype. As pointed out by Schlichting and Pigliucci (1993), Waddington's views were more radical and arguing for revision of the Synthetic Theory.

Waddington's views have almost no following now. Crispo (*loc. cit.*) says, "I propose that the best way to deal with this issue is to assume that Waddington misinterpreted his results, and (we) adhere to his genetic assimilation (concept)"

Crispo (*loc. cit.*) explains the 'genetic assimilation' of environmental effects in terms of the Baldwin Effect by taking to the principle that phenotypic plasticity may lead to more of plasticity. Let us imagine that in a certain population there is a certain range of individual phenotypic variability. If there is an environmental change or there is availability of a new niche with

somewhat different environment, and in the range of the current variability, some variant, near one of the terminals of the range, is well suited to the changed or the new environment, this variant will thrive, and, due to selection in its favour in the new environment, the favoured variant will increase in frequency, and will thus be pushing towards the middle of the range, while new mutations and cryptic variation will accumulate around it, and a new range of variation and plasticity will result. This is how 'genetic assimilation' of the effects of a new environment occurs.

Crispo (*loc. cit.*) points out that phenotypic plasticity is beneficial in two different ways, one that the plasticity allows the organism to live in a heterogeneous environment, and two that it permits the species to extend its range to new niches with novel environmental conditions, and leads to evolutionary diversification. But plasticity is eroded, if the environment is stable, and if maintenance of the plasticity is costly. this reduction in the range of variability promotes 'canalization'

The cost of maintaining polyphenism may be, for example due to :

- (1) Cost of energy required for maintaining certain sensory and regulatory mechanisms,
- (2) Cost of maintaining a certain phenotype needing a trade-off. For instance, the appearance of a summer morph of a pierid butterfly, with a larger thorax and greater flight capacity, is at the cost of fecundity. A summer female lays fewer eggs (Karisson, 2008).
- (3) Cost of maintaining the option of different alternative developmental pathways.

'Canalization' in a stable environment may be 'decanalized' on change of environment by concealed genetic variability finding phenotypic expression, and thus phenotypic plasticity may reappear. This situation is well illustrated in the experimental study by Suzuki and Nijhout (2006) on the black race of the tobacco

hornworm (*Manduca sexta*), described under section 2, subsection (i) of this review.

Jolivet (2008) also finds neo-Darwinian interpretation of the Baldwin Effect cogent.

Nortman (?) has discussed evolution of phenotypic plasticity through the Baldwin Effect. But his predominantly anthropocentric approach, badly mixing up cultural and genetic inheritance, makes his discussion quite confusing. On one hand he rejects Lamarckism, on the other he says, "...it is not specific traits but general propensity to act in a certain (namely, more creative or intelligent) way which is reinforced and transmitted to future generations" He does not care to explain how this reinforcement occurs.

CONCLUDING REMARKS

There has been convincing demonstration of this that the phenotypic plasticity has a genetic basis. However, some evidences have recently come up showing that epigenetic modification in the expression of some genes may also contribute to the plasticity. These evidences have to be kept in view when planning future studies on the nature of the plasticity in a species, as this will help in developing a composite picture of the variability. The Baldwin Effect has served the useful purpose of drawing attention of evolutionists to the significance of environment in the evolutionary process, and of stimulating thinking about 'genetic assimilation' of the environmental effects through the neo-Darwinian mechanism.

SUMMARY

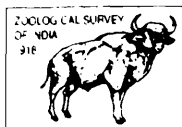
A number of illustrative studies on genetic control of polyphenism have been cited. Some recent communications, pointing to environmental factors inducing epigenetic changes in the genome, have also been referred to. The Baldwin Effect has been discussed. It has been inferred that, while the role of genome in producing phenotypic plasticity is well established, possibility of environmental epigenetic influences may also be kept in view in future investigations in this area.

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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-Symphyleona) 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 Tomocerinae)
- 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 manubrium 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. Antennae shorter than head; eyes absent
..... Neelidae
- Antennae longer than head, or at least 1+1 eyes (sometimes unpigmented) Sminthuridae

Family HYPOGASTRURIDAE

This group of genera may be best recognized by the 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* Börner
— 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* Börner
— Dentes with 20 rather strong setae in 3 longitudinal rows *Isotomina* Börner

Genus III. *Isotomurus* Börner, 19033. *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 tranverse band on the anterior margin of tergites. 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* Börner, 19034. *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, 19395. *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, parbasal 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, 19026. *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* Börner, 19067. *Ballistrura bengalensis* Yosii

1966. *Ballistrura bengalensis* Yosii, *Kyoto Univ., Sci., Expt. 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 characterised 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, 1839Subgenus *Ascocyrtus* Yosii, 19638. *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, 19899. *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 denuded 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 manubrium. 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, antepical 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, 186911. *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* Börner

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

12. *Entomobrya (Homidia) cingula* Börner

1906. *Homidia cingula* Börner, *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 antepical.

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* Börner

1906. *Cyphoderus javanus* Börner, *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 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 fields bearing 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 unpaired 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

bothriotrichia. Antennae/Head as 3/2; antennal segments ratio as 4 : 7 : 6 : 16. Ventral tube with 1 + 1 setae. Dens and mucro related as 58 : 33.

Material examined : Leaf litter, B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 10.ix.2009, coll. G.P. Mandal, 12exs.

Distribution : INDIA : West Bengal, Kerala, Maharashtra (Bombay); COSMOPOLITAN.

Genus XIV. *Sphyrotheca* Börner, 1906

16. *Sphyrotheca gangetica* Yosii

1966. *Sphyrotheca gangetica* Yosii, *Res. Kyoto Univ. Sci. Exped. Karakoram and Hindukush*, 1955, **8** : 333-405.

Diagnosis : Body length upto 1.5 mm. Ground colour white, deep purple pigments present, antennae pigmented distally, head with two transverse stripes. Ant/head ratio as 1 : 8. And ratio as 11 : 14 : 21 : 55. Eye 8 + 8, black. Unguis robust with 2 very distinct inner teeth. Unguiculus broad, apically pointed. Furcula in ratio as 4 : 9 : 3. Manubrium is dorsally with many setose and ventrally nude. Mucro is smooth on outer and minutely serrated on inner margin.

Material examined : Leaf litter, B.B.W.L. Sanct, Parmadan, North 24 Pgs. Dist. 09.ii.2010, coll. G.P. Mandal, 12exs.

Distribution : INDIA : West Bengal and Uttar Pradesh.

SUMMARY

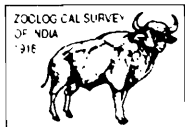
The present paper deals with 16 species of Collembola under 14 genera distributed over 7 families recorded from Bhivuti Bhushan Wild Life Sanctuary, Parmadan, North 24 Pgs. West Bengal. This is the first consolidated report of Collembola fauna from this Sanctuary. The population of the species namely *Lepidocyrtus exploratorius*, *Onychiurus indicus*, *Ballistrura bengalensis* and *Salina bengalensis*, were very rich and collected very good examples from this sanctuary.

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ON A COLLECTION OF INSECTA : DIPTERA : MUSCIDAE FROM UTTARAKHAND

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INTRODUCTION

As constituted by Mc Alpine *et. al* (1981-1989), the family Muscidae (True flies) is coming under the subdivision Calyptrate of the series Schizophora under the superfamily Muscoidea of the infraorder Muscomorpha belonging to the suborder Brachycera.

The members of the family are usually non-metallic, black, but rarely possess metallic colouration similar to that of Calliphoridae. They are small to medium in size; robustly-built, prominent head with holoptic eyes in males and dichoptic in females. Antennae 3 segmented, aristate and plumose. The proboscis is of licking type, however it is greatly modified and adapted for piercing and sucking blood in the subfamily Stomoxyinae. Thorax with dorsal suture continuous across the middle; with well defined posterior calli. Hypopleural bristles absent. Wings exhibiting a sharp bend in vein m (Muscinae), or without a sharp bend in vein m (e.g., Coenosiniinae, Mydaeinae). Wings with a well developed lower calypter. Tibiae with or without a dorsal pre-apical bristle.

Adult Muscids occur in many habitats, but they are less common in dry, open and exposed habitats, or where sandy or acidic soils prevail (Pont, 1986). The adults are closely associated with decaying organic matters; especially dung, but many groups have acquired special habits, which may be widely different. Larvae aquatic (more or less, in some species), or terrestrial; phytophagous, or saprophagous, or coprophagous, or consuming stored produce, or mycophagous, or predatory. Pupa enclosed within a puparium.

Muscidae are well represented in all zoogeographical regions and are extremely numerous in the Oriental Region; though as yet only a small percentage of the species has been described. Out of 3800 species (Skidmore, 1985) of Muscidae India only represents by 258 species (6.7 %).

However, the present paper is based on the recent surveys in Uttarakhand by author himself (2003-2005) and as well as from the previous published data. This is the first consolidated report of the Family Muscidae from the state of Uttarakhand after its separation from the state of Uttar Pradesh (9th November 2002). The present report accounts for 22 species of muscids belonging to 10 genera and 3 tribes under 4 subfamilies of which 6 species under 2 genera are been recorded for the first time from the state of Uttarakhand.

The taxonomic system of this paper was followed by Vockeroth (1972). General morphology, materials & methods have been dealt in the "Fauna of Tripura" and other state fauna series of the author (2000, 2003, 2004, 2006).

LIST OF SPECIES

A. Subfamily MUSCINAE

Tribe MUSCINI

1. *Morellia nigrisquama* Malloch
2. *Morellia pectinipes* Emden
- *3. *Musca (Byomya) conducens* Walker
4. *Musca (Musca) domestica* Linnaeus
- *5. *Musca (Viviparomusca) bezzii* Patton & Cragg
- *6. *Orthellia coerulifrons* (Macquart)
7. *Orthellia gavis* (Walker)
- *8. *Orthellia indica* (Robineau-Desvoidy)
- *9. *Orthellia lauta* (Wiedemann)
- *10. *Orthellia timorensis* (Robineau-Desvoidy)
11. *Orthellia viridis* (Wiedemann)

Tribe HYDROTAEINI

12. *Hydrotaea cilifemorata* Emden
13. *Hydrotaea dentipes* Fabricius

B. Subfamily PHAONIINAE

Tribe PHAONIINI

14. *Helina nemorum* (Stein)

15. *Helina punctata* (Robineau-Desvoidy)
 16. *Phaonia debilis* Stein.
 17. *Phaonia kambaitiana* Emden
 C. Subfamily MYDAEINAE
 18. *Graphomya maculata* (Scopoli)
 19. *Hebecnema umbratica* (Meigen)
 20. *Myospila bina brunneiofemorata* Emden
 D. Subfamily STOMOXYINAE
 21. *Stomoxys calcitrans* (Linnaeus)
 22. *Stomoxys pullus* Austen

SYSTEMATIC ACCOUNT

Key to the subfamily

1. Proboscis elongate, strongly sclerotized; adapted for piercing, tapering from a broad base to a slender apex and with atrophied labella; pteropleuron haired; vein m gradually curved forward apically from about middle of last section STOMOXYINAE
 — Proboscis moderately weakly sclerotized, not distinctly tapering to apex and with well developed and often fleshy labella; propleuron haired or bare; vein m variable, often straight or shortly curved forward near middle of last section 2
 2. Vein m_{1+2} with apical portion curved strongly forward at about middle length, body colour grey to black and often metallic MUSCINAE
 — Vein m_{1+2} straight or curved only slightly forward, body non-metallic 3
 3. Pteropleuron with hairs confined to upper margin below wing base, prosternum bare, hind spiracle without strong black setulae in marginal fringe... MYDAEINAE
 — Pteropleuron with hairs on lower as well as on upper half (bare in the genera *Atherigona*, *Gymnodia*), prosternum haired, hind spiracle with few to many strong black setae in marginal fringe PHAONINAE

A. Subfamily MUSCINAE

Key to the tribes

1. Pteropleuron with tuft of hairs on upper part below base of wings **Muscini**
 — Pteropleuron bare **Hydrotaeini**

Tribe MUSCINI

Key to the genera

1. Thorax and abdomen black or yellow with dark vittae or tessellated patterns 2

- Thorax and abdomen metallic green, blue or purple, without dense grayish pollen **Orthellia** Robineau-Desvoidy
 2. Bend of m subangular (but rather broadly rounded in *Musca lucens*), outline of arisal plumosity forming a convex curve up to tip, ovate; prostigmal present, stem vein with 1 to about 7 setulae on posterior side of dorsal surface **Musca** Linnaeus
 — Bend of m broadly rounded, outline of arisal plumosity forming a very sharp angle at tip, lancet shaped, prostigmal absent, stem vein bare **Morellia** Robineau-Desvoidy
 Genus **Morellia** Robineau-Desvoidy

1830. **Morellia** Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 405. Type-species : **Morellia agilis** Robineau-Desvoidy (= **Morellia hortorum** Fallén).

Key to the species

1. Fuscous black with slight purplish reflections and some silver and grayish dust, palpi and antennae black, thorax shining purplish black; prosternum hairy; lower calyptra dark brown; **nigrisquama** Malloch
 — Black with silver-white pollinosity, palpi and antennae fuscous brown, thorax with dense silver-white dust; prosternal plate with setulose, slightly rounded sides, lower calyptra greysih white, with whitish border and fringe **pectinipes** Emden

Morellia nigrisquama Malloch

1928. **Morellia nigrisquama** Malloch, *Ent. Mitt.* 17 : 329. Type-locality : Sumatra.

Distribution : India : Uttarankhand (Mussorie), Assam, West Bengal.

Elsewhere : Malay, Nepal, Sumatra, Thailand.

Morellia pectinipes Emden

1965. **Morellia pectinipes** Emden, *Fauna. Brit. India*, Muscidae, 1 : 112.

Distribution : India : Uttarankhand (Mussorie), Bihar.

Elsewhere : ? Sri Lanka.

Genus **Musca** Linnaeus

1758. **Musca** Linnaeus, *Syst. Nat. Ed.* 10 : 589. Type-species : **Musca domestica** Linnaeus.

KEY TO THE SUBGENERA

1. Propleural depression hairy **Musca** Linnaeus
 — Propleural depression bare 2

2. Suprasquamal ridge bare
 **Byomya** Robineau-Desvoidy
 Suprasquamal ridge setulose
 **Viviparomusca** Townsend
 Subgenus **Byomya** Robineau-Desvoidy

1830. *Byomya* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 392. Type-species : *Byomya violacea* Robineau-Desvoidy.

***Musca (Byomya) conducens** Walker

1859. *Musca conducens* Walker, *J. Proc. Linn. Soc. Lond., Zool.* 4 : 138.

Material examined : 10 ♀♀, 7 ♂♂, Kharakot, Bageshwar district, 25.ix.2003, coll. B.Mitra. Alt. 1400 mts.

Diagnosis : Thorax fuscous black, two undusted vittae on either side rather close together towards and behind suture, first abdominal segment largely dark on dorsum, second and third orange in male except for a black median vittae.

Distribution : India : Uttarakhand (Bageshwar) Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Madhya Pradesh, Nagaland, Orissa, Punjab, Uttar Pradesh, West Bengal.

Elsewhere : China, Flores Island, Jawa, Lombok, Malaya, Myanmar, Nepal, Philippines, Ryukyu Island, Sabah, Sarawak, Sri Lanka, Sumatera, Sumbawa, Thailand; Ethiopian; New Guinea; Palaearctic.

Subgenus **Musca** Linnaeus

1915. *Promusca* Townsend, *J. Wash. Acad. Sci.*, 5 : 434. Type-species : *domestica* Linnaeus.

Musca (Musca) domestica Linnaeus

1758. *Musca domestica* Linnaeus, *Syst. Nat. Ed.* 10, 1 : 596.

Diagnosis : Four black vittae on thorax, inner pair terminating towards posterior end; propleural depression with fine setulose hairs; suprasquamal ridge without black setulae, all post *dc* strong; mid tibia without *av* and *ad* setae.

Distribution : India : Uttarakhand (Almora), Andaman Islands, Andhra Pradesh, Assam, Bihar, Chandigarh, Goa, Himachal Pradesh, Karnataka, Kashmir, Maharashtra, Manipur, Nagaland, Punjab, Sikkim, Tripura, West Bengal.

Elsewhere : Cosmopolitan.

Subgenus **Viviparomusca** Townsend

1915. *Viviparomusca* Townsend, *J. Wash. Acad. Sci.*, 5 : 435, Type-species : *Musca bezzii* Patton & Cragg.

***Musca (Viviparomusca) bezzii** Patton & Cragg

1913. *Musca bezzii* Patton & Cragg, *Indian J. med. Res.* 1 : 19.

Material examined : 5 ♀♀, 3 ♂♂, Khatima, U.S. Nagar district, 29.ix.2004, coll. B.Mitra.

Diagnosis : Eyes distinctly hairy, thorax densely dusted whitish to cinereous-grey with four (especially in male) black vittae, median vitta of second tergite strongly dilated along fore margin, otherwise almost parallel sided, and at hind margin never dilated, but as a rule slightly narrowed, moderately broad, stem vein with 4-7 setulae an hind side of dorsal surface.

Distribution : India : Uttarakhand (Mussorie, Nainital), Arunachal Pradesh, Assam, Chandigarh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Nagaland, Tamilnadu, Punjab, Sikkim, Uttar Pradesh.

Elsewhere : Malaya, Myanmar, Nepal; East Palaearctic.

Genus **Orthellia** Robineau-Desvoidy

1863. *Orthellia* Robineau-Desvoidy, *Hist. nat. Dipt. env. Paris*, 2 : 837. Type-species : *Lucilia rectinervis* Robineau-Desvoidy.

Key to the species

1. Thorax without prst dc, anterior mesopleural absent; prst acr absent; parafrontalia polished; Thorax without prst dc, anterior mesopleural absent; prst acr absent; parafrontalia polished; interfrontalia narrower than parafrontalia in female 2
- Thorax with two pairs of conspicuous prst dc, anterior mesopleural distinct; one pair of strong prst acr present or interfrontalia wider than one parafrontalia in female 3
2. Palpi and antennae brownish orange, bend of m vein subangular; discal cell without hairs m-m closer to bend than r-m, base of wings yellowish, frons wider than an eye **lauta** (Wiedemann)
- Palpi and antenna fuscous, bend of m vein very broadly and evenly rounded, discal cell more or less extensively haired, at least apical third largely hairy, frons much narrower than an eye **gavisia** (Walker)
3. Thorax with a pair of strong prst acr and 3 pairs of post dc; m with deep behind bend, wing covered with hairs throughout; antennae black to fuscous; parafacialia shining blue green; interfrontalia narrower than parafrontalia; frons wide **viridis** (Wiedemann)
- Thorax without prst acr, interfrontalia wider than a parafrontale, the latter more or less dusted 4
4. Discal cell wholly hairy; m usually without a dip behind, mesonotum either conspicuously dusted

in front, or with only three post dc, the anterior two of which are sub equal; mid tibia without an ad seta

..... *timorensis* (Robineau-Desvoidy)

— Discal cell with a bare strip; m with a distinct bend, mesonotum not markedly dusted in front and with more than 3 post dc, the anterior 2- 4 of which are inconspicuous, palpi slender

5. Mid tibia with an ad seta between apical fifth and fourth, second segment of antenna ferruginous, third and palpi infuscate ferruginous, nearly basal half of discal cell bare, the bare area extended towards apex along 4th, facets on inner part of eyes strongly enlarged

..... *indica* (Robineau-Desvoidy)

— Mid tibia without an ad seta, second antennal segment strongly infuscate, third narrowly reddish at base, otherwise like palpi fuscous, discal cell hairy except on a longitudinal strip close to 5th vein; facets on inner part of eyes only slightly enlarged

..... *coerulifrons* (Macquart)

1851. *Lucilia coerulifrons* Macquart *Mem. Soc. Sci. Agric. Lille.*, 248.

Material examined : 3 ♀♀, 3 ♂♂, Sarada river side, Tanakpur, Champawat district, 13.ix.2004, coll. B. Mitra.

Distribution : India : Uttarankhand (Champawat) Arunachal Pradesh, Assam, Bihar, Kerala, Uttar Pradesh.

Elsewhere : Borneo; Myanmar; Sri Lanka; Flores Island; Formosa; Jawa; Laos; Lombok; Malaya; Nepal; Philippines; Ryukyu Islands; Sumatera; Thailand; Japan.

Orthellia gavis (Walker)

1859. *Musca (Neomyia) gavis* Walker, *J. Proc. Linn. Soc. Lond. Zool.* 4 : 138.

Distribution : India : Uttarankhand (Almora), Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Punjab, Sikkim, West Bengal.

Elsewhere : Jawa, Nepal, Pakistan, Simeule Island, Sumatera, Tamaon Island.

**Orthellia indica* (Robineau-Desvoidy)

1830. *Lucilia indica* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 453.

Material examined : 1 ♀♀, 7 ♂♂, Cantonment Road, Almora district, 18.ix.2003, coll. B. Mitra, alt. 1650 mts.

Distribution : India : Uttarankhand (Almora) Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Goa, Kerala, Maharashtra, Manipur, Mizoram, Nagaland, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Bali, Bangladesh, Malaya, Myanmar, China, Formosa, Jawa, Nepal, Pakistan, Philippines, Simeule Islands, Sumatera, Sumbawa, Thailand, Vietnam; cosmopolitan.

**Orthellia lauta* (Wiedemann)

1830. *Musca lauta* Wiedemann, *Aussereurop. Zweifl. Insekt.* 2 : 410.

Material examined : 6 ♀♀ 2 ♂♂, Khirakot, Bageshwar dist., 25.ix.2003, coll. B. Mitra, alt. 1400 mts.

Distribution : India : Uttarankhand (Bageshwar) Andaman Islands, Andhra Pradesh, Assam, Bihar, Chandigarh Karnataka, Manipur, Madhya Pradesh, Nagaland, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : China, East Malaysia, Flores Island, Jawa, Kalimantan, Laos, Lombok, Malay, Myanmar, Nepal, Pakistan, Philippines, Ryukyu Islands, Sumatera, Sumbawa, Sri Lanka, Taiwan, Thailand; Australia.

**Orthellia timorensis* (Robineau-Desvoidy)

1830. *Lucilia timorensis* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 460.

Material examined : 10 ♀♀, 15 ♂♂, Saiha, Dehradun district., 21.v.2006, coll. B. Mitra.

Distribution : India : Uttarankhand (Dehradun), Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Kerala, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, China, Dammar Islands, Flores Island, Jawa, Malaya Myanmar, Nepal, Philippines, Ryukyu Islands, Simeulae Island, Sulawesi, Sumatera, Taiwan, Thailand, Viet Nam; Japan; Papuan subregions.

Orthellia viridis (Wiedemann)

1824. *Idia viridis* (Wiedemann), *Analecta Ent.*, : 50. Type-locality : North america.

1826. *Musca caesarion* Meigen, *Syst. Besch. europ. zweifl. Insekt.*, 5, 57. Type-locality : Portugal.

Distribution : India : Jammu and Kashmir, Manipur, Punjab, Himachal Pradesh, Sikkim, Tripura, Uttarankhand (Mussorie, Dehradun, Nainital, Almora), West Bengal.

Elsewhere : Nepal, Pakistan, Tibet, Hawaii; Holarctic.

Tribe HYDROTAEINI

Genus *Hydrotaea* Robineau-Desvoidy

1830. *Hydrotaea* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 509. Type-species : *Musca meteorica* Linnaeus.

Diagnosis : Eyes bare or hairy; frontal triangle not reaching lunula (in Oriental species), more or less dusted; arista bare to short-haired; thorax with more or less conspicuous dust, never glossy bluish black, with 4 post dc, pra small or absent; prosternum, propleural depression, pteropleura and hypopleura without setulae; abdomen ovate (σ) or triangularly subcordate (φ), with moderately strong setae only laterally and at apex; wings hyaline in Oriental species, fore femur of male with distinctive pre-apical v teeth, mid tibia (in Oriental species) without an av seta.

Key to the species

1. pd seta of hind tibia indistinct or hardly longer than greatest tibial diameter, only the prsc acr somewhat stronger; eyes virtually bare
..... *cilifemorata* Emden
- pd seta of hind tibia more than twice length of greatest tibial diameter; jowls with some conspicuous upcurved setae on anterior part
..... *dentipes* Fabricius

Hydrotaea cilifemorata Emden

1965. *Hydrotaea cilifemorata* Emden, *Fauna. Brit. India, Muscidae*, 1 : 317. Type-locality : Dehradun.

Distribution : India : Uttarakhand (Dehradun), West Bengal.

Elsewhere : None.

Hydrotaea dentipes Fabricius

1805. *Musca dentipes* Fabricius, *Syst. Antliat.* : 303. Type-locality : Denmark.

Distribution : India : Uttarakhand (Nainital), Himachal Pradesh, Jammu and Kashmir.

Elsewhere : Nepal, Tibet. Holarctic.

B. Subfamily PHAONIINAE

Tribe PHAONIINI

Genus *Helina* Robineau-Desvoidy

1830. *Helina* Robineau-Desvoidy, *Mem. pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 493. Type-species : *Helina euphemioidea* Robineau-Desvoidy.

Diagnosis : Eyes of male holoptic to sub holoptic, female dichoptic; arista short to long plumose; pre-alar bristle very strong; stpl 1 + 2, or 2 + 2; prosternum and hypopleura bare; r_1 bare, dorsal surface at node of r_{4+5} bare, sometimes bare on both surface; m_{1+2} never upcurved at apex, lower squamae tongue-shaped

Key to the species

1. Fuscous black with rather dense whitish dust, eyes rather densely haired, arista densely plumose, ad

surface of hind tibia with 3 or more setae
..... *nemorum* (Stein)

- Fuscous rather densely dusted pale grey, eyes almost bare, arista not very densely plumose, ad surface of hind tibia with only 2 setae
..... *punctata* (Robineau-Desvoidy)

Helina nemorum (Stein)

1915. *Mydaea nemorum* Stein, *Supplta ent.*, 4 : 19. Type-locality : Formosa.

Distribution : India : Uttarakhand (Mussorie), Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere : Myamnar, Formosa.

Helina punctata (Robineau-Desvoidy)

1830. *Rhorella punctata* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 492. Type-locality : France.

Distribution : India : Uttarakhand (Kumaon), Himachal Pradesh, Assam, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Nepal, Holarctic.

Genus *Phaonia* Robineau-Desvoidy

1830. *Phaonia* Robineau-Desvoidy, *Mem. Pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 482. Type-species : *Phaonia viarum* Robineau-Desvoidy.

Diagnosis : Eyes bare or hairy, holoptic to more or less narrowly separated in male, dichoptic in female; female without proclinate fronto-orbital bristles; arista long plumose or short haired; prst ac present or absent; post dc 3-4; prosternum and pteropleura bare; hypopleura bare or hairy; m_{1+2} straight; lower squama tongue-shaped; fore tibia with or without p-seta.

Key to the species

1. 3 strong post dc, 1 + 1 strong and long acr
..... *kambaitiana* Emden
- 4 strong post dc, 0 + 1 strong acr ... *debilis* Stein

Phaonia debilis Stein

1918. *Phaonia debilis* Stein, *Annls. hist-nat. Mus. natn. hung.*, 16 : 167. Type-locality : Mussoorie.

Distribution : India : Uttarakhand (Mussorie), West Bengal.

Elsewhere : Myanmar, Malaysia.

Phaonia kambaitiana Emden

1965. *Phaonia kambaitiana* Emden, *Fauna. Brit. India, Muscidae*, 1 : 236. Type-locality : Myanmar.

Distribution : India : Uttarakhand (Dehradun), Himachal Pradesh.

Elsewhere : Myanmar.

C. Subfamily MYDAEINAE

Key to the genera

1. Three or four stpl bristles present, arranged in a triangle or quadrilateral; hind tibia with distinct anterodorsal apical bristle at least as long as tibial diameter; lower squama usually narrow, rounded posteriorly, and with its antero-median corner distinctly lateral of margin of scutellum, only rarely broadened and truncated posteriorly..... 2

One or three stpl bristles never in a triangle, either the anterior lacking or the lower lacking and the posterior preceded by a row of bristle-like hairs of decreasing size; hind tibia without anterodorsal apical bristle; lower squama broad, truncate posteriorly, and with its antero-median corner extending under anterolateral corner of scutellum **Graphomya** Robineau-Desvoidy

2. Presutural acrostichal hairs in 4 more or less regular rows, those in outer rows longer and stronger than in inner rows **Hebecnema** Schnabl

- Presutural acrostichal hairs uniform in length or strongly, in 6 or more very irregular rows.....
..... **Myospila** Rondani

Genus **Graphomya** Robineau-Desvoidy

1830. *Graphomya* Robineau-Desvoidy, *Mem. pres. div. Sav. Acad. Sci. Inst. Fr.*, 2 : 403. Type-species : *Musca maculata* Scopoli.

Graphomya maculata (Scopoli)

1763. *Musca maculata* Scopoli, *Ent. Carniolica* : 326. Type-locality : North Yugoslavia.

Diagnosis : Fuscous-black with dense whitish-grey or yellowish-grey dust and a broad black pattern, male with largely testaceous abdomen; head with, densely long-haired, in female moderately long-haired; thorax with the median vitta dusted brownish anteriorly and the paramedian dark vittae in male usually fused behind (rarely also in front of) suture with each other, the black median vitta broader near scutellum and more distinctly extended forward; median spot of scutellum never occupying much less than half its basal width, in male almost or quite fused at base with the lateral spots, its apes exceeding level of discal setae. Abdomen much as in rufitibia but the median spots usually reaching further towards hind margins, the fourth segment with conspicuous oblong-ovate fuscous paramedian spots, the dark spots at middle of each lateral half of the intermediate segments in male restricted to posterior half and on second segment sometimes obsolete; lower calyptera markedly greyish-brown in male and slightly

browned in female; legs fuscous with the tibiae brown to reddish-brown.

Distribution : Uttaranchal (Mussoorie), Jammu and Kashmir.

Elsewhere : China, Formosa, Myanmar, Philippines, Ryukyu Is., Sri Lanka.

Genus **Hebecnema** Schnabl

1889. *Hebecnema* Schnabl, *Trudy russk. ent. Obschch.*, 23 : 331. Type-species : *Anthomyia umbratica* Meigen.

Hebecnema umbratica (Meigen)

1826. *Anthomyia umbratica* Meig., *Syst. Besch. Europ. Zweifl. Insekt.* 5 : 88. Type-locality : ? Germany.

Diagnosis : Piceous-black with thin brown dust, thorax with traces of somewhat irregularly defined incomplete vittae, abdomen in male rather densely dusted greyish-brown with a very narrow dark median vitta, which is often vestigial on third and especially fourth segment, in female more glossy, the median vitta broader but less well defined and not reaching posterior segments; head dusted brownish-grey, parafacialia not distinctly dusted whitish in Oriental specimens; eyes in male subcontiguous, arista not very densely short-plumose; anterior mesopleural well developed, auxiliary prostigmal variable, hypopleura bare; wings markedly smoky in male, hardly so in female; calyptera pale brownish-grey with concolorous border and pale golden fringe; halteres dull reddish-yellow; Mid femur with a small a pre-apical, some erect av setulae at base (less numerous in female), and 3-4 pv setae on basal two-fifths, mid tibia with 2(-3) strong p setae; hind femur without pv setae, with 4-6(♂) or 3-4(♀) strong av setae on less than apical half, hind tibia with 1 ad and 1-2 av setae.

Distribution : India : Uttaranchal (Mussoorie, Dehradun), Himachal Pradesh, South India, West Bengal.

Elsewhere : Formosa, Hong Kong, Myanmar.

Genus **Myospila** Rondani

1856. *Myospila* Rondani, *Dipterol. Ital. Prodr.*, 1 : 91. Type-species : *Musca medietabunda* Fabricius.

Myospila bina brunneiofemorata Emden

1965. *Xenosia bina brunneiofemorata* Emden, *Fauna. Brit. India, Muscidae*, 1 : 433. Type-locality : Mussoorie.

Diagnosis : Black with rather dense grey; in places somewhat greenish or bluish grey dust; third antennal segment brown at base; thorax with four conspicuous incomplete vittae, which are usually fuscous; abdomen with a pair of conspicuous small brown spots near hind margin of second and third segments; apical part of m...

more strongly upcurved; fore tibia without a p seta, fore femur of male largely infuscated; mid and usually hind femora infuscated on basal half.

Distribution : India : Uttarakhand (Mussorie), Madhya Pradesh.

Elsewhere : None.

D. Subfamily STOMOXYINAE

Genus *Stomoxys* Geoffroy

1762. *Stomoxys* Geoffroy, *Hist. Ins.*, 3 : 538. Type-species : *Conops calcitrans*.

Diagnosis : Genus *Stomoxys* Geoffroy can be distinguished from all other Muscidae by the strongly sclerotized piercing proboscis combined with the short palpi. Eyes bare and vertically elongated, hind margin concave; ar plumose only on upper side; arrangement of ors in female irregular; prst ac indistinct, only 1 to 2 pairs of post ac, prst dc and post dc normally distinct; ia 0 + 1; prsb 1; hb 2-3; ph 1; np2;sa 1; pa 2; as 1; ds 2-3; ls2; prs and pp depression; posterior half of pt and upper part of hp hairy; wings hyaline; r 4 + 5 setulose on dorsal and ventral surfaces; tibiae without any submedian bristles; abdomen ovate-shaped, T5 with long erect hairs.

Key to the species

1. Abdomen spotted, median vittae short and broad *calcitrans* (Linnaeus)
Abdomen with dark transverse bands with or without median vittae *pullus* Austen

**Stomoxys calcitrans* (Linnaeus)

1758. *Conops calcitrans* Linnaeus, *Syst. Nat., Ed.*, 10, 1 : 604.

Material examined : 8 ♀♀, 12 ♂♂, Bhainkhali, Askot, Pithoragarh district, 23.ix.2004, coll. B. Mitra. Alt. 1650 mts.

Diagnosis : Fuscous black with whitish-grey or cinereous-grey pollinosity and some brown dust on the dark thoracic vittae and forming spots on abdomen; eyes in male separated by a quarter head-width or somewhat more, frons very slightly narrowed from vertex to middle, moderately dilated from there to lunula, interfrontalia parallel-sided; in female frons well over a third head-width at vertex; antennae fuscous-brown, apex of second and base of third segment dull reddish-orange; palpi yellowish-orange, only slightly longer than third antennal segment, not reaching fore margin of mouth; thorax with four fuscous vittae, which are somewhat brown-dusted; abdomen with a moderately broad less densely dusted and darker median vitta and

similar fore and hind margins; wings with the setulae on r₄₊₅ not nearly reaching r-m, m strongly up curved and distinctly sinuous near apex; legs fuscous with pale testaceous knees; base of hind femur with only one long hair, which seldom reaches length of femoral diameter, often with 2-3 shorter hairs following upon the long hair, hairs of the av row somewhat stronger and more erect.

Distribution : India : Uttarakhand (Pithoragarh), Manipur, Nagaland, Sikkim.

Elsewhere : Cosmopolitan.

Stomoxys pullus Austen

1909. *Stomoxys pulla* Austen, *Ann. Mag. nat. Hist.*, 8 (3) : 294. Type-locality : Mussoorie.

Diagnosis : Dark chocolate- brown with some brown dust, which is especially noticeable at neck, shoulders and sides. Head with silver-white and pale golden dust on face and pale golden and brown dust on parafrontalia; eyes in male separated by one-ninth head-width, frons somewhat narrowed from both extremities to middle, interfrontalia almost parallel-sided or slightly widened anteriorly, 4-5 times as wide at middle as a parafrontale, the latter linear at middle, very narrow in front and behind, with about 8 inclinate setae on anterior two-thirds and proclinate setulae continuing the row in single file on upper third; antennae wholly fuscous, greyish-orange, longer than antennae, somewhat exceeding fore margin of mouth; thorax with the four vittae distinct in front of suture, where they appear fuscous-brown on brown ground, but broadly suffused and indistinct behind suture; the dust of the abdomen much more uniformly brown, so that the greyish parts do hardly contrast, fourth segment more greyish-dusted with a pair of broad shifting darker vittae; wings conspicuously browned, the setulae on r₄₊₅ fine, exceeding r-m, apex of m conspicuously upcurved and sinuous, lying somewhat proximad of level of apex of r₄₊₅, R₅ at widest part two-and-a-half times as wide as at apex; lower calyptera brown, subopaque; halteres pale reddish-yellow; legs fuscous with pale testaceous knees; v surface of hind femur at base with one long erect setulose hair, which is longer than the femoral diameter, and beyond it with a few shorter half-erect hairs; basal two segments of fore tarsus in male on ad surface with a row of outstanding setulose hairs; each of these is bent in an a direction at its base, so that their main part lies at right angles with the tarsal segment.

Distribution : India : Uttarakhand (Mussoorie).

Elsewhere : None.

SUMMARY

A comprehensive account of the Muscid fauna of Uttarakhand is consist 22 species under 11 genera of 4 subfamilies from this State, and 6 species are recorded for the first time. Keys and diagnostic characters to the identification of families, genera and species are reported here. Among the 22 species are reported here, three species viz., *Hydrotaea cilifemorata* Emden, *Myospila bina brunneiofemorata* Emden and *Stomoxys pullus* Austen are confined to India. 7 species restricted in

the boundary of Oriental Region, 4 species upto Palaearctic Region, and rest extend their range of distribution beyond the Oriental and Palaearctic Regions.

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ON A COLLECTION OF INSECTA : COLEOPERA : CERAMBYCIDAE AND CURCULIONIDAE (BRACHYDERINAE AND OTIORRHYNCHINAE) FROM UTTARAKHAND

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INTRODUCTION

The members of the family Cerambycidae are commonly known as longicornia or Longicorn beetles. It includes 35,000 species under 4,000 genera in 11 subfamilies from the world (Lawrence, 1982). The number of species known to occur in the Indian region over 1,200. Of which 490 species belong to the subfamily Cerambycinae and 720 species in the subfamily Lamiinae. Over 200 further species have been described since 1914. Of them about 156 species of Cerambycinae and 224 species of Lamiinae are found to attack trees, shrubs, woody climber, vians etc. (Beeson, 1941). Major workers on this family are Gahan (1906), Stebbing (1914), Beeson (1941), Breuning (1960-66).

The members of the family Curculionidae are commonly known as weevils and belongs to the superfamily Curculionoidea under the suborder Rhynchophora of the Order Coleoptera. Subfamily Otiorrhynchinae, Brachyderinae and Tanyrrhynchinae that are known from India (Marshal, 1916) belongs to the section Adelognathi which include short snouted weevils. The members of the subfamily Brachyderinae can be easily distinguished by its scrobes being lateral in position and the sublinear furrow curving downward in front of the eye. The members of the subfamily Otiorrhynchinae can easily be distinguished by its prothorax without post ocular lobes or vibrissae. Their members are found to occur in variable habitat and majority of them appear to feed in rotten wood, cambium of roots, stems, flowers, seeds and many of them are also found in soil as a root feeder. They are very economically important because they eat flower buds, seed, young fruits and also act as defoliators, leaf miners, stem and collar borers, wood borers etc. Major worker on this group are Schönherr, Boheman,

Gyllen & Fahreus (1833-1885), Lacordaire (1866), VonHarold (1871), G.A.K. Marshal (1916) etc.

Present study is based on the collection made by the different survey parties of Zoological survey of India including the earlier material present in the Coleoptera Section have also been included. Distributional data and synonymies of each species has also been given from published records as well as actual study of the specimens.

SYSTEMATIC ACCOUNT (LIST OF TAXA)

Family CERAMBYCIDAE

Subfamily LAMIINAE

Tribe MESOSINI

Genus *Cacia* Newmann, 1842

Subgenus *Pericacia* Breuning

1. *Cacia* (*Pericacia*) *cretifera* (Hope)

Genus *Mesosa* Latreille, 1829

2. *Mesosa indica* (Breun)

Genus *Coptops* Serville, 1835

3. *Coptops aedificator* (F.)

Tribe XENOLEINI

Genus *Xenolea* Thomson, 1864

4. *Xenolea asiatica* (Pic.)

Tribe AGNIINI

Genus *Blepephaeus* Pascoe, 1866

5. *Blepephaeus nigrosparus* Pic.

Genus *Monochamus* Guerin-Meneville, 1826

6. *Monochamus bimaculatus* Gahan

Tribe BATOCERINI

Genus *Batocera* Castelnau, 1840

7. *Batocera rubus* (Linne)

Genus *Apriona* Chevrolat, 1852

8. *Apriona cinerea* Chevrolat

- Tribe APOMECCYNINI
Genus *Ropica* Pascoe, 1858
9. *Ropica rufescens* (Pic.)
Genus *Apomeccyna* Latreille, 1829
10. *Apomeccyna histrio* (F.)
Tribe PTEROPLINI
Genus *Sthenias* Castelnau, 1840
11. *Sthenias grisator* F.
Genus *Pterolophia* Newmann, 1842
Subgenus *Mimoron* Pic.
12. *Pterolophia (Mimoron) brevigibbosa* Pic.
Subgenus *Pterolophia s.str.*
13. *Pterolophia (s.str.) occidentalis* (Schew)
Genus *Desisa* Pascoe, 1865
Subgenus *Desisa* Pascoe
14. *Desisa (s.str.) subfasciata* (Pascoe)
15. *Desisa (s.str.) plagiata* Breuning
Tribe ACANTHOCININI
Genus *Exocentrus* Mulsant, 1839
Subgenus *Pseudocentrus* Fairmaire
16. *Exocentrus (Pseudocentrus) flemingiae* Fisher
17. *Exocentrus (Pseudocentrus) grcurae* (Fish.)
18. *Exocentrus (Pseudocentrus) dalbergiae* (Fish.)
19. *Exocentrus (Pseudocentrus) cudraminae* (Fish.)
20. *Exocentrus (Pseudocentrus) alboguttatus* (Fish.)
Tribe DORCASHEMATINI
Genus *Olenecamptus* Chevrolat, 1835
21. *Olenecamptus indianus* Thomson
22. *Olenecamptus bilobus* (F.)
Tribe SAPERDINI
Genus *Glenea* Newmann, 1842
Subgenus *Glenea s.str.*
23. *Glenea (s.str.) maculata* (Hope)
Subgenus *Stiroleneia* Aurivillius
24. *Glenea (Stiroleneia) spilota* (Thomson)
Tribe CROSSOTINI
Genus *Moechotypa* Thomson, 1864
25. *Moechotypa asiatica* (Pic.)
Subfamily PRIONINAE
Genus *Lophosternus* Guer., 1844
26. *Lophosternus hugelii* Redtenb.
Subfamily LEPTURINAE
Genus *Apioccephalus* Gahan, 1898
Apioccephalus licheneus Gahan
Subfamily CERAMBYCINAE
Group ASEMINI
Genus *Tetropium* Kirby, 1837
27. *Tetropium oreinum* Gahan
- Genus *Criocephalus* Mulsant, 1839
28. *Criocephalus unicolor* Mshl.
Group OEMINI
Genus *Xystrocera* Serv., 1869
29. *Xystrocera globosa* Oliv.
Group CERAMBYCINI
Genus *Aeolesthes* Gahan, 1890
30. *Aeolesthes holosericea* Fab.
Genus *Diorthus* Gahan, 1891
31. *Diorthus simplex* White
Genus *Derolus* Gahan, 1891
32. *Derolus mauritanicus* Buquet
Group MYTHODINI
Genus *Phyodexia* Pascoe, 1871
33. *Phyodexia concinna* Pascoe
Group PURPURICENINI
Genus *Purpuricenus* Latrielle, 1829
34. *Purpuricenus montanus* White
Group PYRESTINI
Genus *Erythrus* White, 1853
35. *Erythrus westwoodi* White
Group CLYTINI
Genus *Xylotrechus* Chevrolat, 1860
36. *Xylotrechus stebbingi* Gahan
37. *Xylotrechus subscutellatus* Chev.
Genus *Perissus* Chevrolat, 1863
38. *Perissus fuliginosus* Chev.
Genus *Caloclytus* Fairm., 1864
39. *Caloclytus annularis* F.
Group EPIPEDOCERINI
Genus *Epipedocera* Chevrolat, 1863
40. *Epipedocera affinis* Chev.
Family CURCULIONIDAE
Division ADELOGNATHI
Subfamily BRACHYDERINAE
Group BLOSYRIDES
Genus *Blosyroides* Jek., 1875
1. *Blosyroides variegates* (Redtenbacher)
Group TANYMECIDES
Genus *Tanymecus* Schönh., 1826
2. *Tanymecus circumdatus* var. *rusticus* Gyll.
3. *Tanymecus agrestis* Fst.
Genus *Dereodus* Schönh., 1826
4. *Dereodus polinosus* (Redt.)
Genus *Astycus* Schönh., 1826
5. *Astycus lateralis* (F.)

Genus *Lepidospyris* Mshl., 1916

6. *Lepidospyris cretacea* Faust.
7. *Lepidospyris demissa* Mshl.

Genus *Leptomias* Fst., 1866

8. *Leptomias angustatus* (Redt.)
9. *Leptomias lituratus* (Redt.)
10. *Leptomias curtus* Mshl.
11. *Leptomias jekeli* Fst.
12. *Leptomias bipustulatus* Fst.
13. *Leptomias sulcicollis* Mshl.
14. *Leptomias longulus* (Fst.)
15. *Leptomias curvipes* Mshl.

Genus *Xylinophorus* Faust, 1885

16. *Xylinophorus strigifrons* Fst.

Genus *Pachynotus* Redt., 1848

17. *Pachynotus globulicollis* Redt.

Genus *Achlaenomus* Waterhouse, 1853

18. *Achlaenomus ebeninus* Waterhouse

Subfamily OTIORRHYNCHINAE

Group PHYLLOBIIDES

Genus *Myllocerus* Schönh., 1826

19. *Myllocerus setulifer* Desbr.
20. *Myllocerus setulifer* Mshl.
21. *Myllocerus setulifer* (Hbst.)
22. *Myllocerus setulifer* Mshl.
23. *Myllocerus setulifer* Mshl.
24. *Myllocerus setulifer* Boh.
25. *Myllocerus setulifer* Mshl.

Genus *Arrhines* Schönh., 1834

26. *Arrhines languides* Gyllenhal

SYSTEMATIC ACCOUNT

Family CERAMBYCIDAE

Subfamily LAMIINAE

Tribe MESOSINI

Genus *Cacia* Newmann, 1842

1842. *Cacia* Newmann, *Ent.*, **1** : 290 (Type *spinigera* Newmann).
1864-65. *Cacia*, Pascoe, *Trans. Ent. Soc. Lond.*, (2)**3** : 106.
1869. *Cacia*, Lacordaire, *Gen. Col.* **9** : 369, 374.
1939. *Cacia*, Breuning, *Ent. Nov.*, 3rd *Supp.* **55** : 435-460.
1951. *Cacia*, Gressitt, *Longicornia*, **2** : 421-424.
1970. *Cacia*, Rendon & Breuning, *Pac. Ins. Monograph*, **24** : 19-21.

Subgenus *Pericacia* Breuning

1970. *Cacia (Pericacia)* Rendon & Breuning, *Pac. Ins. Monograph*, **24** : 19-20.

Cacia (Pericacia) cretifera (Hope)

1831. *Lamia cretifera* Hope, *In Grey. Zool. Misc.*, 27.
1865. *Cacia incensa* Pascoe, *Trans. Ent. Soc. Lond.*, (3)**3** : 112, note.
1939. *Cacia crucifera* Breuning, *Ent. Nov.*, 3rd *supp.* **55** : 459.
1970. *Cacia (Pericacia) cretifera* (Hope), Rendon & Breuning, *Pac. Ins. Monograph*, **24** : 19-20.

Material examined : 1 ex., India : Uttarakhand : Dehradun : Nakronda, 2.viii.1936, 6682/H4, FRI, Deh.; 1 ex., Dehradun 23.vi.1934, 6683/H4, FRI, Deh.

Distribution : India : Uttarakhand (Dehradun), Himalaya, Assam, Andaman Island.

Elsewhere : Southern Asia, Indochina, Laos, Tenasserim, South China, Myanmar.

Remarks : This species first time recorded from this state.

Genus *Mesosa* Latreille, 1829

1829. *Mesosa* Latreille, *In Cuvier, Regne Anim. Ins.* **2**(2) : 124 (Type : *curculionoides* Linne).
1829. *Mesosa*, Castelnau, 1840. *Hist. Nat. Col.* **2** : 463.
1869. *Mesosa*, Lacordaire, *Gen. Col.*, **9** : 369, 378.
1939. *Mesosa*, Breuning, *Ent. Nov.*, 3rd *Supp.* **55** : 403-09.
1970. *Mesosa*, Rendon & Breuning, *Pacific Insect Monograph*, **24** : 11-16.

Mesosa indica (Breun.)

Material examined : 1 ex., India : Uttarakhand : Dehradun : Lachiwala, 1.vii.1930, 6684/H4, FRI.; 1 ex., Lachiwala 12. vii. 1929, 6685/H4, FRI Deh.

Distribution : India : Ostindien, Uttarakhand.

Remarks : The species is first time recorded from this state, though reference not seen.

Genus *Coptops* Serville, 1835

1835. *Coptops* Serville. *Ann. Soc. ent. Fr.*, **4** : 64 (Type : *aedificator* F.).
1840. *Coptops*, Castelnau, *His. Nat. Col.*, **2** : 466.
1864. *Coptops*, Thomson, *Syst. Nat.*, 371.
1864-65. *Coptops*, Pascoe, *Trans. Ent. Soc. Lond.*, (3)**3** : 96, 116.
1869. *Coptops*, Lacordaire, *Gen. Col.*, **9** : 369, 384.
1933. *Coptops*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 338-44.
1951. *Coptops*, Gressitt, *Longicornia*, **2** : 430-32.
1970. *Coptops*, Rendon & Breuning, *Pac. Ins. Monograph*, **24** : 28-30

Coptops aedificator (F.)

1792. *Coptops aedificator* F., *Ent. Syst.*, **1**(2) : 279.
1877. *Coptops bidens* Wollast., *Col. S. Helena*, P. 210.

1792. *Coptops fusca* Ol., *Encycl. Ma'th. Ins.*, 7 : 210.
 1835. *Coptops parallela* Serv., *Ann. Soc. ent. Fr.*, 4 : 64.
 1872. *Coptops quadristigma* Fähr., *Ofvers. Vet. Akad. Forhandl.*, 29(2) : 30.

Material examined : 1 ex., India : Dehradun : Jhaira, 1.x.1929, 6687/H4, FRI, Deh.

Distribution : India : Uttarakhand (Dehradun), Ostindien.

Elsewhere : Africa, Madagascar, Bauritius, Bourbon, Sir Lanka.

Tribe XENOLENINI

Genus *Xenolea* Thomson, 1864

1864. *Xenolea* Thomson, *Syst. Cer.*, 91 (Type : *collaris* Th.)
 1872. *Xenolea*, Lacordaire, *Gen. Col.*, 9 : 460.
 1934. *Xenolea*, Matsushita, *J. Fac. Agric. Hokk.*, 44(2) : 356.
 1934. *Xenolea*, Philip, *J. Sci.*, 72 : 135.
 1950. *Xenolea*, Breuning, *Longicornia*, 1 : 272, fig. 1.
 1951. *Xenolea*, Gressitt, *i.e.* : 447.

Xenolea asiatica (Pic.)

1924. *Aeschopalea siatica* Pic., *Echange*, 41 : 16.
 1894. *Xenolea tomentosa* v. *asiatica*, Gahan, *Trans. Ent. Soc. Lond.* : 483.
 1938. *Xenolea asiatica*, Gressitt, *Lingn. Sci. J.*, 17 : 158.
 1950. *Xenolea asiatica*, Breuning, *Longicornia*, 1 : 274.
 1939. *Xenolea tomentosa asiatica* Gressitt, *Lingn. Sci. J.*, 18 : 69; 1951, *i.c.* 447.

Material examined : 1 ex., India : Uttarakhand : Dehradun : Ramgarh, 11.vi.1931, 6608/H4, Dr. B.N. Chopra; 1 ex., Dehradun, Ramgarh, 13.vi.1931, 6609/H4, Dr. B.N. Chopra; 1 ex., Dehradun, Ramgarh, 5.vi.1931, 6610/H4, Dr. B.N. Chopra.

Distribution : India : Uttarakhand.

Elsewhere : North Vietnam, China, Japan, Laos, Singapore, Indonesia.

Remarks : This species is recorded here for the first time from India (Uttarakhand).

Tribe AGNINI

Genus *Blepephaeus* Pascoe, 1866

1866. *Blepephaeus* Pascoe, *Proc. Zool. Soc. Lond.*, (3)3 : 249 (type : *Succinctor* Chev.).
 1869. *Blepephaeus*, Lacordaire, *Genl. Col.*, 9 : 339.
 1943. *Blepephaeus*, Breuning, *Nov. Ent. 3rd Supp.*, 116-117 : 355-364.
 1951. *Blepephaeus*, Gressitt, *Longicornia*, 2 : 377-379.

Blepephaeus nigrosparsus Pic.

1925. *Blepephaeus nigrosparsus* Pic *Eclarge*.

Material examined : 1 ex., India : Uttarakhand : Haldwani : Chakrata range, 14.vi.1930, 6613/H4, Dr. B.N. Chopra.

Distribution : India : Uttarakhand (Haldwani).

Elsewhere : South China.

Remarks : This species is found to attack *Clerodendron infortunatum* in this state.

Genus *Monochamus* Guerin-Meneville, 1826

1826. *Monochamus* Guerin-Meneville, *Dict. Class. Hist. Nat.*, 9 : 186 (type : *sutor* F.).
 1913. *Monochamus*, Reitter, *Fauna. Germ.*, 4 : 54-55.
 1943. *Monochamus*, Breuning, *Nov. Ent. 3rd Supp.*, pp. 123-128, 441-456.
 1951. *Monochamus*, Gressitt, *Longicornia*, 2 : 390-396.
 1970. *Monochamus*, Rondon & Breuning, *Paci. Ins. Monograph*, 24 : 134-136.

Monochamus bimaculatus Gahan

1888. *Monochamus bimaculatus* Gahan, *Ann. Mag. Nat. Hist.*, (6)2 : 260.
 1943. *Monochamus bimaculatus*, Breuning, *Nov. Ent. 3rd Supp.*, P. 435.
 1951. *Monochamus bimaculatus*, Gressitt, *Longicornia*, 2 : 393.
 1970. *Monochamus bimaculatus*, Rondon & Breuning, *Paci. Ins. Monograph*, 24 : 135.

Material examined : 1 ex., India : Uttarakhand : Dehradun : Lachiwala, 4.vii.1937, 6637/H4, FRI, Deh.; 1 ex., Dehradun : Lachiwala, 3.vii.1937, 6638/H4, FRI, Deh.

Distribution : India : Uttarakhand (Lachiwala), Sikkim.

Elsewhere : Southern & Eastern Asia, Laos, Myanmar, Siam.

Remark : This species is recorded for the first time from this state.

Tribe BATOCERINI

Genus *Batocera* Castelnau, 1840

1840. *Batocera* Castelnau, *Hist. Nat. Col.*, 2 : 479 [Type : *Cerambyx rubus* L.].
 1858. *Batocera*, Thomson, *Arch. Ent.*, 2 : 447.
 1866. *Batocera*, Pascoe, *Trans. Ent. Soc. Lond.*, (3)3 : 259-261.
 1869. *Batocera*, Lacordaire, *Genl. Col.*, 9 : 354.
 1951. *Batocera*, Gressitt, *Longicornia*, 2 : 407-409.
 1970. *Batocera*, Rondon & Breuning, *Paci. Ins. Monograph*, 24 : 142-145.

Batocera rubus (L.)

1758. *Cerambyx rubus* L., *Syst. Nat.*, ed. 10 : 390.
 1775. *Lamia rubus* F., *Syst. Ent.*, P. 77.

1778. *Lamia stigma* Voet., *Cat. Col.*, **2** : 15, Pl.13, fig. 54.
 1914. *Batacera albofaciata* Stebbing, *Ind. For. Ins.*, P.366. f. 244.
 1940. *Batacera rubus* (L.) : Gressitt, *Lign. Sci. J.* **19 B** : 8.
 1970. *Batacera rubus*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 144.

Material examined : Not examined.

Distribution : India : Bihar, W.B., Assam, Himalaya, Uttarakhand (Dehradun).

Elsewhere : Southern & Eastern Asia, Laos, Baluchistan.

Genus *Apriona* Chevrolat, 1852

1852. *Apriona* Chev., *Rev. Mag. Zool.*, (2)**4** : 414 (Type : *Lamia germari* Hope).
 1860. *Apriona*, Thomson, *Class. Cer.*, 78.
 1866. *Apriona*, Pascoe, *Trans. Ent. Soc. Lond.*, (3)**3** : 259, 272.
 1872. *Apriona*, Lacordaire, *Genl. Col.*, **9** : 354-356.
 1933. *Apriona*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 337.
 1951. *Apriona*, Gressitt, *Longicornia*, **2** : 409-410.
 1970. *Apriona*, Rondon & Breuning, *Pact. Ins. Monograph*, **24** : 141-142.

Apriona cinerea Chevrolat

1852. *Apriona cinerea* Chevrolat, *Rev. Zool.* (2)**4** : 416.

Material examined : Not examined.

Distribution : India : North India, Uttarakhand (Dehradun, Almora).

Tribe APOMECCYNINI

Genus *Ropica* Pascoe, 1858

1858. *Ropica*, Pascoe, *Trans. Ent. Soc. Lond.*, (2)**4** : 247 (Type : *R. piperata* Pasc.).
 1872. *Ropica*, Lacordaire, *Genl. Col.*, **9** : 580, 590.
 1933. *Ropica*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 366.
 1939. *Ropica*, Gressitt, *Lign. Sci. J.* **18** : 78.
 1964. *Ropica*, Breuning, *Ent. Abh. Dresden.*, **30** : 357.
 1970. *Ropica*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 47-50.

Ropica rufescens (Pic.)

Material examined : 1 ex., India : Uttarakhand : Dehradun, Lachiwala, 12.v.1999, 6666/H4, FRI Deh; 1 ex., Dehradun : Lachiwala 6.v.1937, FRI, Deh.

Distribution : India : Uttarakhand (Dehradun).

Elsewhere : Sri Lanka.

Remarks : This species is recorded for the first time from India (Uttarakhand), though reference not seen.

Genus *Apomecyna* Latreille, 1829

1829. *Apomecyna*, Latreille, *In. Cuvier. Regne Anum.* ed. 2(V)**1** : 126. (Type : *A. histrio* F.).
 1835. *Apomecyna*, Serville, *Ann. Soc. ent. Fr.* **4** : 77.
 1840. *Apomecyna*, Castelnau, *Hist. Nat. Col.*, **2** : 491.
 1860. *Apomecyna*, Thomson, *Ess. Cer.*, 43.
 1865. *Apomecyna*, Pascoe, *Trans. Ent. Soc. Lond.*, (3)**3** : 141.
 1872. *Apomecyna*, Lacordaire, *Genl. Col.*, **9** : 579-580.
 1933. *Apomecyna*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 366.
 1940. *Apomecyna*, Gressitt, *Phil. J. Sci.* **72** : 159-160.
 1951. *Apomecyna*, Gressitt, *Longicornia*, **2** : 488.
 1964. *Apomecyna*, Breuning, *Ent. Abh. Dresden*, **30** : 19-30.

Apomecyna histrio (F.)

1792. *Lamia histrio*, F., *Ent. Syst.*, **2** : 288.
 1840. *Apomecyna histrio*, Castelnau, *Hist. Nat. Col.*, **2** : 40.
 1868. *Apomecyna quadrifasciata*, Thomson, *Physis*, **2** : 59.
 1918. *Apomecyna maculaticollis*, Pic, *Mel. Exot. Ent.*, **28** : 6.
 1964. *Apomecyna histrio*, Breuning, *Ent. Abh. Dresden*, **30** : 21.

Material examined : 1 ex., India : Uttarakhand : Tehri Garhwal : Rishikesh : Muni Ki Reti, 03.ix.2002, S.K. Mandal.

Distribution : India : Arunachal Pradesh, Uttarakhand (Tehri Garhwal).

Elsewhere : Southern Asia, Sunda Islands, Malacca, Philippines, Japan, Laos.

Remarks : This species is recorded for the first time from this state.

Tribe PTEROLINI

Genus *Sthenias* Castelnau, 1840

1840. *Sthenias*, Castelnau, *Hist. Nat. Col.*, **2** : 466 (Type : *S. grisator* F.).
 1860. *Sthenias*, Thomson, *Class. Cer.*, 38.
 1865. *Sthenias*, Pascoe, *Trans. Ent. Soc. Lond.*, (3)**3** 140, 159.
 1872. *Sthenias*, Lacordaire, *Genl. Col.*, **9** : 552, 563.
 1951. *Sthenias*, Gressitt, *Longicornia*, **2** : 479-480.
 1962. *Sthenias*, Breuning, *Ent. Arb. Mus. Frey*, **13** : 428-442.
 1970. *Sthenias*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 68-69.

Sthenias grisator F.

1787. *Sthenias grisator*, F., *Mant. Ins.*, **1** : 136.
 1792. *Sthenias grisator*, Ol., *Encycl. meth.*, **7** : 467.
 1840. *Sthenias grisator*, Cast., *Hist. Nat. Col.*, **2** : 466.
 1872. *Sthenias grisator*, Lacordaire, *Genl. Col.*, **9** : 564.

1914. *Sthenias grisator*, Fletcher., *South. Ind. Ins.*, P. 326, fig 182.

Material examined : 1 ex., India : Uttarakhand : Dehradun, Rajpur, 3.vii.1930, 6670/H4, FRI, Deh.; 1 ex., Dehradun, Rajpur, 9.vii.1930, 6671/H4, FRI, Deh.

Distribution : India : Kerala (Tranuebar), Uttarakhand (Dehradun : Rajpur).

Remarks : This species is recorded for the first time from this state.

Genus *Pterolophia* Newmann, 1842

1842. *Pterolophia*, Newmann, *Ent.* **1** : 370 (Type : *P. vitticollis* New.).

1895. *Pterolophia*, Gahan, *Ann. Mus. Civ. Genova*, **34** : 66.

1933. *Pterolophia*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 357.

1939. *Pterolophia*, Gressitt, *Lingn. Sci. J.* **18** : 71.

1965. *Pterolophia*, Breuning, *Ent. Arb. Mus. Frey.* **16** : 161-472.

1970. *Pterolophia*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 70-85.

Subgenus *Mimoron* Pic.

1970. *Pterolophia (Mimoron)* Pic. Rondon & Breuning, *Pac. Ins. Monograph*, **24** : 82-83.

Pterolophia (Mimoron) brevegibbosa Pic.

1925. *Pterolophia brevegibbosa* Pic., v. *brevigibbosa*. Pic., *Mel. Exot. Ent.*, **45** : 32.

1931. *Pterolophia gardneri* Schwarzer, *Senckenberg.* **13** : 71. Fig. 32.

1965. *Pterolophia (Mimoron) brevegibbosa*, Breuning, *Ent. Arb. Mus. Frey.* **16** : 433.

1970. *Pterolophia (Mimoron) brevegibbosa*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 83.

Material examined : 1 ex. India : Uttarakhand : Jhajra, 15.vii.1930, 6668/H4, FRI, Deh; 1 ex., Dehradun : Sherpur, 8.ix.1930, 6669/H4, FRI, Deh.

Distribution : India : Uttarakhand (Jhajra, Sherpur).

Elsewhere : Southeast Asia, Laos.

Remarks : This species is recorded here for the first time from India (Uttarakhand).

Subgenus *Pterolophia* (s. str.)

1970. *Pterolophia (s.str.)* Rondon & Breuning,, *Paci. Ins. Monograph*, **24** : 72.

Pterolophia (s.str.) occidentalis (Schew)

Material examined : 1 ex., India : Uttarakhand : Dehradun, 17.ix.1930, 6678/H4, FRI, Deh.

Distribution : India : Uttarakhand.

Remarks : Reference not seen.

Genus *Desisa* Pascoe, 1865

1865. *Desisa* Pascoe, *Trans. Ent. Soc. Lond.*, (3)**3** : 163 (Type : *D. subfasciata* Pasc.).

1933. *Desisa*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 357, 364.

1939. *Desisa*, Gressitt, *Lingn. Sci. J.* **18** : 72.

1863. *Desisa*, Breuning, *Ent. Arb. Mus. Frey.*, **14**(1) : 177-186.

1970. *Desisa*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 86.

Subgenus *Desisa* Pascoe

1970. *Desisa (s.str.)* Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 86.

Desisa (s.str.) subfasciata (Pasc.)

1862. *Praonetha subfasciata* Pascoe, *J. Ent.*, **1** : 348.

1872. *Desisa subfasciata*, Lacordaire, *Genl. Col.*, **9** : 566.

1970. *Desisa (s.str.) subfasciata* (Pasc.) : Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 86.

Material examined : 2 ex., India : Uttarakhand : Dehradun, 17.ix.1930, 6641/H4, FRI, Deh.

Distribution : India : Uttarakhand.

Elsewhere : Southeast Asia, North Vietnam, Laos.

Desisa (s.str.) plagiata Br.

1963. *Desisa (s.str.) plagiata* Breuning, *Ent. Arb. Mus.* **14**(1) : 177-186.

Material examined : 2 ex., India : Uttarakhand : Dehradun : Barkat, 17.ix.1925, 6622/H4, 5.vi.1925, 6621/H4, FRI, Deh.

Distribution : India : Uttarakhand (Dehradun).

Tribe ACANTHOCININI

Genus *Exocentrus* Mulsant, 1839

1839. *Exocentrus*, Mulsant, *Col. Fr., Long.*, P. 152 (Type : *E. lusitanus* L.).

1866. *Exocentrus*, Bates, *Ann. Mag. Nat. Hist.*, (3)**17** : 191.

1884. *Exocentrus*, Ganglbauer, *Best. Tab.* **7** : 692.

1933. *Exocentrus*, Matsushita, *J. Fac. Agric. Hokk.* **34**(2) : 389.

1939. *Exocentrus*, Gressitt, *Lingn. Sci. J.* **18** : 82.

1958. *Exocentrus*, Breuning, *Bull. Brit. Mus. Ent.*, **7**(5) : 211-328.

1970. *Exocentrus*. Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 181-187.

Subgenus *Pseudocentrus* Fairmaire

1970. *Exocentrus (Pseudocentrus)*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 185-187.

Exocentrus (Pseudocentrus) flemingiae Fisher

1932. *Exocentrus flemingiae* Fisher, *Ind. For. Res.*, **16** : 296-297.

1939. *Exocentrus rufiscapus* Pic., VII. *Inter. Kongr. Ent.*, **1** : Sc. Syst., P. 344.

1958. *Exocentrus (Pseudocentrus) flemingiae*, Breuning, *Bull. Brit. Mus. Ent.*, **7**(5) : 299.

1970. *Exocentrus (Pseudocentrus) flemingiae*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 186.

Material examined : 2 ex., India : Uttarakhand : Dehradun : Lachiwala, 16.v.1929, 6645-46/H4, FRI. Deh.

Distribution : India : Bihar, Sikkim, Uttar Pradesh, Uttarakhand (Dehradun).

Elsewhere : North Vietnam, Laos.

Exocentrus (Pseudocentrus) grcurae (Fish.)

Material examined : 1 ex., India : Uttarakhand : Dehradun, 3.vi.1929, 6639/H4, FRI. Deh. : 1 ex., Dehradun, 8.vii.1930, 6640/H4, FRI. Deh.

Description : India : Uttarakhand (Dehradun).

Remarks : Reference not seen.

Exocentrus (Pseudocentrus) dalbergiae (Fish.)

Material examined : 1 ex., India : Uttarakhand : Dehradun, 16.ix.1930, 6650/H4, FRI. Deh.; 1 ex., Dehradun, 23.vii.1936, 6651/H4, FRI. Deh.

Description : India : Uttarakhand.

Remarks : Reference not seen.

Exocentrus (Pseudocentrus) cudraminae (Fish.)

Material examined : 1 ex., India : Uttarakhand : Dehradun, 3.viii.1930, 6652/H4, FRI. Deh.; 1 ex., Dehradun : Jhajra, 30.vii.1930, 6653/H4, FRI. Deh.

Distribution : India : Uttarakhand (Dehradun, Jhajra).

Reference : not seen.

Exocentrus (Pseudocentrus) alboguttatus (Fish.)

Material examined : 1 ex., India : Uttarakhand : Dehradun, 2.iii.1937, 6655/H4, FRI. Deh.

Distribution : India : Uttarakhand (Dehradun).

Remarks : Reference not seen.

Tribe DORCASHEMATINI

Genus ***Olenecamptus*** Chevrolat, 1835

1835. *Olenecamptus*, Chevrolat, *Mag. Zool.*, **5** : *Ins.*, pl. 134 (Type : *O. serratus* Chev.).

1866. *Olenecamptus*, Pascoe, *Trans. Ent. soc. Lond.*, (3) **3** : 259, 316.

1872. *Olenecamptus*, Lacordaire, *Genl. Col.*, **9** : 457-458.

1926. *Olenecamptus*, Schwarzer, *Senchenberg*, **8** : 287.

1951. *Olenecamptus*, Gressitt, *Longicornia*, **2** : 442-446.

Olenecamptus indianus Thomson

1857. *Olenecamptus indianus*, Thomson, *Archives Ent.*, **1** : 192.

1872. *Olenecamptus indianus*, Lacordaire, *Genl. Col.*, **9** : 458.

Material examined : 2 ex., India : Uttarakhand : Dehradun : Lachiwala, 26.vi.1929, 6658-59/H4, FRI. Deh.

Distribution : India : Ostindien, Uttarakhand (Dehradun : Lachiwala).

Remarks : This species is recorded here for the first time from the state.

Olenecamptus bilobus (F.)

1801. *Saperda biloba* F., *Syst. El.* **2** : 324.

1866. *Olenecamptus bilobus*, Pascoe, *Trans. Ent. Soc. Lond.*, (3) **3** : 316.

1970. *Olenecamptus bilobus*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 152.

Material examined : 1 ex., India : Uttarakhand : Tehri Garhwal. Rishikesh west, 31.viii.2002, S.K. Mandal.

Distribution : India : W.B., Uttarakhand (Tehri Garhwal : Rishikesh), Tamil Nadu, Kerala, Andaman Islands.

Remarks : This species is recorded here for the first time from Uttarakhand.

Tribe SAPERDINI

Genus ***Glenea*** Newmann, 1842

1842. *Glenea* Newm., *Etomologist*, **1** : 301 (Type : *Glenea novemguttata* Guerin).

1939. *Glenea*, Gressitt, *Lingn. Sci. J.*, **16** : 94.

1970. *Glenea*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 198-213.

Subgenus ***Glenea s.str.***

Glenea (s.str.) maculata (Hope)

Material examined : 1 ex., India : Uttarakhand : Kumaon, Almora, 14.vi.1937, 6627/H4, FRI, Deh.; 1 ex., Dehradun, 2.viii.1924, 6628/H4, FRI. Deh.

Distribution : India : Uttarakhand.

Remarks : Reference not seen.

Subgenus ***Stirolene*** Aurivillius

Glenea (Stirolene) spilota (Thomson)

1860. *Glenea (Stirolene) spilota* Thomson, *Classif. Ceramb.*, P. 58.

Material examined : 1 ex., India : Uttarakhand : Dehradun, 25.vi.1929, 6625/H4, FRI. Deh.; 1 ex., Dehradun, 1.vi.1929, 6626/H4, FRI Deh.

Distribution : India : Uttarakhand (Dehradun).

Elsewhere : Indonesia (Java).

Remarks : This species is recorded for the first time from Uttarakhand.

Tribe CROSSOTINI

Genus *Moechotypa* Thomson, 1864

1864. *Moechotypa* Thomson, *Syst. Cer.*, **55** : 368 (Type : *M. suffusa* Pascoe).
 1872. *Moechotypa*, Lacordaire, *Gen. Col.*, **9** : 518.
 1933. *Moechotypa*, Matsushita, *J. Fac. Agric. Hokk.*, **34** : 355.
 1951. *Moechotypa*, Gressitt, *Longicornia*, **2** : 449-451.
 1970. *Moechotypa*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 155-158.

Moechotypa asiatica (Pic.)

1903. *Hecyrda asiatica* Pic., *Echange*, **19** : 121.
 1929. *Moechotypa asiatica*, Schwarzer, *Senckenberg*, **11** : 374.
 1970. *Moechotypa asiatica*, Rondon & Breuning, *Paci. Ins. Monograph*, **24** : 157-158.

Material examined : India : Uttarakhand : Nagrasu in Rudraprayag Dist., 07.xi.2002, Dr. P. Mukhopadhyay, ex. on leaf.

Distribution : India : Assam, Uttarakhand (Nagrasu : Rudraprayag).

Elsewhere : Myanmar, China, Laos.

Subfamily PRIONINAE

Genus *Lophosternus* Guer., 1844

1844. *Lophosternus* Guerin, *Icon. Regne Anim. Ins.* P. 209.
 1844. *Cyrtosternus* Guer., *Icon. Regne Anim. Ins.* 210.
 1869. *Cyrtognathus* (Part), Lacord, *Gen. Coleopt.*, **8** : 53.
 1906. *Lophosternus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 9-13.

Lophosternus hugelii Redtenb.

1848. *Lophosternus hugelii* Redtenb. (*Cyrtognathus*). *Hugel's Kaschmir*, **4**(2) : 550, Pl. 28, fig. 1.
 1906. *Lophosternus hugelii*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 11-12.

Material examined : 1 ex., India : Uttarakhand : Rudraprayag : Gaurikund, 28.iv.2004, S.K. Chakraborty & Party, ex. at light.

Distribution : India : Assam, North West Provinces, Punjab, Himachal Pradesh, Kashmir, Uttarakhand.

Remarks : This species is recorded here for the first time this state.

Subfamily LEPTURINAE

Genus *Apioccephalus* Gahan, 1898

1898. *Apioccephalus* Gahan, *Ann. Mag. Nat. Hist.*, (7)**2** : 42.
 1906. *Apioccephalus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 74.75.

Apioccephalus licheneus Gahan

1906. *Apioccephalus licheneus* Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 74-75.

Material examined : Not seen.

Distribution : India : Uttarakhand (Dehradun).

Subfamily CERAMBYCINAE

Group ASEMINE

Genus *Tetropium* Kirby, 1837

1837. *Tetropium* Kirby, *Fauna Boreali. Americana*, **4** : 174.
 1850. *Tetropium*, Leconte, *J. Acad. Philad.*, (2)**2** : 34.
 1860. *Tetropium*, Thomson, *Classif. Ceramb.* P. 258.
 1869. *Tetropium*, Lacordaire, *Gen. Coleopt.* **7** : 208.
 1906. *Tetropium*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 95-96.

Tetropium oreinum Gahan

1906. *Tetropium oreinum* Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 95-96.

Mistribution : India : North west Himalaya, Kashmir, Himachal Pradesh, Uttarakhand (Tehri Garhwal).

Genus *Criocephalus* Mulsant, 1839

1839. *Criocephalus* Mulsant, *Col. de France, Longic.*, P. 63 (Type : *C. rusticus* Linn.).
 1869. *Criocephalus*, Lacordaire, *Gen. Coleopt.* **8** : 210.
 1905. *Criocephalus*, Sharp, *Trans. Ent. Soc. Lond.*, P. 145.

Criocephalus unicolor Mshl.

1906. *Criocephalus unicolor*, Mshl., *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 97-98.

Material examined : 2 ex., India : Uttarakhand; Bhowali in Nainital District, 08.ix.2005, S.K. Chatter & party.

Distribution : India : Assam, Uttarakhand (Bhowali : Nainital).

Elsewhere : Japan.

Remarks : This species is recorded here for the first time from this state.

Group OEMINE

Genus *Xystocera* Serv., 1869

1834. *Xystocera*, Serv., *Ann. Soc. ent. Fr.*, P. 69.
 1869. *Xystocera*, Lacordaire, *Gen. Col.*, **8** : 229.
 1906. *Xystocera*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 105-107.

Xystocera globosa Oliv.

1795. *Xystocera globosa*, Oliv. (*Cerambyx*), *Entom.*, **4**(No. 67) : 27, pl. 12, fig. 81.

1906. *Aystocera*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 106-107.

Material examined :

Distribution : India : W.B., Maharashtra, Karnataka, Uttarakhand (Mussoorie), Tamil Nadu, Assam.

Elsewhere : Sri Lanka, Myanmar, Siam, Malay Peninsula, Indonesia, Philippines, Egypt, Mauritius, Hawaiian Islands.

Remarks : This species is found to attack trees like Semul (*Bombax malabaricum*).

Group CERAMBYCINI

Genus *Aeolesthes* Gahan, 1890

1890. *Aeolesthes* Gahan, *Ann. Mag. Nat. Hist.*, (6)6 : 250 [Type : *A. aurifaber* White (*Hammatichorus*)].

1906. *Aeolesthes*, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 126-129.

Aeolesthes holosericea Fab.

1787. *Aeolesthes holosericea* F. (*Cerambyx*). *Mant. Ins.*, 1 : 135.

1865. *Pachydissus velutinus* Thomson, *Syst. Ceramb.*, P. 576.

1890. *Pachydissus similis* Gahan, *Ann. Mag. Nat. Hist.*, (6)5 : 52.

1899. *Neocerambyx holosericea* Cotes, *Ind. Mus. Notes*, I(No. 2) : 60, 89, pl. 5, fig. 3.

1906. *Aeolesthes holosericea*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 127-128.

Material examined : 1 ex., India : Uttarakhand : Uttarkashi F.R.H. Campus, 07.v.2002, S.K. Chakraborty, ex. at light.

Distribution : India : Uttarakhand (Uttar Kashi), N.W. India, Maharashtra, Tamil Nadu, Assam, Andaman & Nicobar Islands.

Elsewhere : Sri Lanka, Tenasserim, Siam, Malay Peninsula.

Remarks : This species has been recorded for the first time from this state.

Genus *Diorthus* Gahan, 1891

1891. *Diorthus*, Gahan, *Ann. Mag. Nat. Hist.*, (6)7 : 27 [Type : *D. simplex* White (*Hammatichorus*)].

1906. *Diorthus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 132-133.

Diorthus simplex White

1891. *Diorthus simplex*, White, *Cat. Col. Brit. Mus., Longic.*, P. 130.

Material examined : 1 ex., India : Uttarakhand : Mailani in Nainital District, 30.iv.2008, 14757/H4 R.H.; 1 ex., Srinagar : Paurigarhwal, 14.v.2002, S.K. Chakraborty

& party, ex. dusting.; 1 ex., Rajwala in Dehradun Dist., 20.v.2002, S.K. Chakraborty & party.

Distribution : India : W.B., Tamil Nadu, Uttarakhand (Mailani, Srinagar, Rajwala).

Elsewhere : Beluchistan, North Myanmar, Siam, Indonesia, Aden, Mauritius, W. Africa.

Remarks : This species has been recorded for the first time from this state.

Genus *Derolus* Gahan, 1891

1891. *Derolus* Gahan, *Ann. Mag. Nat. Hist.*, (6)7 : 26 (Type : *D. mauritanicus* Buquet).

1894. *Copnocerambyx* Reitter, *Ent. Nachr.*, 20 : 356.

Derolus mauritanicus Buquet

1840. *Derolus mauritanicus* Buquet (*Hammatichorus*), *Ann. Soc. ent. Fr.*, P. 295.

1906. *Derolus mauritanicus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 135-136.

Material examined : 3 ex., India : Uttarakhand : Jaknidhar in Tehri Garhwal Dist., 15.v.2002, S.K. Chakraborty & party, ex. dusting; 2 ex., Raiwala : Dehradun, 20.v.2002, S.K. Chakraborty & party.

Distribution : India : Uttarakhand (Jaknidhar, Raiwala).

Elsewhere : Beluchistan, Persia, Algeria, S. Europe.

Remarks : This species is recorded here for the first time from India (Uttarakhand).

Group MYTHODINI

Genus *Phyodexia* Pascoe, 1871

1871. *Phyodexia* Pascoe, *Ann. Mag. Nat. Hist.*, (4)8 : 273 (Type : *P. concinna* Pascoe).

1906. *Phyodexia*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 182-183.

Phyodexia concinna Pascoe

1871. *Phyodexia concinna*, Pascoe, *Ann. Mag. Nat. Hist.*, (4)8 : 273, pl. 3, fig. 2.

1906. *Phyodexia concinna*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae, 1* : 183.

Material examined : Not seen.

Distribution : India : W.B., Assam, Uttarakhand (Mussoorie).

Elsewhere : Bhutan, Myanmar.

Group PURPURICENINI

Genus *Perpuricenus* Latrielle, 1829

1829. *Perpuricenus* Latr., *Regne Anim.*, ed. 2, 5 : 114 (Type *P. desfontainei* F.).

1846. *Gyclodera* White, *Stokess Voy., App.* **1** : 510.
 1869. *Philagathes* (Thomson), Lacord. (in part), *Genl. Coleopt.* **9** : 176.
 1906. *Perpuricenus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 184-186.

***Perpuricenus montanus* White**

1853. *Perpuricenus montanus*, White, *Cat. Col. Brit. Mus., Longic.*, **7** : 138.
 1906. *Perpuricenus montanus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 186.

Material examined : Not seen.

Distribution : India : West Kashmir, Himalaya, Uttarakhand (Tehri Garhwal).

Elsewhere : Tibet.

Group PYRESTINI

Genus ***Erythrus*** White, 1853

1853. *Erythrus* White, *Cat. Col. Brit. Mus., Longic.*, P. 142 (Type : *E. championi* White).
 1906. *Erythrus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 229-232.

***Erythrus westwoodi* White**

1853. *Erythrus westwoodi*, White, *Cat. Col. Brit. Mus., Longic.*, P. 143.
 1906. *Erythrus westwoodi*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 231.

Material examined : Not seen.

Distribution : India : Himalaya, Uttarakhand (Almora), Manipur.

Group CLYTINI

Genus ***Xylotrechus*** Chevrolat, 1860

1860. *Xylotrechus* Chevr., *Ann. Soc. ent. Fr.*, P. 456 (Type : *X. sartorlli* Chevr.).
 1906. *Xylotrechus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 241-245.

***Xylotrechus stebbingi* Gahan**

1906. *Xylotrechus stebbingi* Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 244.

Material examined : Not seen.

Distribution : India : North west Himalayas, Uttarakhand (Jaunsar, Nainital, Almora).

Elsewhere : Tibet.

***Xylotrechus subscutellatus* Chevr.**

1863. *Xylotrechus subscutellatus* Chevr., *Mem. Soc. R. Sci. de Liege*, **18** : 317.

1906. *Xylotrechus subscutellatus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. Cerambycidae*, **1** : 242-243.

Material examined : 2 ex., India : Uttarakhand Srinagar in Pauri Garhwal Dist., 14.v.2002 S.K. Chakraborty & party, ex. dusting; 1 ex., Rudraprayag. 29.ix.2004, P. Mukhopadhyay, ex. at light.

Distribution : India : W.B., Maharashtra, Tamil Nadu, Uttarakhand (Sri nagar, Rudraprayag).

Remarks : This species is recorded for the first time from this state.

Genus ***Perissus*** Chevrolat, 1863

1863. *Perissus*, Chevr., *Mem. Soc. R. sci. de Liege*, **18** : 262. (Type : *P. x-littera*).
 1906. *Perissus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 254-259.

***Perissus fuliginosus* Chevr.**

1863. *Perissus fuliginosus*, Chevr. (*Amauraesthes*), *Mem. Soc. R. Sci. de Liege*, **18** : 328.
 1906. *Perissus fuliginosus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 254.

Material examined : Not seen.

Distribution : India : Uttarakhand (Almora).

Elsewhere : Tibet.

Genus ***Caloclytus*** Fairm., 1864

1860. *Anthoboscus* Chevr. (in part), *Ann. Soc. ent. Fr.*, (3)**8** : 455.
 1863. *Chlorophorus* Chevr, (nec. Robineau-Desvoidy), *Mem. Soc. R. Sci. de Liege*, **18** : 290.
 1864. *Caloclytus* Fairm., in *Jacq du Val & Fairm., Gen. Coleopt. d' Europe*, **4** : 145, (Type : *C. speciosus* Schneid).
 1906. *Caloclytus*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 260-270.

***Caloclytus annularis* Fab.**

1787. *Caloclytus annularis*, F. (Callidium), *Mant. Ins.*, **1** : 156.
 1906. *Caloclytus annularis*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*, **1** : 261.

Material examined : 1 ex., India : Uttarakhand : Bhimtal in Nainital Dist., 15.iv.2002, S. Roy Chaudhury R.I.

Distribution : India : Northern India from north west to Assam, W.B., Bihar, Uttarakhand (Dehradun, Bhimtal).

Elsewhere : Myanmar, Siam, Northwards to China & Japan, Southwares Through Malayan Peninsula & Archipelago to New Guinea.

Group EPIPEDOCERINI

Genus *Epipedocera* Chevrolat, 1863

1863. *Epipedocera*. Chevr., *Mem. Soc. R. Sci. de Liege*, **18** : 339 (Type : E. zona Chevr.).

1906. *Epipedocera*. Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. Cerambycidae*, **1** : 305-308.

Epipedocera affinis Chevr.

1863. *Epipedocera affinis*, Chevr. *Soc. R. Sci. de Liege*, **18** : 341.

1906. *Epipedocera affinis*, Gahan, *The Fauna of British India incl. Ceylon & Burma, Col. : Cerambycidae*. **1** : 307.

Material examined : 1 ex., India : Uttarakhand : Dehradun : New Forest, 7.viii.1990, 7965/H4, S.L. Mark.

Distribution : India : Tamil Nadu, Maharashtra, Uttarakhand (Dehradun).

Remarks : This species has been recorded for the first time from this state.

Family CURCULIONIDAE

Division ADELOGNATHI

Subfamily BRACHYDERINAE

Goup BLOSYRIDES

Genus *Blosyroides* Jek., 1875

1875. *Blosyroides* Jekel. *Col. Jekel.*, P. 157.

1916. *Blosyroides*. Marshall, *The Fauna of British India including Ceylon and Burma, Coleoptera : Rhynchophora : Curculionidae* : 38-44.

Blosyroides variegatus (Redtenbacher)

1848. *Blosyroides variegatus* Redt., *Hugel's Kaschm.*, **4** : 539.

1875. *Blosyroides interruptus* Jekel, *Col. Jekel.*, : 161.

1916. *Blosyroides variegatus* (Redt.) : Marshall, *The Fauna of British India including Ceylon and Burma.*, Coleoptera : Rhynchophora : Curculionidae : 40-41.

Material examined : Not examined.

Distribution : India : Kashmir, Uttarakhand (Mussoorie, 7000 ft).

Group TANYMECIDES

Genus *Tanymecus* Schönh., 1826

1826. *Tanymecus* Schönh., *Disp. Meth.*, : 127.

1916. *Tanymecus*, Mshl. *The Fauna of British India including Ceylon and Burma, Coleoptera : Rhynchophora : Curculionidae* : 68-107.

Tanymecus circumdatus (wied.) var. *rusticus* Gyl.

1821. *Curculio circumdatus* Weidemann. *Germ. Mag.*, **4** : 156.

1834. *Tanymecus rusticus* Gyllenhal. *Schönh. Gen. Curc.*, **2** : 83.

1916. *Tanymecus circumdatus* var. *rusticus* Gyl. : Mshl., *The Fauna of British India including Ceylon and*

Burma. Coleoptera : Rhynchophora : Curculionidae : 91.

Material examined : Not examined.

Distribution : India : Bihar, Uttarakhand (Dehradun).

Tanymecus agrestis Fst.

1899. *Tanymecus agrestis* Faust. *Ann. Soc. Ent. Belg.* **43** : 394.

1916. *Tanymecus agrestis* : Mshl., *The Fauna of British India including Ceylon and Burma Coleoptera : Rhynchophora : Curculionidae* : 104-105.

Material examined : Not examined.

Distribution : India : Bihar, Uttarakhand (Sura bagh, Dehradun).

Elsewhere : Myanmar.

Remarks : Ventricle 5 of male of the species deeply bisinuate at apex.

Genus *Dereodus* Schönh., 1826

1826. *Dereodus* Schönh., *Disp. Meth.* : 125.

1916. *Dereodus* Mshl., *The Fauna of British India including Ceylon and Burma, Coleoptera : Rhynchophora : Curculionidae* : 118-125.

Dereodus pollinosus (Redt.)

1848. *Hypomeces pollinosus* Redtenbacher, *Hugel's Kaschm.*, **4** (pt. 2) : 545.

1891. *Dereodus himalayanus* Faust, *Stettin. Ent. Zeit.*, : 262.

1916. *Dereodus pollinosus* (Redt.); Mshl. *The Fauna of British India including Ceylon and Burma Coleoptera : Rhynchophora : Curculionidae* : 121.

Material examined : Not examined.

Distribution : India : Uttarakhand (Mussoorie, Almora, Dalmoti, Kumaon; Thano, Sabhawala and Thadiar, 7000, Dehradun), Punjab, Himachal Pradesh, Kashmir.

Elsewhere : Baluchistan, Nepal.

Genus *Astycus* Schonh., 1826.

1826. *Astycus* Schonh., *Disp. Meth.*, P. 129.

1916. *Astycus*, Mshl., *The Fauna of British India including Ceylon and Burma, Coleoptera : Rhynchophora : Curculionidae* : 128-152.

Astycus lateralis (F.)

1792. *Curculio lateralis* F., *Ent. Syst.*, **1**(2) : 454.

1892. *Astycus lateralis* var. *subacuminatus* Faust., *Ann. Soc. ent. Fr.* : 505.

1916. *Astycus lateralis*, Mshl., *The Fauna of British India including Ceylon and Burma, Coleoptera : Rhynchophora : Curculionidae* : 139-140.

Material examined : 2 exs., India : Uttarakhand : Tehri : Tehri Garhwal dist., 2.xi.2000, Dr. P. Mukhopadhyay & party.

Distribution : India : Widely distributed in India : Uttarakhand, Assam.

Elsewhere : Myanmar, Siam, Malaya Peninsula.

Remarks : This species is recorded here for the first time from Uttarakhand.

Genus *Lepidospyris* Mshl., 1916

1916. *Lepidospyris* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 153-156.

Lepidospyris cretacea Faust

1897. *Astycophobus cretaceus* Faust, *Deut. Ent. Zeit.*, : 348.

1916. *Lepidospyris cretacea* : Mshl., *The Fauna of British India including Ceylon and Burma*. Coleoptera : Rhynchophora : Curculionidae : 153-154.

Material examined : Not examined.

Distribution : India : Maharashtra, Uttarakhand (Kathgodam 1200" : Kumaon).

Lepidospyris demissa Mshl.

1916. *Lepidospyris demissa* Mshl., *The Fauna of British India including Ceylon and Burma*. Coleoptera : Rhynchophora : Curculionidae : 154-155.

Material examined : Not examined.

Distribution : India : Uttarakhand (Dehradun).

Genus *Leptomias* Fst., 1866

1866. *Leptomias* Faust, *Stettin. Ent. Zeit.*, : 132.

1916. *Leptomias* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 172-191.

Leptomias angustatus (Redt.)

1848. *Pachynotus angustatus* Redt., *Hugel's Kaschm.*, 4, pt. 2, P. 542.

1916. *Leptomias angustatus* Redt. : Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 177-178.

Material examined : Not examined.

Distribution : India : Kashmir, Uttarakhand (Mussoorie, 7000, Mundali, Jaunsar division, Dehradun).

Leptomias lituratus (Redt.)

1848. *Cneorhinus lituratus* Redt., *Hugel's Kaschm.* 4. Pt. 2, P. 543.

1916. *Leptomias lituratus* Redt. : Mshl., *The Fauna of British India including Ceylon and Burma* Coleoptera : Rhynchophora : Curculionidae : 179.

Material examined : Not examined.

Distribution : India : Kashmir, Uttarakhand (Mussoorie; Mandali; 9000, Jaunsar division, Dehradun).

Leptomias curtus Mshl.

1916. *Leptomias curtus* Mshl., *The Fauna of British India including Ceylon and Burma*. Coleoptera : Rhynchophora : Curculionidae : 180.

Material examined : Not examined.

Distribution : India : Uttarakhand (Dehradun).

Leptomias jekeli Fst.

1886. *Leptomias jekeli* Fst., *Stettin. Ent. Zeit.*, : 135.

1916. *Leptomias jekeli* : Mshl., *The Fauna of British India including Ceylon and Burma*. Coleoptera : Rhynchophora : Curculionidae : 181-182.

Material examined : Not examined.

Distribution : India : Punjab, Uttarakhand (Almora).

Leptomias bipustulatus Fst.

1897. *Leptomias bipustulatus* Fst., *Deut. Ent. Zeit.*, 342.

1916. *Leptomias bipustulatus* : Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 184.

Material examined : Not examined.

Distribution : India : Punjab, Uttarakhand (Kului, Thano and Lachiwala, Dehradun; Almora, 5500").

Leptomias sulcicollis Mshl.

1916. *Leptomias sulcicollis* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 187.

Material examined : Not examined.

Distribution : India : Punjab, Uttarakhand (Bhimtal, 4500' Kumaon).

Leptomias longulus (Fst.)

1897. *Parisomias longulus* Faust, *Deut. Ent. Zeit.*, : 345, note 3.

1916. *Leptomias longulus* : Mshl. *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 189-190.

Material examined : Not examined.

Distribution : India : Uttarakhand (Bagarkote, 8000', Kumaon).

Genus *Xylinophorus* Faust, 1885

1885. *Xylinophorus* Faust, *Deut. Ent. Zeit.*, : 177.

1916. *Xylinophorus* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 191-194.

Xylinophorus strigifrons Fst.

1897. *Xylinophorus strigifrons* Fst., *Deut. Ent. Zeit.*, 347.

1916. *Xylinophorus strigifrons* : Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 194.

Material examined : Not examined.

Distribution : India : Uttarakhand (Dehradun).

Genus *Pachynotus* Redt., 1848

1848. *Pachynotus* Redt., *Hugel's Kaschm.*, 4(2) : 541.

1916. *Pachynotus Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 201-202.

***Pachynotus globulicollis* Redt.**

1848. *Pachynotus globulicollis* Redt., *Hugel's Kaschm.* 4(1) : 541. Pl. 26, fig. 5.

1848. *Cneorhinus obscurus* Redt., *Hugel's Kaschim.* : 544.

1916. *Pachynotus globulicollis* Redt. : Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 201-202.

Material examined : Not examined.

Distribution : India : Kashmir, Uttarakhand (Mussoorie, 7000" Dehradun; Mandali, 9000", Jaunsar division; Bargarkote, 8000" Kumaon; Painsur, above Lohba, 8000" Garhwal).

Genus *Achlaenomus* Waterhouse, 1853

1953. *Achlaenomus* Waterhouse. *Trans. Ent. Soc. Lond.*, (2)2 : 178.

1916. *Achlaenomus*. Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 202-203.

***Achlaenomus ebeninus* Waterhouse**

1853. *Achlaenomus ebeninus* Waterhouse, *Trans. Ent. Soc.*, (2)2 : 179.

1916. *Achlaenomus ebeninus* : Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : P. 202-203.

Subfamily OTIORRHYNCHINAE

Group PHYLLOBIIDES

Genus *Myllocerus* Schonh., 1826

1826. *Myllocerus* Schonh., *Disp. Meth.*, : 178.

1916. *Myllocerus* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 291-352.

***Myllocerus setulifer* Desbr.**

1899. *Myllocerus setulifer* Desbrochers des Loges. *Ind. Mus. Notes.*, 4 : 111.

1916. *Myllocerus setulifer* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 312-313.

Material examined : Not examined.

Distribution : India : Uttarakhand (Dehradun).

***Myllocerus setulifer* Mshl.**

1916. *Myllocerus sabulosus* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 336-337.

Material examined : Not examined.

Distribution : India : Bihar, Uttarakhand (Karwapani, Dehradun), Tamil Nadu.

***Myllocerus transmarinus* (Hbst.)**

1795. *Curculio transmarinus* Herbst. *Kaf.*, 6 : 213, Pl. 75, f. 1.

1914. *Myllocerus transmarinus* : Stebbing, *Indian Forest Insects.* : 402.

1916. *Myllocerus transmarinus* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 337-338.

Material examined : Not examined.

Distribution : India : Punjab, Himachal Pradesh, Uttar Pradesh, Uttarakhand (Dehradun), West Bengal, Bihar, Madhya Pradesh, Maharashtra, Tamil Nadu.

***Myllocerus cardoni* Mshl.**

1916. *Myllocerus cardoni* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 339.

Material examined : Not examined.

Distribution : India : Bihar, West Bengal, Uttarakhand (Dehradun), Tamil Nadu.

***Myllocerus lefroyi* Mshl.**

1916. *Myllocerus lefroyi* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 340-341.

Material examined : Not examined.

Distribution : India : Bihar, Uttarakhand (Chandbagh, Dehradun), West Bengal.

***Myllocerus discolor* Boh.**

1834. *Myllocerus discolor* Boh., in *Schonh. Gen. cure.* 2 : 428.

1914. *Myllocerus discolor var variegates* Boh. : Stebbing, *Indian Forest Insects.* : 403.

1916. *Myllocerus discolor* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 348-349.

Material examined : Not examined.

Distribution : India : Punjab, Uttarakhand (Almora 5000" & Takula, Kumaon; Dehradun), Uttar Pradesh, West Bengal, Bihar, Orissa.

Elsewhere : Bangladesh.

***Myllocerus discolor var. uniformis* Mshl.**

1916. *Myllocerus discolor var uniformis* Mshl., *The Fauna of British India including Ceylon and Burma*, Coleoptera : Rhynchophora : Curculionidae : 349-350.

Material examined : Not examined.

Distribution : India : Uttarakhand (Mundali, Jaunsar).

Genus *Arrhines* Schonh., 1834

1834. *Arrhines* Schonh., Gen. Curc., 2 : 465.

1916. *Arrhines*, Mshl., *The Fauna of British India including Ceylon and Burma*. Coleoptera : Rhynchophora : Curculionidae : 355-359.

Arrhines languides Gyllenhal

1834. *Arrhines languidus* Gyl., in *Schonh., Gen. Curc.*, 2 : 466.

1886. *Arrhines brunneus* Faust, *Stett. Ent. Zeit.*, : 142.

1916. *Arrhines languidus* Gyl., Mshl., *The Fauna of British India including Ceylon and Burma*. Coleoptera : Rhynchophora : Curculionidae : 356-357.

Material examined : Not examined.

Distribution : India : Uttarakhand (Dehradun), Delhi, West Bengal, Bihar, Kashmir.

SUMMARY

Present study includes 40 species under 34 genera of the family Cerambycidae and 26 species under 11

genera of the subfamily Brachyderinae & Otirrhynchinae of Curculionidae. Of Which 4 species under 4 general viz., *Pterolophia (Mimoron) brevigibbosa* Pic., *Xenolia asiatica* (Pic.), *Ropica rufescens* (Pic.) and *Derolus mauritanicus* Buquet and 14 species under 13 genera of the family Cerambycidae and 1 species viz. *Astycus lateralis* (F.) of the subfamily Brachyderinae are recorded for the first time from this state. Beside this synonymies and distribution of the species have also been included from the literature and actual study of the specimens.

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NEW RECORD OF MALE AND EPHIPPIAL FEMALE OF *CYCLESTHERIA HISLOPI* (BAIRD, 1859) (BRANCHIOPODA : DIPLOSTRACA : CYCLESTHERIIDAE) FROM A WETLAND IN KERALA, INDIA

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INTRODUCTION

Kerala lying on the southern tip of peninsular India is blessed with a series of world renowned wetland systems popularly referred to as backwaters, lagoons, inlets and several others having immense biodiversity potential. Even though, we have some authentic work on the taxonomy of lower crustaceans, like cladocerans, copepods and ostracods but information on large branchiopods are very limited (Durga Prasad & Simhachalam, 2009). *C. hislopi* is considered a monotypic genus showing circumtropical distribution in which males are rarely reported (Olesen *et al*, 1996). However, males were reported from Australia (Sars, 1887; Dady, 1926) that from USA (Sisson, 1980) and also from Colombia (Roessler, 1995). Although Sars (1887) reported the males in *C. hislopi* from Australian population, but his description was based on an immature male from the brood pouch of a parthenogenetic female, however the descriptions were incomplete. Several specimens of *C. hislopi* also reported from South East Asian countries, but could not report any males or sexual females (Martin *et al*, 2003). Parthenogenetic females, males and sexual females (ephippial females) of *C. hislopi* were reported from Columbia (Olesen *et al*, 1996; Roessler, 1995) Moreover a comparative study on male prehensile organs of various diplostracans are also reported by Olesen *et al* (1996).

Although there are some available reports on *Cyclestheria hislopi* from India (Gurney, 1906; Nayar, 1968; Nayar and Nair, 1968; Paul & Nayar, 1977; Battish, 1981; Usha Balaraman, 2004), these studies were restricted to the parthenogenetic females. It was in this context that, present study gives a detailed account on

the morphological features of the male and ehippial female (sexual female) of *C. hislopi* in comparison with that of the published reports of the same specimen from Colombia. This is the first report on male and ehippial female (sexual female) of *C. hislopi* from India.

MATERIALS AND METHODS

Specimens for the study were collected from an isolated shallow irrigated paddy field (60 ha.) at Thommana, Trichur in Kerala (10° 20' 30" N, 76° 15' 23"E). Collections were made with a standard scoop net with mesh size 70mm having a mouth area of 8 inches diameter. After collection, the samples were brought to laboratory in live condition in order to observe its behavior and subsequently the specimens were fixed with 4% formalin and the male, ehippial females and parthenogenetic females were sorted out using wide mouthed pipettes under low power binocular microscope. The sex ratio of male and parthenogenetic females and ehippial females were computed and analyzed by Chi-square test using the SPSS package (version 16.0). The specimens were dissected with two fine tungsten needles under low power microscope and measurements were made using ocular micrometer. Then camera lucida diagrams were made. Nomenclature, species confirmation and morphological studies were done using standard literature and monographs (Baird, 1859; Dodson & Frey, 1991). The order "Conchostaca" in the recent updating has been reclassified as Diplostraca (Martin & Davis, 2001). For scanning electron microscopy (SEM) the material was treated with ethanol series and after the critical drying at 60°C for 24 hours, the material was coated with platinum 10nm and observed in a Jeol (JSM-6390). The specimens have

been deposited in the Marine Biology Museum, School of Marine Sciences, Cochin University of Science & Technology having Code: MBM/Ch/21/08.

RESULTS AND DISCUSSION

SYSTEMATICS

Order DIPLOSTRACA GERSTAECKER

Family CYCLESTHERIIDAE SARS

Genus *Cyclestheria*

Cyclestheria hislopi (Baird, 1859)

Male

Size : $3.64 \pm .05\text{mm}$ (n=5)

Males slightly smaller than females with 3-4 lines of growth (Fig. 1A & Fig. 2A). Sexual dimorphism not very prominent in the species. Its shape is slightly oval with yellowish colour. In live condition, males could be distinguished from females based on their more active behavior. Head conical in shape with convex dorsal and concave ventral margin with very prominent serrations on its vertex region (Fig. 1E & Fig. 2B). Eye slightly bigger than ocellus and situated near dorsal margin (Fig. 1E). The first antenna (antennule) slender, elongated and more dilated than that of female with tufts of sensory hairs (sencille) on its tip (Fig. 1F). The post maxillary thoracopods, 15 in number and the first thoracopod modified as a prehensile organ (Claspers) (Fig. 1H & Fig. 2C). Right and left claspers similar in size and shape. Unlike other branchiopods, the second pair of thoracopod is not modified as prehensile organ. The distal 4 and 5 endites and endopod of first thoracopods modified into palm and the 6th endite as the finger (Figs. 1I & J, Fig. 2D). Palm and finger armed with two types of teeth like structures (Fig. 2E). The palm beset with multi-cusped teeth like structures and finger with single cusped terminal teeth (Fig. 1K & L). Apart from these teeth, there were many button like structures on the anterior region of palm (Fig. 1J). Only single plumose seta on the antero-dorsal area of moving finger whereas in the palm 8-9 plumose setae were present. A thick palp originated from the base of the finger carrying a few terminal setae on its distal end (Fig. 1I). The epipod was oval in shape (Fig. 1H). Rest of the thoracopods reduced in size towards its posterior end. Telson almost similar to female with 7-8 spines on its dorsal margin, distal spines elongated, claw like and serrated on concave margin. Number of basal spines on the base of the second claw 4-5 (Fig. 2F). Testis slightly yellowish and seen on both sides of the alimentary canal.

Ephippial female

Size : $4.20 \pm .09\text{mm}$ (n=5)

Ephippial female are pale white and opaque with ephippium (egg case). They are modified form of parthenogenetic female itself, having size and shape almost similar to parthenogenetic female. Carapace thick and reinforced by chitinous material. Unlike in cladocerans, the ephippium is part of their body. Ephippial females were capable of producing a special kind of resting eggs (diapause eggs). Eggs dark in colour, slightly oval in shape, larger than parthenogenetic eggs. Outer covering of these eggs are hard without any ornamentation. Mean size of eggs was 4.2 mm and number of eggs/brood was 5.4 ± 1.7 (n=5). Unlike other large Branchiopods, in *C. hislopi* eggs were free and not glued. Eggs well encased within the modified form of carapace, the ephippium. After the formation of ephippium, the female settles at the bottom. The ephippium without eggs were also observed in the present study. Ephippial female is very similar to parthenogenetic female but looks slightly whitish in colour due to the presence of ephippia. Average ratio between male with ephippial female were 1: 4. The other details of ephippial female fully agree with description given by Roessler (1995) on Colombian population.

Parthenogenetic female

Size : $4.27 \pm .14\text{mm}$ (n=10)

Carapace oval in shape with maximum height in the middle, laterally compressed and slightly yellowish in colour. The umbone situated close to the antero-dorsal side of the carapace. The shell with very specific shell gland had 4-5 growth lines (carapace lines). Head large and somewhat rounded in shape with serrated vertex (Fig. 1B). Eye slightly larger than ocellus and situated at antero-dorsal margin of the head whereas ocellus is central in position (in lateral view). Antennule (first antenna) slender elongated and distally dilated (spatula shaped) with a few terminal sensory hairs. (Fig. 1D). Antenna biramus, stout, seven segmented; each segment beset with setae and spine like structures. Body segmented, slightly arched in profile with 16 pairs of swimming appendages and each segment carries one pair of swimming legs. Ovary paired, one on either side of the alimentary canal as in cladocerans. Eggs spherical and slightly greenish in colour with mean size (0.34mm). The number of eggs in the brood varies from 3-21 depending on the age of the specimen. Eggs soft without any ornamentation. A large number of individuals were observed in which the brood contains developing embryos. In the sample collected male to

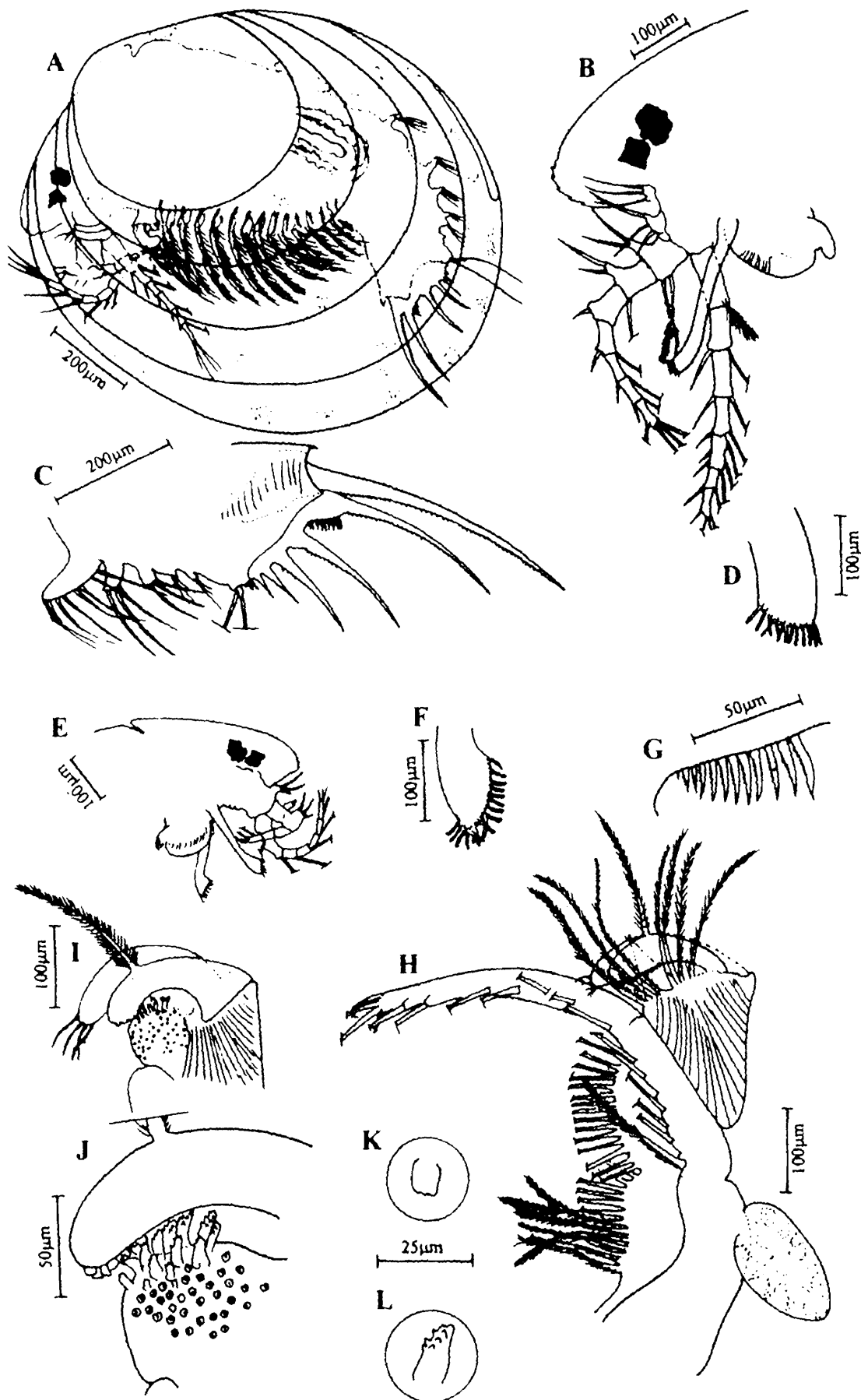


Fig. 1(A-L). 1A. *Cyclestheria hislopi* (male), 1B. Head of *C. hislopi* (female) 1C. Telson (fem-ale). 1D. Tip of the antennules (female). 1E. Head of the *C. hislopi* (male). 1F. Tip of the antennules (male). 1G. Basal spines on the second claw enlarged (female). 1H. First thoracopod with clasper (male). 1I. Clasper with palm and moving finger (male). 1J. Clasper enlarged (male). 1K. Single cusped tooth. (finger, male). 1L. Multi-cusped tooth (palm. male).

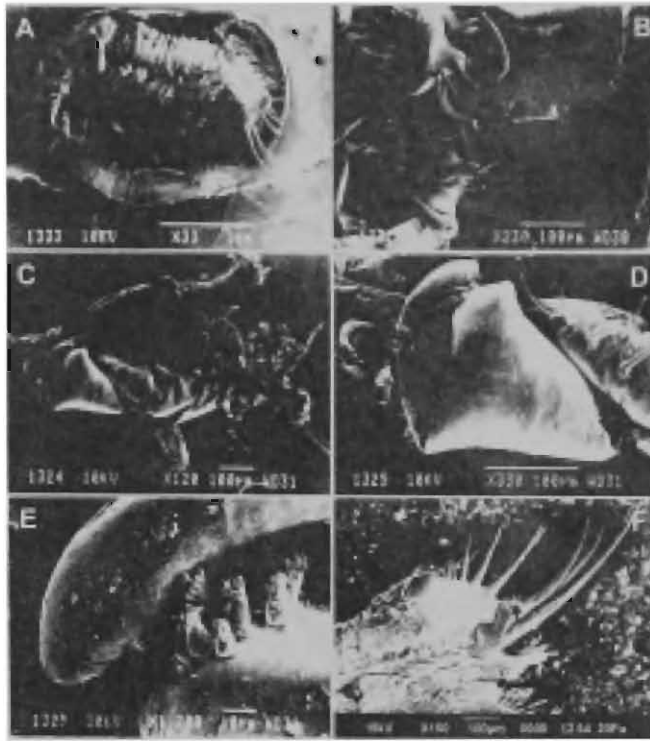


Fig. 2(A-F). 2A. (SEM) *Cyclestheria hislopi*, male (left side of the carapace removed). 2B. Serrated vertex (lateral view) 2C. First thoracopod (lateral view). 2D. First thoracopod with clasping organ. 2E. Clasping organ enlarged (lateral view). 2F. Telson showing 4 basal spinules on the base of the second claw (lateral view)

parthenogenetic female ratio was 1 : 46. Telson large with eight pair of strong and elongated claws; first pair large and slightly curved, serrated on its concave margin (Fig.1C). Second claw shorter than the first pair with a series of serrated spinules on its basal portion (Fig. 1G). The Pearson Chi Square test showed that the sex ratio between males and parthenogenetic females were significant at 1% level.

Remarks : *Cyclestheria hislopi* was first reported from Nagpur, India by Baird in 1859 and named the species after its collector, Rev. Hislop. Initially, the species was placed under the genus *Estheria* and later, the genus *Estheria* to *Cyclestheria* and family Cyclestheriidae (Sars, 1887). *C. hislopi* is a large Branchiopod, commonly seen in the wetlands of Kerala, associated with lush vegetation of aquatic weeds. The abundance of *C. hislopi* associated with vegetation in perennial habitats indicates the presence of certain survival strategies to overcome predatory pressures.

This agrees with the observations on Colombian population (Roessler, 1995).

The formation of male, ephippial female, resting eggs (diapause egg) and appearance of sexual phase within the life cycle of *C. hislopi* remained obscure for long time (Olesen, et. al., 1996). *C. hislopi* is the only diplostracan showing very indistinguishable sexual dimorphism and this was the reason why people overlooked the presence of males in its population. Majority of diplostracans normally reproduces parthenogenetically but under the drastic environmental conditions the animals can switch over from parthenogenetic life-cycle to sexual phase (Shan, 1969; Subhash Babu & Nayar, 1997) and this phenomenon is not very common in *C. hislopi* (Roessler, 1995).

In the present study the male to female ratio was 1:46, which was considerably high as compared to that reported from Colombia. In natural population of the African large branchiopods the marked fluctuations were observed in the male female ratio (Brendonck *et al.*, 1990). So far, no male and ephippial female are reported from the natural population of *C. hislopi* from India.

A close evaluation on the morphological feature of the first thoracopod of male, *C. hislopi* in the present study showed only a single seta on the dorsal side of the finger with button like projections on the anterior part of the palm. Whereas the same specimens reported from Columbian waters had 3 plumose setae on the dorsal side of the finger without any projections on the palm (Olesen *et al.*, 1996). The number of pores on the neck organ was two in both the present and the Columbian specimens, whereas its shape and size was different in the Columbian specimen (Usha Balaraman, 2004). The antennule (first antenna), of *C. hislopi* in the present study was tubular, elongated, spatula shaped, with highly dilated tip fringed with tuft of sensory hairs. However, in the Columbian specimen, it was club shaped, robust with distal end little dilated having sensory hairs not only on its tip but also on its lateral side (Olesen *et al.*, 1996). The number of basal spines on the second claw of telson was 4-5 in the male of the present specimen, but was 7-9 in the Columbian specimens. Therefore, the Columbian

specimens showed considerable level of variations with the *C. hislopi* collected from Kerala, India. Therefore, from the basic taxonomical characters investigated, it could be concluded that there is considerable variation with Colombian population of *C. hislopi*.

SUMMARY

The detailed morphological structure of the male, ehippial female (sexual female) and parthenogenetic female of the large branchiopod, *Cyclestheria hislopi* (Baird, 1859), from a wetland in India is presented with camera lucida diagrams and SEM. This is the first report of male and ehippial female (sexual female) of *C. hislopi* from the Indian sub-continent. The male antennule and prehensile organs (first thoracopod), a prominent distinguishing character, has been discussed in this context. The presence of male and ehippial female in the *C. hislopi* population indicates the presence of sexual mode of life cycle. The males displaying higher

sex ratio of 1 : 46 with parthenogenetic females were a characteristic observation. The morphological characters of male in the present study are compared with that reported from the Colombian waters.

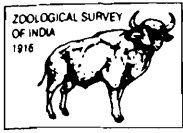
ACKNOWLEDGEMENTS

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Rec. zool. Surv. India, 111(Part-2) : 95-97, 2011

Short Communication

NEW RECORDS OF *COMITAS ALBICINCTA* (ADAMS AND REEVE, 1830) AND *TURRITELLA BICINGULATA* LAMARCK, 1822) (MOLLUSCA; GASTROPODA : TURRITELLIDAE) FROM INDIA

INTRODUCTION

During the course of our faunistic survey along the Karnataka coast (2005-2007) two shells of *Comitas albicincta* and many examples of *Turritella bicingulata* were collected. The species *Comitas albicincta* belongs to subfamily Turriculinae under family Turridae. *Turritella bicingulata* belongs to the family Turritellidae. These species were not been reported earlier from India. The present record of the species from India is considered significant since its very limited distribution.

Turridae is a large family divided into 15 subfamilies consisting of 600 genera and subgenera comprising of about 2000 species. These are carnivorous and use a dart-like tooth to harpoon and capture the prey. They occur in shallow water to deep seas, majority being off shore forms. There is not much work on Indian Turrids. So far, about 80 species were reported from Indian waters, out of which only 23 species were dealt by Subba Rao (2003). The genus *Comitas* has a very wide distribution in the Indo-Pacific, ranging from South Africa to Japan and south ward through Australian waters to southern New Zealand. Two individual of *Comitas albicincta* (Admas and Reeve, 1830), were collected from Karnataka, a rocky outcrop at Ohm beach, (14°31'N; 74°18'E) near Gokarn at Karnataka.

Turritellidae is a large family consisting of five subfamilies comprising about 18 genera and an estimated 150 species. The genus *Turritella* has been some what neglected by Conchologists. Lamarck (1822) described only 11 species and later another 6 species were dealt by Kiener (1839). Reeve (1860) reported about 65 species of Turritellidae in his Monograph in *Conchological Iconica*. Marwick (1957) worked upon the generic revision of Turritellidae, Garrad (1972) revised the Australian Turritellidae. In India two genera *Turritella* and *Haustator*, belonging to the subfamily

Turritellinae are reported. Subba Rao and Dey (2000) reported about 4 species belonging to two genera of Turritellidae from Indian waters. Many individuals of *Turritella bicingulata* Lamarck, were collected from a rocky outcrop at St. Mary's Island along Udipi coast. (13°20'N; 74°43'E) near Mangalore, Karnataka.

SYSTEMATIC ACCOUNT

Family TURRIDAE

Subfamily TURRICULINAE

Genus *Comitas* Finlay

Comitas albicincta (Adams and Reeve)
(Plate-I, Fig.-1)

1830. *Pleuroloma albicincta* Adams and Reeve, *Zool. Voy. H.M.S. Samarang. Moll.*, p. 40, pl. 10, fig. 6.
1969. *Comitas albicincta*; Powell, *Indo Pacific Mollusca* 1. (10) p. 278, pl. 223, fig. 1.

Material examined : 2ex., Ohm beach, Karnataka, 10.01.2006, Coll. R. Venkitesan and party.

Measurements (in mm) : Length 28.20-32.50; Width : 11.30-12.40; Length of the aperture 11.50-11.80.

Description : Shell medium in size, (28.20 mm), narrowly fusiform, spire slightly larger than the body whorl, spire without protoconch; whorls 9, medially angulated by heavy peripheral keel; upper part of the whorls with 8 nodes, not extending up to shoulder area. Sub sutural margin absent. The whole surface of the post nuclear whorls is sculptured with closely spaced fine spiral threads plus about nine evenly spaced rather distant stronger threads. Aperture long and narrow, anterior canal short. Posterior canal recurved with weak notch at extremity; sinus broadly arcuate; columella slightly calloused, operculum absent. Dark brown with a cream colour band encircles the periphery. Aperture brownish white, inner side smooth, brown and white markings seen through; columella white.

Distribution : India : Karnataka coast.

Elsewhere : China seas.

Remarks : This species was recorded from the type locality (China seas) only. Now it is from India.

Family TURRITELLIDAE Woodward, 1851

Genus *Turritella* Lamarck

Turritella bicingulata Lamarck

(Plate-I, Fig.-2)

1822. *Turritella bicingulata* Lamarck, *Anim. Sans. Vert.* (Deshayes edit) 9 : 256.

1860. *Turritella bicingulata* Lamarck, Reeve, *Conch Icon*, 5. Pl. 5, sp. no. 20.

Material examined : 17 ex., St. Mary's Island, Udipi district, Karnataka, 01.01.2006. Coll. R. Venkitesan and party.

Measurements (in mm) : Length : 20.80-35.90, Width : 6.20-10.80; Length of the aperture; 3.10-5.70.

Description : Shell medium in size, up to 36.00 mm in height, acuminate turreted, whorls about 11, aperture sub quadrangular, outer lip sinuous, sculptured with two spiral ridges, which are equally distant and

prominent, intermediate grooves concave and spirally striated. Ornamented with profusely flamed, variegated; with reddish brown markings. Suture rather deeply excavated, below the suture spotted with reddish brown mottling and stripes. Brown line encircles whorls. Brown line seen through the aperture. Base concave and neatly striated with violet colour. Shell white with brown markings, white base marked with violet; brown markings and the interior of the aperture purple rose.

Distribution : India : St. Mary's Island Karnataka.

Elsewhere : Pakistan and Adens.

Remarks : It can be distinguished from other by a pair of conspicuous swollen keels and a bold profuse style of painting. *T. maculata* a nearer species differs from *T. bicingulata* having in difference in early whorls the keels are very prominent developed even to the apex. The base of the shell is more concave, and is marked of numerous coloured linear striae, but the upper margin of the whorl is always distinguished by a row of irregular red brown spots immediate beneath the suture.

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PLATE-I



Fig. a, b. *Comitas albicincta*; **Fig. c, d.** *Turritella bicingulata*.

INSTRUCTION TO AUTHORS

Frequency of Publication : Quarterly 4 parts in one volume.

Publication time : Within 3 months after final acceptance.

Categories of published material : Full paper, Interesting Case Reports, Field Reports, Taxonomic description and distributions, Description of new taxa, Short Communications, Checklists.

Instruction of submission : The article to be organized as :—1. Title; 2. Author/Authors along with address clearly mentioning the corresponding author and Affiliation, e-mail address; 3. Introduction; 4. Materials and Methods; 5. Systematic accounts; 6. Results; 7. Discussion; 8. Summary; 9. Acknowledgement, 10. References; 11. Tables and Figures with appropriate title and legends on separate sheets.

For short communication, the combination of some of the above sections is recommended.

Format of Manuscript : Submission of a manuscript implies that the report is original, unpublished and is not being considered/disqualified for publication elsewhere.

Manuscript in English should be computer-typed, double-spaced with 1.5-inch right-hand margins on one side in A4 paper (210 × 297 mm). Font size 10-12 points, Times New Roman. Text should be justified. Footnotes should be avoided. All units of measurement are in metric. All manuscript sheets must be numbered successively. No portion of the article should be underlined except Latin names of genera and species, if not typed in italics. Submit in triplicate with a CD in MS Word, photo/map/chart/drawings in jpg/psd (photoshop).

Introduction section should clearly describe the objectives of the study and provide enough background information to make it clear why the study was undertaken. Lengthy literature review is discouraged. Some earlier references of work may be cited.

Materials and Methods should provide the reader with all the information necessary to repeat the work. For modification of published methodology, only modification needs to be described with reference to the original source.

Under material examined the following format should be followed strictly for e.g. :

Material Examined : Holotype : Female : India, Kerala, Calicut University campus, 3-xii-1994, coll. T.C. Narendran and Party (Reg. No.)

Results to be presented by referring to tables and figures (if any) and without discussion.

Discussion should include a concise statement of the findings, a discussion of the variety of the observations, a discussion of the findings in the light of other published works dealing with the same or allied subjects.

Summary : A short write up to be given describing the article and its importance/need.

References should be cited as follows :

Title of periodicals should be abbreviated as in the latest edition of World list of Scientific Periodicals, London.

Entries under "Reference" should not include any reference which is not cited in the text.

Examples :

Journal : Raghunathan, M.B. and Valarmathi, V. 2007. Zooplankton investigation from a paddy field in Tamil Nadu. *Rec. zool. Surv. India*, **107**(1) : 55-62.

Nandi, N.C., Das, S.R., Bhuinya, S. and Dasgupta, J.M. 1993. Wetland Faunal Resources of West Bengal, I, North and South 24-Parganas Districts. *Rec. zool. Surv. India, Occ. Paper No.*, **150** : 1-50.

Silas, E.G. 1961. Occurrence of the Sea-cow *Halicore dugong* (Erxl) off Saurashtra coast. *J. Bombay nat. Hist. Soc.*, **58**(1) : 263-266.

State Fauna/Conservation Areas : Mukhopadhyay, S.K. 1999. Fresh water Oligochaetes. *Fauna of West Bengal, State Fauna Series*, **3**(Part-10) : 95-123. Published by Zool. Surv. India.

Radhakrishna, C. 2007. Amphibia. In : *Fauna of Kudermukh National Park, Karnataka, Conservation Area Series*, **32** : 20-25, Published by Zool. Surv. India.

Book : Gupta, S.K. 1985. *Handbook on Plant Mites of India* : 1-520. Published by Zool. Surv. India.

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