

## **AN APPEAL**

Zoological Survey of India (ZSI) is a premier taxonomic research organization, under the Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India, engaged in zoological research and documentation of the faunal resources of the country. It was established on 1<sup>st</sup> July 1916 to promote the survey, exploration and research on the fauna of the Indian Region.

Zoological Survey of India at the time of its inception had inherited enormous collection of zoological specimens/ exhibits from the erstwhile Asiatic Society of Bengal and the Indian Museum, Kolkata. Since then the Survey has been acting as the custodian of this heritage collection, caring and maintaining them. The collection, comprising the zoological specimens of all groups of animals from microscopic protozoa to huge elephants and whales, is a priceless wealth of the country and is called the “National Zoological Collection” (NZC).

Zoological Survey of India has been making all efforts to enrich its zoological collections by accepting the ‘types’ and other identified faunal materials from animal taxonomists and biodiversity researchers of various zoological institutions and universities in the country and abroad. Zoological Survey of India, Kolkata, including its Regional Centres, has been designated by MoEF&CC to act as the ‘National Repository’ for all faunal groups from India, under the Act, in exercise of the powers conferred by sub-section (1) of Section 39 of the Biological Diversity Act, 2002, read with sections 6 and 12 of Notification S.O. 1911 (E), dated 8th November, 2006.

The zoological collection under the custody of ZSI has grown over the years to become the best and the largest one in South-East-Asia, with the well-represented collections of the fauna of India and adjacent countries, even that of the distant Kampuchea in Southeastern Asia. ZSI has at present in its NZC holding nearly 4.5 million specimens of about 70,000 species, out of the approximately 96,373 species (nearly 8 per cent of the world fauna) so far realized from the Indian Region. Among this collection includes about 18,000 ‘type’ specimens, such as holotypes, paratypes, syntypes, etc., which are unique and of highest scientific importance. They are the original specimens, serving as the voucher specimens, on which new species descriptions have been based. The ‘type specimens’ typify and fix the species/genus name for all time, and remain available for examination, comparison and correction in future studies.

Type specimens and identified reference collections are invaluable to researchers for any taxonomic work as they form the basis for accurate and reliable identification; they are also the fundamental units of bio-resource for new analytical techniques related to higher-level research on taxonomy and systematics (e.g. molecular taxonomy). They represent the irreplaceable national/international asset in perspectives of zoological research and biodiversity informatics.

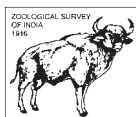
ZSI intends to augment its zoological collection to make it a more complete one, enriching it with species not represented in the collection. Zoological Survey of India is therefore soliciting the

cooperation of the animal taxonomists, biodiversity researchers, scientists and naturalists, appealing to them to deposit their 'type' materials—holotype or paratype(s)—and other identified specimens to the 'National Repository' of Zoological Survey of India. The researchers may deposit their 'material' to ZSI in the following address:

Officer-in-Charge, Identification and Advisory Section,  
Zoological Survey of India, M-Block, New Alipore,  
Kolkata – 700 053.

The 'type' and other identified specimens will be duly registered, and the data will be computerized. The researchers may use the Registration number of their deposited 'type'(s) in their publications of the new taxon/ taxa.

**Dr. K. Venkataraman**  
*Director*  
Zoological Survey of India



## **FIRST REPORT OF MITES (ACARI) OCCURRING ON ORCHIDS AND LICHENS IN WEST BENGAL, INDIA**

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### **INTRODUCTION**

The Orchids are important plants not only because they have export potentiality and thus help in earning foreign exchange but also because of the fact that some of those have high medicinal values. On the other hand, lichens are also having economic value as well as are sources of medicines and pollution indicators. Many insects and mites are known to be associated with these plants and some are injurious especially to the orchids causing damage and thus become unthrifty. Unfortunately, association of mites with these plants have not been explored from India and whatever little is known is with regard to mites of lichens Kocheril and Mohanasundaram (1995, 1995a, 1995b) who reported some mites from South India. So far as orchid mites from India is concerned, it appears to be totally unexplored and available information from abroad are also very few. Some such works are Andre (1975, 1985) on orchid mite Aoki (1977), Colloff (1983), Hughes & Tillbrook (1966), MacNeill (1966) – all on lichen mites.

Due to this paucity of knowledge, a preliminary programme was taken up to explore the mites associated with orchids and lichens available in the campus of Ramakrishna Mission Ashrama, Narendrapur and the present paper is based on that collection.

### **MATERIAL AND METHODS**

The campus of Ramakrishna Mission Ashrama, Narendrapur (10 km south of Kolkata in the

district of South 24 Parganas, West Bengal) is quite big and spreads over 150 acres of land and rich with various types of trees, shrubs, under shrubs, creepers, and herbs and have all types of field crops, vegetables, fruit trees, medicinal plants, etc. In many of the trees there are good growths of lichens. Recently, some orchids having medicinal values were introduced into the medicinal plants garden. The collection of mites was done from those lichens and orchids during March to September, 2013. The lichens were scrapped out from the tree trunk, brought to the laboratory in a polythene bag and examined under stereo binocular microscope and mites were collected from there by a fine brush, moistened with alcohol. The orchid mites were collected directly in the field by examining those with a hand lens (20x) and mites were picked up by a alcohol-moistened brush. The mite specimens were preserved in 70% ethyl alcohol and mounted in modified Hoyer's medium.

### **RESULTS AND DISCUSSIONS**

The study of the collected material revealed the occurrence of a total of 15 species of mites under 10 families and 14 genera, of those, 7 species under 5 families and 6 genera were from orchids and 8 species under 5 families and 8 genera were from lichens. All these form new reports from orchids and lichens from West Bengal. The occurrence of the family Cryptognathidae in India is being done for the first time. The details about the collected species are as below:

**A. Mite species collected on orchids**

## Order PROSTIGMATA

## Family I. CUNAXIDAE

1. *Cunaxa* sp. nr. *cynodona* Gupta & Ghosh

*Collection records:* 2 specimens were collected on an orchid, *Dendrobium crepedetum* from Narendrapur Campus of R. K. Mission on August, 2013. This species differs from *cynodona* in setal characters of palp and in dorsal chaetotaxy. In all probability, this may turn out to be a new as it does not conform with any of the known species of this genus. The occurrence of this mite on orchid was earlier unknown.

## Family II. TARSONEMIDAE

2. *Tarsonemus* sp.

*Collection records:* 3 female specimens were collected in September, 2013 on an orchid, *Dendrobium farneri*, from Narendrapur Campus. Since only female specimens were collected and no male was found, the correct identity could not be determined. The search is on for collecting male specimens for confirming the identity. The mites of this genus have varied food habits and in the present case it was seen in association with mould. No report of this genus on orchid was earlier known from India.

## Family III. ERYTHRAEIDAE

3. *Erythraeus* sp.

*Collection records:* Only one larval specimen in association with a beetle was collected on an orchid, *Lupsia aphyllum* on July, 2013. Normally, the larvae of this family are associated with insects as predator. Earlier record of this mite on orchid was unknown.

## Family IV. TYDEIDAE

4. *Pronematus fleschneri* Baker

*Collection records:* Two specimens were collected in August, 2013 on orchid, - *Dendrobium nobili* at Narendrapur campus. This is a predatory mite and was earlier collected on a number of plants from different parts of India, mostly as predators of spider mites (Gupta, 2003).

## Family V. TENUIPALPIDAE

5. *Brevipalpus phoenicis* (Geijks.)

*Collection records:* Several specimens were collected in August, 2013 on orchid, - *Lupsia brchystachya* at Narendrapur campus. This is a widely distributed phytophagous species and has been reported earlier from over 50 plants in India. This produced brownish spots on the host. This is the first report of occurrence of this mite on orchid in India.

6. *Brevipalpus obovatus* Donnadieu

*Collection records:* Two specimens were collected in July, 2013 on an orchid, - *Dendrobium transparens* at Narendrapur campus. This is an important phytophagous mite having wide distribution and its occurrence on orchid was earlier unknown. No damage symptom was seen on the host as the population was very poor.

7. *Tenuipalpus* sp.

*Collection records:* Only one specimen of this uncommon genus was collected in September, 2013 on an orchid, *Arundina graminifolia* at Narendrapur campus.

**B. Mite species collected on Lichens**

## Family VI. CRYPTOGNATHIDAE

8. *Cryptognathus* sp.

*Collection records:* Only one specimen of this previously unreported family from India was collected in April, 2013 on lichen thallus at Narendrapur campus.

The lack of literature made the authors unable to reach up to species level. This is a predatory mite. It was not reported earlier on lichens.

## Family VII. CUNAXIDAE

9. *Neocunaxoides andrei* (Baker & Hoffmann)

*Collection records:* One specimen, from lichen thallus was collected in April, 2013 from Narendrapur campus. This species was earlier recorded from India on citrus. This is a predatory species but such behavior was not seen in field. It was not reported earlier on lichens.

10. ***Cunaxoides*** species nr. ***croceus*** (Koch)

*Collection records:* Collection of this mite on thallus of a lichen at Narendrapur campus in March, 2013. It was not earlier reported on lichens.

## Family VIII. CHEYLETIDAE

11. ***Cheletogenes ornatus*** (C. & F.)

*Collection records:* Only one specimen was found associated with lichens at Narendrapur campus in March, 2013. Earlier record of this predatory mite was from mango inflorescens in India. However, it has been recorded on a number of plants from various parts of the world but this is the first record on lichens.

## Order MESOSTIGMATA

## Family IX. ASCIDAE

12. ***Lasioseius terrestris*** (Menon & Ghai)

*Collection records:* One specimen was associated with lichen thallus was collected at Narendrapur campus in April, 2013. Earlier, it was described from Delhi collected on mango inflorescence. This is a first record on lichen.

## Order ASTIGMATA

## Family X. ACARIDAE

13. ***Tyrophagus putrescentiae*** (Schrank)

*Collection records:* Several specimens of this mite were collected on lichen thallus during August, 2013. Normally this is a fungus associated mite but has been collected from varied habitats like stored products, bird nests, house dust, plants, etc. and is

widely distributed throughout the globe. Kocheril & Mohanasundaram (1995a) also collected this mite on lichens from South India.

14. ***Calloglyphus oudemansi*** (Zachvatkin)

*Collection records:* A specimen of this mite was collected from lichen thallus at Narendrapur campus in April, 2013. Kocheril & Mohanasundaram (1995a) also collected it on lichen from South India.

15. ***Rhizoglyphus*** sp.

*Collection records:* Two undetermined specimens of this genus were collected on lichen thallus at Narendrapur campus in August, 2013. Kocheril & Mohanasundaram (1995a) reported *R. oudemansi* on lichen from South India. The present specimen could not be placed in any known species and looking for further material for specific identification.

## SUMMARY

The present paper reports the occurrence of 15 species of mites under 10 families and 14 genera, all being new reports on the respective hosts from India. This included 7 species under 5 families on orchids and 8 species under 5 families from lichens. The collection data and importance, if any, are also provided.

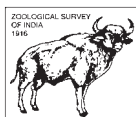
## ACKNOWLEDGEMENTS

The authors are thankful to the Secretary, Ramakrishna Mission Ashrama, Narendrapur for permission for collecting the mite specimens from Narendrapur campus.

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## NEW RECORDS OF ANTS (INSECTA: HYMENOPTERA: FORMICIDAE) FROM HARYANA, INDIA

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### INTRODUCTION

Ants have the most highly organized 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 organized and integrated units the societies or colonies. Bingham's (1903) fauna is the main source of knowledge of ants in India. Chapman and Capco (1951) published a checklist of the ants of Asia. Bharti (2001, 2002, 2003, 2004 & 2012) has published a checklist of ants of North-West India which includes the works from Haryana, also reported 4 new species and Indian ants on ant website. Bolton (1995) has published A New General Catalogue of the Ants of the World and Catalogue of the Ants of the World CD-ROM 2007. Karmaly (2004) has also reported 1 new species and a key to species of *Polyrhachis*. Sheela & Narendran (1997 & 1998) has reported 7 new species of ants. Sheela *et al.* (2000) has redescribed a new myrmicine ant. Sheela (2008) has published a handbook on Formicidae. Distributional record of one species of ant from Haryana is also known from works of Tiwari *et al.* (2003). Tiwari (1994) has reported 2 new species of ants from Kerala. Tiwari (1998) has worked on ants of Southern India; Tiwari & Jonathan (1986) has reported 2 new species of ants of Andaman and Nicobar Islands; Tiwari & Tiwari (2002) has studied the ants of Orissa. Tiwari *et al.* (1998, 2003 & 2004) has worked on the ants of West Bengal, Sikkim and Manipur. Varghese (2003, 2004, 2006 &

2009) has studied the ants of Indian Institute of Science campus, Bangalore; reported a new record from Bangalore, 2 new species and published a Review of Extant Subfamilies, Tribes and Ant Genera in India.

The present studies are based on the material collected by the second author from Pinjore, Haryana. Pinjore, a town in Panchkula district of Haryana state is located close to Chandigarh set over 1,800 feet above the sea level in a valley, overlooking the Sivalik Hills. Panchkula district has a sub tropical continental monsoon climate with hot summer, cool winter, good monsoon rainfall and great variation in temperature (0 °C to 43 °C). The average rainfall of the district is about 1283 mm. Morni hills constitute the highest point of the district as well as of Haryana. The Ghaggar River is the only perennial river. The other important rivers/streams of the district are Sirsa and Kaushalya. Pinjore has a total geographic area of about 288 sq. km. and lies between latitudes 30°47'50''N and 76°55'02'' East longitudes. It is known for the Asia's best 17<sup>th</sup> Century Pinjore Garden. Thorny, dry, deciduous forest and thorny shrubs can be found all over the state. Due to good rainfall and elevation Pinjore has rich, abundant and diverse flora and fauna. Tree species generally found are *Eucalyptus camaldulensis*, *Dalbergia sissoo*, *Acacia nilotica*, *Acacia tortilis*, *Acacia catechu*, *Mangifera indica* and *Prosopis juliflora*. The major species grown under Agro-forestry are *Eucalyptus camaldulensis* and *Populus deltoides*. The present paper describes

eight species distributed under eight genera of the family Formicidae comprising five subfamilies namely Formicinae with one genera and one species, Ponerinae with two genera and two species, Dolichoderinae with one genera and one species, Pseudomyrmecinae with one genera and one species, Myrmicinae with three genera and three species along with a checklist of ant species from Haryana. Out of eight species seven species are new records from Haryana state. All the eight species of ants (Formicidae) from Haryana state has been deposited and registered in the Identified Register of Invertebrate collection of Desert Regional Centre, ZSI, Jodhpur.

### SYSTEMATICS

#### Order HYMENOPTERA

#### Family FORMICIDAE LATREILLE, 1809

##### (i) Subfamily FORMICINAE LEPELETIER, 1809

1. *Camponotus (Tanaemyrmex) invidus* Forel, 1892

##### (ii) Subfamily PONERINAE LEPELETIER, 1835

2. *Odontoponera transversa transversa* (Smith, F. 1857)

3. *Pachycondyla rufipes rufipes* (Jerdon, 1851)  
(iii) Subfamily DOLICHODERINAE  
FOREL, 1878

4. *Tapinoma melanocephalum melanocephalum* (Fabricius, 1793)

##### (iv) Subfamily PSEUDOMYRMECINAE SMITH, 1952

5. *Tetraponera nigra* (Jerdon, 1851)

##### (v) Subfamily MYRMICINAE EMERY, 1877

6. *Monomorium mayri* Forel, 1902
7. *Myrmecaria brunnea brunnea* Saunders, 1842
8. *Pheidologeton affinis affinis* (Jerdon, 1851)

Ants are polymorphic social insects having three distinct forms- the perfect and fertile female, the male, and workers (major or minor). The largest forms are soldiers. Identification of ants is mainly based on the worker caste.

### IDENTIFICATION KEY IS BASED ON THE WORKER CASTE OF ANTS

(Modified from Bolton, 1994)

#### Key to the sub-families of family Formicidae

1. Body with a single reduced segment *i.e.* petiole between alitrunk and abdomen .....2  
Body with two reduced segment *i.e.* petiole and post petiole between alitrunk and abdomen .  
..... 4
2. Apex of gaster with a semicircular or circular acidopore, usually guarded by setae, sting absent .....*Formicinae*  
Apex of gaster without a semicircular or circular acidopore, sting present..... 3
3. Either pygidium or hypopygidium armed with peg like teeth or short spines .....*Ponerinae*  
Pygidium or hypopygidium unarmed.....  
.....*Dolichoderinae*
4. Posterior margin of clypeus not projecting in between antennal sockets, promesonotal suture present, hind tibia with a conspicuous pectinate spur .....*Pseudomyrmecinae*  
Posterior margin of clypeus projecting in between antennal sockets, promesonotal suture absent, hind tibia with only a simple spur...  
.....*Myrmicinae*

##### (i) Subfamily FORMICINAE LEPELETIER, 1809

#### Genus *Camponotus* Mayr, 1861

1. *Camponotus (Tanaemyrmex) invidus* Forel, 1892

Original Combination – *Camponotus invidus* Forel, 1892

1892. *Camponotus (Tanaemyrmex) invidus* Forel, J. Bombay nat. Hist. Soc., 7: 225 & 234, fig. 2, Worker, Soldier.
1903. *Camponotus (Tanaemyrmex) invidus* (Forel), Bingham, Fauna Brit. India, Hym., 2: 367.
1995. *Camponotus (Tanaemyrmex) invidus* (Forel), Bolton, B., A New General Catalogue of the Ants of the World. : 105.

*Material examined:* Workers-2 exs., Pinjore, 26.ii.2013, Seema Kumar Coll. (Reg. No. 9077/A).

*Diagnostic Characters:* Length worker (minor) -5-6 m.m.

*Worker:* Head, alitrunk and abdomen entirely pale yellow with sparse erect yellowish pubescens. 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, Uttar Pradesh, Andaman & Nicobar Islands.

*Remarks:* Reported for the first time from Haryana state.

(ii) Subfamily PONERINAE LEPELETIER,  
1835

### Key to the genera of sub-family Ponerinae

1. Pronotum with teeth or spines .....  
..... *Odontoponera* Mayr

Pronotum without teeth or spines .....  
..... *Pachycondyla* Smith

Genus *Odontoponera* Mayr, 1862

2. *Odontoponera transversa transversa*  
(Smith, F., 1857)

Original Combination – *Ponera transversa*  
Smith, F., 1857

1857. *Odontoponera transversa* Smith, F., *J. Proc. Linn. Soc. Lond. Zool.* 2: 68, Worker, (*Ponera*).

1858. *Ponera*, pt., Smith, *Cat.* vi : 86, Worker.

1862. *Odontoponera* Mayr, *Verh. zool. -bot Ges. Wien*, xii: 717, Worker.

1900. *Odontoponera transversa* (Smith, F.) Forel, *J. Bombay nat. Hist. Soc.*, 13: 314, Worker.

1903. *Odontoponera transversa* (Smith, F.) Bingham, *Fauna Brit. India, Hym.*, 2: 73.

*Material examined:* Workers- 4 exs., Pinjore, 26.ii.2013, Seema Kumar Coll. (Reg. No. 9078/A).

*Diagnostic Characters:* Length worker-9-12 m.m.

*Worker:* Black, mandibles, antennae and legs dark castaneous, the mandibles and clypeus longitudinally striate, the anterior margin of the latter denticulate, the striae on the thorax and node of the petiole transverse, abdomen smooth but dull, with piligerous points in the smaller form or variety. Head quadrate, the occiput slightly emarginated, the posterior lateral angles rounded, mandibles powerful, subtriangular, strongly dentate. Antennal carinae widened anteriorly, more or less covering base of antennae, antennae 12 jointed, stout, the scape passing by very little beyond the top of the head, the second joint of the flagellum very little longer than 1st or 3rd joint of the flagellum. Alitrunk massive, pronotum convex, anteriorly narrowed into a short collar, the anterior lateral angles with teeth or spines; pro-meso and meso-metanotal sutures distinct above, mesonotum transversely oval, slightly convex, metanotum slightly compressed, the basal portion passing into the apical portion by a gradual slope, the latter broad, flat, with a denticulate ridge on each side dividing it from the sides of the metanotum. Claws not pectinate. Petiole free, with a flexible joint between it and abdomen. Petiole one jointed, node moderately raised, flattened anteriorly and posteriorly, its border emarginated. Abdomen short, constriction between the basal two segments distinct.

*Distribution:* India: Assam, Karnataka, Meghalaya, Sikkim, Tripura, Chandigarh, Himalaya. *Elsewhere:* Myanmar, China, Sumatra, Singapore, Borneo, Java, Philippines, Siam, Annam, Malaya.

*Remarks:* Reported for the first time from Haryana state.

Genus ***Pachycondyla*** Smith, 1858

3. ***Pachycondyla rufipes rufipes***  
(Jerdon, 1851)

Original Combination-*Ponera rufipes*  
Jerdon, 1851

1851. *Ponera rufipes* Jerdon, *Madras J. Lit. Sci.*, **17**: 102, Worker.
1858. *Pachycondyla rufipes* (Jerdon) Smith, *Cat. Hym. Brit. Mus.*, **4**: 106.
1903. *Bothroponera rufipes* (Jerdon) Bingham, *Fauna Brit. India, Hym.*, **2**: 96, Worker.
1911. *Pachycondyla (Bothroponera) rufipes* (Jerdon) Emery, *Genera Insect*, **118**: 76-77.
1951. *Bothroponera rufipes* (Jerdon) Chapman and Capco, *Monogr. Inst. Sci. Tech., Manila (Check List Ants Asia)*, **1**: 50.
1984. *Pachycondyla rufipes* (Jerdon), Mathew, *Bull. Zool. Surv. India*, **6**(1-3): 307-308.
1994. *Bothroponera rufipes* (Jerdon), Tiwari *et al.*, *State Fauna Series 3: Fauna of West Bengal*, **8**: 21.
1995. *Pachycondyla rufipes* (Jerdon), Bolton, B., *A New General Catalogue of the Ants of the World.* : 105.

**Material examined:** Workers: 2 exs., Pinjore, 26.ii.2013; 5 exs., Pinjore, 27.ii.2013; Seema Kumar Coll. (Reg. No. 9079/A & Reg. No. 9080/A).

**Diagnostic Characters:** Worker: length 13- 15 mm. Dull black, mandibles, antennae and legs castaneous red, the apical two or three abdominal segment bright ferruginous. The whole insect covered with an abundant pale reddish yellow pilosity. Mandibles longitudinally striate without distinct teeth. Eyes small. Posterior margin of clypeus defined by a suture. Middle of front margin of clypeus not produced. Antennal carinae widened anteriorly, more or less covering base of antennae. Antennae 12 jointed, scape of antennae reaching to posterior margin of head, club thick at apex. Alitrunk rounded above, Pronotum without teeth or spines, metanotum unarmed, the apical truncated face of metanotum smooth and shining and strongly margined on the sides and above. Posterior coxae unarmed. Posterior tibia with two spurs, claws simple. Petiole free, with a flexible joint between it and abdomen. The node of petiole

about twice as broad as long, convex and rounded above, posteriorly concave, smooth and shining, spinous processes on the posterior margin above irregular. Abdomen very massive, constriction between the basal two segments distinct, sting powerful and exerted, claws simple.

**Distribution:** India: Andaman & Nicobar Islands, Assam, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Sikkim, Tripura, Western India (from Kanara to Malabar), West Bengal. **Elsewhere:** Myanmar, Sri Lanka.

**Remarks:** Reported for the first time from Haryana state.

(iii) Subfamily DOLICHODERINAE  
FOREL, 1878

Genus ***Tapinoma*** Forster, 1850

4. ***Tapinoma melanocephalum melanocephalum*** (Fabricius, 1793)

Original Combination-*Formica melanocephala*,  
Fabricius, 1793

1793. *Tapinoma (Micromyrma) melanocephalum* Fabricius, *Ent. Syst.*, ii: 353, (*Formica melanocephala*).
1793. *Formica*, pt., Fabricius, *Ent. Syst.* ii: 353.
1850. *Tapinoma* Forster, *Hym. Stud.* i: 43, Worker, Female.
1862. *Tapinoma (Micromyrma) melanocephalum* (Fabricius) Mayr, *Verh. k-k zool.-bot Ges. Wien*, xii: 651, Worker.
1928. *Tapinoma (Micromyrma) melanocephalum* (Fabricius), *Nouvelles fourmis d Australie. Bull. Soc. Vaudoise Sci. Nat.* **56**: 475.
1903. *Tapinoma (Micromyrma) melanocephalum* (Fabricius) Bingham, *Fauna Brit. India, Hym.*, ii : 304.

**Material examined:** Workers-20 exs., Pinjore, 26.ii.2013, Seema Kumar Coll. (Reg. No. 9081/A).

**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, Lakshadweep, Andaman & Nicobar Islands, Nagaland. **Elsewhere:** Spread through both the hemispheres, S. America, French Guiana.

**Remarks:** Reported for the first time from Haryana state.

(iv) Subfamily PSEUDOMYRMECINAE  
SMITH, 1952

Genus ***Tetraponera*** Smith, F., 1852

5. ***Tetraponera nigra*** (Jerdon, 1851)

Original Combination - *Eciton nigrum*  
Jerdon, 1851

1851. *Tetraponera (Tetraponera) nigra* Jerdon *Madras J. Lit. Sci.*, xvii : 112 (Worker).
1877. *Tetraponera (Tetraponera) nigra* (Jerdon) Smith, F., Description of new species of the genera *Pseudomyrma* and *Tetraponera*, belonging to the family Myrmicidae. *Trans. Entomol. Soc. Lond.* **1877**: 68.
1919. *Tetraponera (Tetraponera) nigra* (Jerdon), Wheeler, W.M. The ants of Borneo. *Bull. Mus. Comp. Zool.* **63**: 63.
1903. *Tetraponera (Tetraponera) nigra* (Jerdon) Bingham, *Fauna Brit. India, Hym.*, **2**: 110-111.
1995. *Tetraponera (Tetraponera) nigra* (Jerdon) Bolton, B., *A New General Catalogue of the Ants of the World.* : 418.

**Material examined:** Worker: 10 exs., Pinjore, 27.ii.2013, Seema Kumar Coll. (Reg. No. 9082/A).

**Diagnostic Characters:** Worker: length 7- 8 mm. Black, the mandibles, antennae and legs dark with very sparse and thin pubescens. Head rectangular, a little longer than broad, the posterior margin very broad as broad as the front of the

head. Lateral angles not prominent, rounded. Mandibles broad and linear. Antennae short and stout. Alitrunk narrower, more compressed, the emargination at the meso-metanotal sutures very much deeper and wider, the metanotum higher viewed from the side with a regular arch from front to back. Petiole anteriorly of first node as long as node itself, with the nodes comparatively large, the 1<sup>st</sup> node oval, much narrower than 2<sup>nd</sup> node. 2<sup>nd</sup> node much broader than the 1<sup>st</sup> not constricted posteriorly. Abdomen elongate, narrowly oval.

**Distribution:** India: Haryana, Karnataka, Kerala, Maharashtra, Meghalaya, Punjab, Sikkim, Tamil Nadu, West Bengal, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh. **Elsewhere:** Myanmar, Philippines, Sri Lanka, Malaya, Bangladesh, Borneo, Java, Tennasserim.

**Remarks:** New distributional record from Pinjore, Haryana. Earlier reported from Rohtak and Panchkula, Haryana (Bharti, 2001).

(v) Subfamily MYRMIICINAE  
EMERY, 1877

**Key to the genera of sub-family Myrmicinae**

1. Antennae with less than 12 joints..... 2  
Antennae 12 jointed ..... *Monomorium* Mayr
2. Antennae 9 jointed..... *Myrmicaria* Saunders  
Antennae 11 jointed..... *Pheidologeton* Mayr

Genus ***Monomorium*** Mayr, 1855

6. ***Monomorium mayri*** Forel, 1902

Original Combination – *Monomorium gracillum* var. *mayri* Forel, 1902

1861. *Monomorium gracillum* (Forel) Smith (*Myrmica*), *Jour. Linn. Soc.* vi : 34, Worker.
1902. *Monomorium (Parholcomymex) gracillum* var. *mayri*, Forel, *Rev. Suisse Zool.*, **10**: 209, (Worker).
1903. *Monomorium (Parholcomymex) gracillum* var. *mayri* (Forel) Bingham, *Fauna Brit. India, Hym.*, **2**: 210-211.
1995. *Monomorium (Parholcomymex) gracillum* var. *mayri* (Forel) Bolton, B., *A New General Catalogue of the Ants of the World.* : 264.

**Material examined:** Workers – 5 exs., Pinjore, 26.ii.2013, (1 exs., female) Seema Kumar Coll. (Reg. No. 9083/A).

**Diagnostic characters:** Worker: Length 2.5-3 mm. Dark brown with the mandibles, antennae pale yellow in colour. Abdomen with a patch of pale yellow at the base. Head convex a little longer than broad, the posterior lateral angle rounded. Mandibles with the masticatory margin very oblique, armed with four teeth. Antennae short, slender, the scape falling short of the top by one fourth of its length. Alitrunk narrower than the head, emarginate at the meso-metanotal suture, mesonotum convex apical portion obliquely truncate. Petiole 1<sup>st</sup> node conical rounded above higher than and 2<sup>nd</sup> node and petiolate anteriorly, 2<sup>nd</sup> node globose not broader than the 1<sup>st</sup> node. Abdomen oval.

**Distribution:** India: Rajasthan, Gujarat, Tamil Nadu, Kerala, Lakshadweep. *Elsewhere:* Sri Lanka, North Africa, Arabia, Myanmar.

**Remarks:** Reported for the first time from Haryana state.

Genus *Myrmicaria* Saunders, W.W. 1842

#### 7. *Myrmicaria brunnea brunnea*

Saunders, 1842

1841. *Myrmicaria brunnea* Saunders, *Trans. Ent. Soc. Lond.*, **3**: 57, pl. 5, fig 2, Male.
1903. *Myrmicaria brunnea* (Saunders) Bingham, *Fauna Brit. India, Hym.*, **2**: 118, Male, Female, Worker.
1951. *Myrmicaria brunnea* (Saunders) Chapman and Capco, *Monogr. Inst. Sci. Tech.*, Manila (*Check List Ants Asia*), **1**: 124.
1995. *Myrmicaria brunnea* (Saunders) Bolton, B., *A New General Catalogue of the Ants of the World.* : 285.

**Material examined:** Worker: 2 exs., Pinjore, 26.ii.2013; 20 exs., 27.ii.2013, Seema Kumar Coll. (Reg. No. 9084/A & Reg. No. 9085/A).

**Diagnostic Characters:** Worker: Length 5.5 - 8 mm. Shining, chestnut brown. Head short, more or less rounded, longitudinally striate. Mandibles finely and closely striate, broadening towards the masticatory margin, armed with 4 acute teeth. Antennae 7 jointed, the joints of the flagellum slender much longer than broad with no distinct club. Pronotum convex and round above, the anterior lateral angles marked with distinct

tubercles, pro-mesonotal suture obsolete, meso-metanotal suture deep the posterior lateral angles armed with acute spines. The nodes of pedicel conical, subequal, slightly compressed, the 1<sup>st</sup> node with a long petiole anteriorly and a very short petiole posteriorly. Abdomen oval, smooth and polished.

**Distribution:** India: Karnataka, Kerala, Meghalaya, Tamil Nadu, West-Bengal. *Elsewhere:* China, Indonesia, Myanmar, Sumatra, Sri Lanka, Indo-China, Vietnam.

**Remarks:** Reported for the first time from Haryana state.

Genus *Pheidologeton* Mayr, 1862

#### 8. *Pheidologeton affinis affinis* (Jerdon, 1851)

1851. *Oecodoma*, pt. Jerdon, *Madras J. Lit. Sci.*, **17**: 110, Worker, Soldier.
1862. *Pheidologeton*, Mayr, *Verh. zool. -bot Ges. Wien*, xii: 750.
1851. *Pheidologeton affinis* Jerdon, *Madras J. Lit. Sci.*, **17**: 110, Worker, Soldier (*Oecodoma*).
1903. *Pheidologeton affinis* (Jerdon) Bingham, *Fauna Brit. India, Hym.*, **2**: 164-165, Male, Female, Worker, Soldier.
1951. *Pheidologeton affinis* (Jerdon) Chapman and Capco, *Monogr. Inst. Sci. Tech.*, Manila (*Check List Ants Asia*), **1**: 159.
1994. *Pheidologeton affinis* (Jerdon) Tiwari, *et al.*, *State Fauna Series 5: Fauna of West Bengal*, **8**: 52.
1995. *Pheidologeton affinis* (Jerdon) Bolton, B., *A New General Catalogue of the Ants of the World.* : 333.

**Material examined:** Soldiers - 2 exs., Workers - 8 exs., Pinjore, 26.ii.2013; Soldiers-2 exs., Workers - 6 exs., Pinjore, 27.ii.2013, Seema Kumar Coll. (Reg. No. 9086/A & 9087/A).

**Diagnostic Characters:** Worker-Length 2 - 2.5 mm. Light brownish yellow, polished and shining and the mandibles black, the antennae and legs yellowish red. Sculpture more feeble and the median longitudinal furrow less deeply impressed. Head proportionately much longer and anteriorly stiate. Ocellus absent. Mandibles large, smooth, the masticatory margin with two strong teeth at apex. Antennae 11 jointed, scape

short, club of the antennae formed of 2 apical joints of flagellum. Alitrunk smaller, scutellum prominent and gibbous, the basal portion of the metanotum transversely striate armed with two spines, pronotum anteriorly striate and not armed. Petiole with 1<sup>st</sup> node narrower, more conical and not emarginate above, the keel below less strongly marked. Abdomen broadly oval.

*Distribution:* India: Assam, Karnataka, Kerala, Maharashtra, Manipur, Rajasthan, Tamil Nadu, West Bengal, Nagaland, Manipur. *Elsewhere:* Malaysia, Myanmar, Sri Lanka.

*Remarks:* Reported for the first time from Haryana state.

## SUMMARY

The paper deals with 8 species of ants belonging to the family Formicidae reported from Haryana with 7 species recorded for the first time from the Haryana state.

## ACKNOWLEDGEMENTS

The authors are thankful to Dr. K. Venkataraman, Director, ZSI, Kolkata and Dr. T. S. Rathore, Director, AFRI, Jodhpur for providing opportunity to work. We are also thankful to Officer-in-charge, DRC, ZSI, Jodhpur and Head, Silviculture Division, AFRI, Jodhpur to facilitate and kind support.

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# CHECK LIST ON ANT SPECIES FROM HARYANA

## Order HYMENOPTERA

### Family FORMICIDAE LATREILLE, 1809

#### (i) Subfamily AENICTINAE EMERY, 1901

1. *Aenictus clavatus clavatus* Forel, 1901

#### (ii) Subfamily DOLICHODERINAE FOREL, 1878

2. *Ochetellus glaber glaber* (Mayr, 1862)

3. *Tapinoma melanocephalum melanocephalum* (Fabricius, 1793) **nr**

#### (iii) Subfamily CERAPACHYNAE FOREL, 1883

4. *Cerapachys aitkenii* Forel, 1900

5. *Cerapachys sulcinodis* Emery, 1889

*Cerapachys risii* Forel, 1892 (Junior synonym of *sulcinodis*)

#### (iv) Subfamily PSEUDOMYRMECINAE SMITH, M.R., 1952

6. *Tetraponera nigra* (Jerdon, 1851)

7. *Tetraponera rufonigra* (Jerdon, 1851)

#### (v) Subfamily MYRMIICINAE EMERY, 1877

8. *Crematogaster (Crematogaster) brunnea contemta* Mayr, 1879

9. *Crematogaster (Crematogaster) subnuda subnuda* Mayr, 1879

10. *Crematogaster (Crematogaster) buddhae* Forel, 1902

11. *Crematogaster (Crematogaster) rothneyi rothneyi* Mayr, 1879

12. *Crematogaster (Crematogaster) sagei* Forel, 1902

13. *Crematogaster (Mesocrema) walshi* Forel, 1902

14. *Crematogaster (Physocrema) inflata* Smith, F., 1857

15. *Monomorium dichroum* Forel, 1902

16. *Monomorium destructor* (Jerdon, 1851)

17. *Monomorium glabrum* (Ern. Andre, 1883)

18. *Monomorium indicum indicum* Forel, 1902

19. *Monomorium longi* Forel, 1902

20. *Monomorium monomorium* Bolton, 1987

21. *Monomorium orientale* Mayr, 1879

22. *Monomorium pharaonis* (Linnaeus, 1758)

23. *Monomorium wroughtoni* Forel, 1902

24. *Pheidole latinode angustior* Forel, 1902

25. *Pheidole asperata* Emery, 1895

26. *Pheidole fervens fervens* Smith, F., 1858

*Pheidole javana* Mayr, 1867 (Junior synonym of *fervens*)

27. *Pheidole bhavanae* Bingham, 1903

28. *Pheidole fergusoni* Forel, 1802

29. *Pheidole ghatika* Forel, 1902

30. *Pheidole horni* Emery, 1901

31. *Pheidole indica* Mayr, 1879

32. *Pheidole jucunda fossulata* Forel, 1902

33. *Pheidole lamellinoda* Forel, 1902

34. *Pheidole latinoda latinoda* Roger, 1863

35. *Pheidole multidens* Forel, 1902

36. *Pheidole parva parva* Mayr, 1865

37. *Pheidole sharpi hoogwerfi* Forel, 1902

38. *Pheidole spathifera spathifera* Forel, 1902

39. *Pheidole sykesii* Forel, 1902

40. *Aphaenogaster beccarii* Emery, 1887

41. *Aphaenogaster sagei sagei* (Forel, 1902)

42. *Tetramorium christlei* Forel, 1902

43. *Tetramorium coonoorensense* Forel, 1902

44. *Tetramorium fergusoni* Forel, 1902

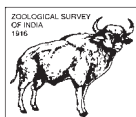
45. *Tetramorium nursei* Bingham, 1903

46. *Tetramorium smithi* Mayr, 1879

47. *Pheidologeton diversus diversus* (Jerdon, 1851)

*Pheidologeton megacephala* Smith, F., 1860 (Junior synonym of *diversus*)

48. *Meranoplus rothneyi* Forel, 1902
49. *Monomorium mayri* Forel, 1902 **nr**
50. *Myrmicaria brunnea brunnea* Saunders, 1842 **nr**
51. *Pheidologeton affinis affinis* (Jerdon, 1851) **nr**
- (vi) Subfamily AMBLYOPONINAE  
FOREL, 1893
52. *Myopopone castanea* (Smith, F., 1860)
- Myopopone moelleri* Bingham, 1903 (Junior synonym of *castanea*)
- (vii) Subfamily FORMICIINAE  
LEPELETIER, 1809
53. *Polyrhachis (Myrmhopla) jerdonii* Forel, 1892
54. *Camponotus (Tanaemyrmex) invidus* Forel, 1892 **nr**
- (viii) Subfamily PONERINAE  
LEPELETIER, 1835
55. *Odontoponera transversa transversa* (Smith, F. 1857) **nr**
56. *Pachycondyla rufipes rufipes* (Jerdon, 1851) **nr**



## STUDIES ON LAND AND FRESHWATER MOLLUSCS IN THE COLLECTION OF WESTERN GHAT REGIONAL CENTRE, ZOOLOGICAL SURVEY OF INDIA, KOZHIKODE

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### INTRODUCTION

Molluscs dwelling on land belong to the class Gastropoda and those inhabiting in freshwater are represented by the classes Gastropoda and Bivalvia. About 24000 species of land molluscs and 7000 species of freshwater molluscs are known to science (Lydeard *et al.*, 2004). In India, 1129 species of land molluscs (Ramakrishna *et al.*, 2010) and 208 species of freshwater molluscs (Ramakrishna and Dey, 2007; Köhler & Glaubrecht, 2007; Reid *et al.*, 2013) are so far reported.

Western Ghats, a global biodiversity hotspot, has 269 land molluscs (with 75% endemic species) and 65 freshwater molluscs (with about 39% endemic species) (Mavinkurve *et al.*, 2004a; Aravind *et al.*, 2005; Köhler & Glaubrecht, 2007; Reid *et al.*, 2013). Nonetheless, molluscs particularly land snails of Western Ghats are by and large unknown or understudied or with scanty information (Mavinkurve *et al.*, 2004a). Among the several reasons for poor documentation of species diversity in the Western Ghats, major causes are inaccessibility to remote areas and poor sampling efforts. For example, Köhler & Glaubrecht (2007) described 2 new pachychilid snails from Krishna River drainage system in Karnataka while Reid *et al.* (2013) described six new species of freshwater littorinid snail from a single drainage system (linear distance of 80 km)

of Western Ghats from the same state. Another reason for scanty records of molluscs in the Western Ghats is poorly studied or unstudied museum specimens particularly that of the Western Ghat Regional Centre of Zoological Survey of India. Therefore, we attempted to study land and freshwater molluscs deposited at the National Zoological Collections (NZC) of Western Ghat Regional Centre (WGRC), Zoological Survey of India (ZSI), Kozhikode.

Important systematic contributions on land and freshwater molluscs of India including Western Ghats were that of Benson (1836), Blanford (1870 & 1880), Beddome (1875 & 1891), Blanford and Godwin Austen (1908), Gude (1914 & 1921), Preston (1915), Annandale and Rao (1925), Rao (1925), Subba Rao (1989), Mitra *et al.* (2005) and Ramakrishna and Dey (2007). Moreover, many catalogues and checklists have been prepared reporting land and freshwater molluscs of India (Theobald, 1860, 1876; Mitchell, 1867; Nevill, 1877, 1878, 1884; Satyamurti, 1960; Ramakrishna *et al.*, 2010) besides that of Karnataka (Mavinkurve *et al.*, 2004b) and Maharashtra (Patil & Talmale, 2005).

### MATERIAL AND METHODS

The National Zoological Collections of Western Ghat Regional Centre, Kozhikode hold about

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1049 specimens of land and freshwater molluscs (including 20 type material: 6 holotype specimens and 13 paratype specimens) collected mainly from the Western Ghats of Karnataka, Kerala, Maharashtra and Tamil Nadu states during the period of 33 years from 1981 to 2013. Molluscan specimens were identified following Subba Rao (1989), Mitra *et al.* (2005), Ramakrishna and Dey (2007) and Reid *et al.* (2013). The classification systems of gastropod and bivalve families followed here are according to Bouchet and Rocroi (2005; 2010). However, the phylogenetic arrangement of the suprageneric taxa is according to Poppe & Tagaro (2006) for gastropods and according to Carter *et al.* (2011) for bivalves.

The following abbreviations are used: Coll.: Collector; dist.: district; INV: Invertebrate; IR: Identified Register; N.P.: National Park; NZC: National Zoological Collections; R.F.: Reserve Forest; T.R.: Tiger Reserve; W.L.S.: Wildlife Sanctuary; WGRC: Western Ghat Regional Centre; ZSI: Zoological Survey of India.

### SYSTEMATIC LIST

#### Land molluscs:

Phylum MOLLUSCA

Class GASTROPODA

Subclass CAENOGASTROPODA

Order unassigned CAENOGASTROPODA

Superfamily CYCLOPHOROIDEA

Family CYCLOPHORIDAE

Subfamily CYCLOPHORINAE

1. *Cyclophorus (Litostylus) nilagiricus* (Benson, 1852)

Subclass HETEROBRANCHIA

Order STYLOMMATOPHORA

Superfamily ACHATINOIDEA

Family ACHATINIDAE

Subfamily ACHATININAE

2. *Achatina (Lissachatina) fulica* (Bowdich, 1822)

Superfamily PLECTOPYLOIDEA

Family PLECTOPYLIDAE

3. *Corilla anax* (Benson, 1865)

Superfamily HELICARIONOIDEA

Family ARIOPHANTIDAE

Subfamily ARIOPHANTINAE

4. *Euplecta subcastor* (Beddome, 1891)
5. *Hemiplecta basileus* (Benson, 1861)
6. *Indrella ampulla* (Benson, 1850)

#### Freshwater molluscs:

Phylum MOLLUSCA

Class GASTROPODA

Subclass CAENOGASTROPODA

Order unassigned CAENOGASTROPODA

Superfamily AMPULLARIOIDEA

Family AMPULLARIIDAE

Subfamily AMPULLARIINAE

7. *Pila virens* (Lamarck, 1822)

Superfamily VIVIPAROIDEA

Family VIVIPARIDAE

Subfamily VIVIPARINAE

8. *Bellamya bengalensis* (Lamarck, 1822)
9. *Bellamya dissimilis* (Müller, 1774)

Superfamily CERITHIOIDEA

Family PACHYCHILIDAE

10. *Paracrostoma huegelii* (Philippi, 1843)

Family PALUDOMIDAE

Subfamily PALUDOMINAE

11. *Paludomus (Paludomus) annandalei* Preston, 1909
12. *Paludomus (Philopotamis) sulcatus* Reeve, 1847
13. *Paludomus (Tanalia) neritoides* Reeve, 1847

Family THIARIDAE

Subfamily THIARINAE

14. *Melanoides tuberculata* (Müller, 1774)
15. *Tarebia granifera* (Lamarck, 1822)

16. *Thiara (Thiara) scabra* (Müller, 1774)

Superfamily LITTORINOIDEA

Family LITTORINIDAE

Subfamily LACUNINAE

17. *Cremnoconchus agumbensis* Reid, Aravind & Madhyastha, 201318. *Cremnoconchus canaliculatus* Blanford, 187019. *Cremnoconchus castanea* Reid, Aravind & Madhyastha, 201320. *Cremnoconchus cingulatus* Reid, Aravind & Madhyastha, 201321. *Cremnoconchus conicus* Blanford, 187022. *Cremnoconchus dwarakii* Reid, Aravind & Madhyastha, 201323. *Cremnoconchus globulus* Reid, Aravind & Madhyastha, 201324. *Cremnoconchus hanumani* Reid, Aravind & Madhyastha, 201325. *Cremnoconchus syhadrensis* (Blanford, 1863)

Subclass HETEROBRANCHIA

Order HYGROPHILA

Superfamily LYMNAEOIDEA

Family LYMNAEIDAE

Subfamily LYMNAEINAE

26. *Radix luteola* (Lamarck, 1822)

Superfamily PLANORBOIDEA

Family PLANORBIDAE

Subfamily BULININAE

27. *Indoplanorbis exustus* (Deshayes, 1834)

Class BIVALVIA

Subclass PALAEOHETERODONTA

Order UNIONOIDA

Superfamily UNIONOIDEA

Family UNIONIDAE

Subfamily AMBLEMENAE

28. *Lamellidens consobrinus* (Lea, 1859)29. *Lamellidens marginalis* (Lamarck, 1819)

Subfamily PARREYSIINAE

30. *Parreysia (Parreysia) corrugata* (Müller, 1774)

## SYSTEMATIC ACCOUNT

1. *Cyclophorus (Litostylus) nilagiricus*

(Benson, 1852)

(Plate-I, Figs. 1–3)

1852. *Cyclostoma nilagiricum* Benson, *Ann. Mag. nat. Hist.*, Ser. 2, X : 268.2005. *Cyclophorus (Litostylus) nilagiricus* Mitra, Dey and Ramakrishna, *Pictorial Handbook-Indian Land Snails* : 52.*Material examined*: 2 ex., Kakkayam, Kozhikode dist., Kerala, 07. 10. 1982, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2884.*Distribution* : India : Western Ghats (Endemic): Kerala.2. *Achatina (Lissachatina) fulica*

(Bowdich, 1822)

(Plate-I, Figs. 4, 5)

1822. *Achatina fulica* Bowdich, *Elements of Conchology*, part I. Univalves : pl. 13, fig. 3.2005. *Achatina (Lissachatina) fulica* Mitra, Dey and Ramakrishna, *Pictorial Handbook-Indian Land Snails* : 166.*Material examined*: 1 ex., Chulliyar, Palakkad dist., Kerala, 23. 03. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2785.*Distribution*: India: Found throughout the country (including Andaman Islands) except north-west region. *Elsewhere* : American Samoa, Argentina, Bangladesh, Barbados, Bolivia, Brazil, Brunei Darussalam, Cambodia, Caribbean, Central African Republic, China, Christmas Island, Colombia, Cote d'Ivoire, Ecuador, Fiji, French Polynesia, Guadeloupe, Guam, Indonesia, Japan, Kenya, Kiribati, Madagascar, Malagasy, Malaysia, Maldives, Marshall Islands, Martinique, Mauritius, Micronesia, Morocco, Myanmar, New Caledonia, New Zealand, Nigeria, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Paraguay, Peru, Philippines, Saint Lucia, Samoa, Seychelles,

Singapore, Solomon Islands, Sri Lanka, Taiwan, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Tuvalu, United States Virgin Islands, US Minor Outlying Islands, USA, Vanuatu, Venezuela, Vietnam, Wallis and Futuna, West Africa and Zanzibar.

### 3. *Corilla anax* (Benson, 1865)

(Plate-I, Figs. 6–8)

1865. *Helix anax* Benson, *Ann. Mag. nat. Hist.*, Ser. 3, **XV**: 12.

2005. *Corilla anax* Mitra, Dey and Ramakrishna, *Pictorial Handbook-Indian Land Snails* : 187.

**Material examined**: 1 ex., Sholayar R.F., Thrissur dist., Kerala, 21. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2831.

**Distribution**: India: Hills of South India including Kerala. *Elsewhere* : Sri Lanka.

### 4. *Euplecta subcastor* (Beddome, 1891)

(Plate-I, Figs. 9–11)

1891. *Nanina subcastor* Beddome, *Proc. zool. Soc. London* : 313, pl. XXIX, fig. 1–3.

2005. *Euplecta subcastor* Mitra, Dey and Ramakrishna, *Pictorial Handbook-Indian Land Snails* : 239.

**Material examined**: 1 ex., Athirapally, Thrissur dist., Kerala, 23. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2870.

**Distribution**: India: Western Ghats : Kerala and Tamil Nadu.

### 5. *Hemiplecta basileus* (Benson, 1861)

(Plate-I, Figs. 12–14)

1861. *Helix basileus* Benson, *Ann. Mag. nat. Hist.*, Ser. 3, **VII** : 81.

2005. *Hemiplecta basileus* Mitra, Dey and Ramakrishna, *Pictorial Handbook-Indian Land Snails* : 241.

**Material examined**: 1 ex., Varakiliyar, Anaimalai, Coimbatore dist., Tamil Nadu, 12. 12. 1983, Coll. G.U. Kurup & Party, ZSI/WGRC/IR/INV/2840; 3 ex., Manjapara, Malayattor, Divi, Ernakulam dist., Kerala, 15. 11. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2841; 1 ex., Thattekkad, Ernakulam dist., Kerala, 02. 12. 2006, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2839 and 3 ex., Mannavan Shola, Eravikulam N.P.,

Idukki dist., Kerala, 06. 04. 2012, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2947.

**Distribution**: India: Western Ghats : Kerala and Tamil Nadu.

### 6. *Indrella ampulla* (Benson, 1850)

(Plate-I, Figs. 15, 16)

1850. *Helix ampulla* Benson, *Ann. Mag. nat. Hist.*, Ser. 2, **V** : 213.

2005. *Indrella ampulla* Mitra, Dey and Ramakrishna, *Pictorial Handbook-Indian Land Snails* : 243.

**Material examined**: 2 ex., Periyar Peak, Wayanad dist., Kerala, 15. 08. 1994, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2880; 1 ex., Thusaragiri, Kodanchery, Kozhikode dist., Kerala, 22. 06. 1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2882; 2 ex., Anakkampoyil, Kozhikode dist., Kerala, 17. 07. 1995, Coll. Promod, ZSI/WGRC/IR/INV/2881; 1 ex., Sholayar R.F., Thrissur dist., Kerala, 21. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2830; 1 ex., Kapayem, Kuttampuzha R.F., Ernakulam dist., Kerala, 19. 11. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2885; 1 ex., Idamalayar/Keerithodu, Ernakulam dist., Kerala, 20. 11. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2883; 1 ex., Kakkad, Engapuzha, Kozhikode dist., Kerala, 20. 10. 2009, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2879 and 1 ex., Ambalapara, Kakkayam, Malabar W.L.S., Kozhikode dist., Kerala, 29. 05. 2013, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2944.

**Distribution**: India: Western Ghats : Kerala and Tamil Nadu.

### 7. *Pila virens* (Lamarck, 1822)

(Plate-II, Figs. 1, 2)

1822. *Ampullaria virens* Lamarck, *Hist. nat. Anim. Sans Vert.*, **6**(2): 179.

2007. *Pila virens* Ramakrishna & Dey, *Handbook on Indian Freshwater Molluscs* : 105.

**Material examined**: 11 ex., Nedupuzha, Trichur, Thrissur dist., Kerala, 20. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2773; 1 ex., Maduyikavu, Kannur dist., Kerala, 23. 11. 1994, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2846;

1 ex., Vazhani, Thrissur dist., Kerala, 07. 10. 1995, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2843; 10 ex., Kainakari, Alappuzha dist., Kerala, 24. 02. 2000, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2786; 1 ex., Kidangoor/Periyar, Kottayam dist., Kerala, 30. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2851; 1 ex., Thavanakkadavu, Vaikom, Ernakulam dist., Kerala, 26. 06. 2002, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2842; 3 ex., Madayipara, Kannur dist., Kerala, 22. 07. 2004, Coll. Md. Jaffer Palot, ZSI/WGRC/IR/INV/2837 and 9 ex., Thattekkad, Ernakulam dist., Kerala, 02. 12. 2006, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2838.

*Distribution*: India : Andhra Pradesh, Assam?, Karnataka, Kerala, Maharashtra and Tamil Nadu.

#### 8. *Bellamya bengalensis* (Lamarck, 1822)

(Plate-II, Figs. 3, 4)

1822. *Paludina bengalensis* Lamarck, *Hist. nat. Anim. Sans Vert.*, **6**(2) : 174.

2007. *Bellamya bengalensis* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 78.

*Material examined*: 3 ex., Nedupuzha, Trichur, Thrissur dist., Kerala, 20. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2774; 10 ex., Bharathapuzha, Kalpathi, Palakkad dist., Kerala, 22. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2821; 1 ex., Kidangoor/Periyar, Kottayam dist., Kerala, 30. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2852 and 1 ex., Velloor, Kottayam dist., Kerala, 31. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2817.

*Distribution*: India: Common throughout the country including Kerala. *Elsewhere* : Bangladesh, Iran, Myanmar, Nepal, Pakistan and Sri Lanka.

#### 9. *Bellamya dissimilis* (Müller, 1774)

(Plate-II, Figs. 5, 6)

1774. *Nerita dissimilis* Müller, *Verm. Terr. et Fluv.*, **2**: 184.

2007. *Bellamya dissimilis* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 90.

*Material examined*: 8 ex., Chuliyar, Palakkad dist., Kerala, 23. 03. 1999, Coll. P.M. Sureshan,

ZSI/WGRC/IR/INV/2782 and 7 ex., Velloor, Kottayam dist., Kerala, 31. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2818.

*Distribution*: India : Common throughout the country including Kerala. *Elsewhere* : Bangladesh, Malaysia, Myanmar, Pakistan, Sri Lanka and Thailand.

#### 10. *Paracrostoma huegelii* (Philippi, 1843)

(Plate-II, Figs. 7, 8)

1843. *Melania hügelii* Philippi, *Abbild. Beschreib. Conch.* **1**: 61.

2007. *Sulcospira huegeli* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 174.

2007. *Paracrostoma huegelii* Köhler & Glaubrecht, *Biol. J. Linn. Soc.*, **91**: 630.

*Material examined*: 8 ex., Thakarapadi Forest Area, Kozhikode dist., Kerala, 05. 10. 1981, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2826; 8 ex., Mananthavady, Bavali River, Wayanad dist., Kerala, 16. 03. 1982, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2819; 18 ex., Thalayad, Kozhikode dist., Kerala, 18. 04. 1983, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2778; 10 ex., Bethri, Coorg, Kodagu dist., Karnataka, 05. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2771; 1 ex., Bethri, Coorg, Kodagu dist., Karnataka, 05. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2860; 6 ex., Sampaje, Kodagu dist., Karnataka, 07. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2834; 29 ex., Harangi, Kodagu dist., Karnataka, 16. 01. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2777; 25 ex., Mykayam, Kasaragod dist., Kerala, 27. 01. 1994, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2825; 10 ex., Vattapoil, Kannur dist., Kerala, 02. 03. 1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2829; 16 ex., Solley Kolley, Kodagu dist., Karnataka, 06. 03. 1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2789; 2 ex., Rodiyar, Kanyakumari dist., Tamil Nadu, 02. 05. 1994, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2862; 15 ex., Kottiyour, Kannur dist., Kerala, 03. 02. 1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2945; 6 ex., Kottiyour, Kannur dist., Kerala, 22. 02. 1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2948; 10 ex.,

Thellickal, Parambikulam W.L.S., Palakkad dist., Kerala, 15. 03. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2769; 2 ex., Bhagavathi Nature Camp, Kudremukh, Chikkamagaluru dist., Karnataka, 24. 10. 2005, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2853; 55 ex., Kurukkathodu, Aralam W.L.S., Kannur dist., Kerala, 28. 02. 2006, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2781; 20 ex., Kottencheri R.F., Kasaragod dist., Kerala, 05. 03. 2006, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2768; 50 ex., Kakkad, Engapuzha, Kozhikode dist., Kerala, 20. 10. 2009, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2779; 20 ex., Meenmutti, Aralam W.L.S., Kannur dist., Kerala, 12. 10. 2011, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2772; 13 ex., Ambalapara, Kakkayam, Malabar W.L.S., Kozhikode dist., Kerala, 09. 05. 2013, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2942; 21 ex., Kakkayam, Malabar W.L.S., Kozhikode dist., Kerala, 22. 05. 2013, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2941 and 23 ex., Athikode, Kakkayam, Malabar W.L.S., Kozhikode dist., Kerala, 29. 05. 2013, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2943.

**Distribution:** India : South India (including Western Ghats) : Karnataka, Kerala and Tamil Nadu.

**Remarks:** Records from Assam and Meghalaya (Garo and Khasi Hills) (Ramakrishna & Dey, 2007) is incorrect since the species is endemic to south India (Köhler & Glaubrecht, 2007).

#### 11. *Paludomus (Paludomus) annandalei*

Preston, 1909

(Plate-II, Figs. 9, 10)

1909. *Paludomus annandalei* Preston, *Rec. Ind. Mus.*, III(III) : 277.

2007. *Paludomus (Paludomus) annandalei* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 177.

**Material examined:** 1 ex., Bharathapuzha, Kalpathi, Palakkad dist., Kerala, 22. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2822; 2 ex., Kuruva, Wayanad dist., Kerala, 25. 12. 1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2874; 20 ex., Sholayar R.F., Thrissur dist., Kerala, 21.

02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2833; 6 ex., Athirapally, Thrissur dist., Kerala, 23. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2867; 12 ex., Karimala, Parambikulam W.L.S., Palakkad dist., Kerala, 18. 03. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2765; 1 ex., Parambikulam Tunnel, Parambikulam W.L.S., Palakkad dist., Kerala, 21. 03. 1996, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2857; 2 ex., Mlappara, Periyar T.R., Idukki dist., Kerala, 08. 11. 1996, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2856; 3 ex., Poogemkutti / Naralsemthodu, Ernakulam dist., Kerala, 23. 11. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2854; 30 ex., Idamaruku, Kottayam dist., Kerala, 29. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2844; 1 ex., Engapuzha, Kozhikode dist., Kerala, 24. 04. 2002, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2823; 14 ex., Kakkad, Engapuzha, Kozhikode dist., Kerala, 20. 10. 2009, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2780 and 120 ex., Mlappara, Periyar T.R., Idukki dist., Kerala, 03. 03. 2010, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2770.

**Distribution:** India : Western Ghats: Kerala.

#### 12. *Paludomus (Philopotamis) sulcatus*

Reeve, 1847

(Plate-II, Figs. 11, 12)

1847. *Paludomus sulcatus* Reeve, *Conch. Icon.*, 4: pl. 2, fig. 8a, pl.3, figs. 8b, c.

2007. *Paludomus (Philopotamis) sulcatus* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 190.

**Material examined:** 15 ex., Naduvathumoozhi, Pathanamthitta dist., Kerala, 22. 01. 1992, Coll. M.B. Raghunatha & Party, ZSI/WGRC/IR/INV/2820; 15 ex., Puliyilappara, Vazhachal, Thrissur dist., Kerala, 20. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2788; 7 ex., Sholayar R.F., Thrissur dist., Kerala, 21. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2832; 3 ex., Karimala, Parambikulam W.L.S., Palakkad dist., Kerala, 18. 03. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2766;

7 ex., Poogemkutti/Naralsemthodu, Ernakulam dist., Kerala, 23. 11. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2855; 24 ex., Ponkunnam, Kottayam dist., Kerala, 27. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2812 and 2 ex., Karadipara, Athirapally, Thrissur dist., Kerala, 28. 02. 2013, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2939.

*Distribution*: India : Kerala. *Elsewhere* : Sri Lanka.

### 13. *Paludomus (Tanalia) neritoides*

Reeve, 1847

(Plate-II, Figs. 13, 14)

1847. *Paludomus neritoides* Reeve, *Conch. Icon.*, **4**: pl. 1, fig. 3a, b.

2007. *Paludomus (Tanalia) neritoides* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs*: 194.

*Material examined*: 1 ex., Varakiliyar, Anaimalai, Coimbatore dist., Tamil Nadu, 22. 07. 1988, Coll. G.U. Kurup, ZSI/WGRC/IR/INV/2946; 5 ex., Athirapally, Thrissur dist., Kerala, 23. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2868 and 16 ex., Karimala, Parambikulam W.L.S., Palakkad dist., Kerala, 18. 03. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2767.

*Distribution*: India : Kerala and Tamil Nadu. *Elsewhere*: Sri Lanka.

*Remarks* : New record to Tamil Nadu.

### 14. *Melanoides tuberculata* (Müller, 1774)

(Plate-II, Figs. 15, 16)

1774. *Nerita tuberculata* Müller, *Verm. Terr. et Fluv.*, **2**: 191.

2007. *Melanoides tuberculata* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 161.

*Material examined*: 18 ex., Munderi, Nilambur, Malappuram dist., Kerala, 24. 02. 1992, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2813 and 4 ex., Chulliyar, Palakkad dist., Kerala, 23. 03. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2783.

*Distribution*: India: Common throughout the country except Jammu and Kashmir. *Elsewhere*:

Algeria, Australia, Bahrain, Bangladesh, Burundi, China, Congo, Egypt, Eritrea, Ethiopia, Iran, Japan, Kenya, Kuwait, Libya, Malawi, Malaysia, Morocco, Mozambique, Namibia, Nepal, Niger, Oman, Qatar, Saudi Arabia, South Africa, Sri Lanka, Sudan, Swaziland, Tanzania, Thailand, Tunisia, United Arab Emirates, Vietnam, Yemen and Zimbabwe.

### 15. *Tarebia granifera* (Lamarck, 1822)

(Plate-III, Figs. 17, 18)

1822. *Melania granifera* Lamarck, *Hist. nat. Anim. Sans Vert.*, **6**(2): 167.

2007. *Tarebia granifera* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 168.

*Material examined*: 4 ex., Sampaje, Kodagu dist., Karnataka, 07. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2835; 1 ex., Coorg, Kodagu dist., Karnataka, 14. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2875 and 3 ex., Kuruva, Wayanad dist., Kerala, 25. 12. 1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2872.

*Distribution*: India : Andaman and Nicobar, Andhra Pradesh, Bihar, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Odisha, Tripura, and West Bengal. *Elsewhere*: Bangladesh, Bhutan, Cambodia, China, Cuba, French Polynesia, Hong Kong, Indonesia, Japan, Madagascar, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Singapore, South Africa, Sri Lanka, Taiwan, Thailand, United States of America, Venezuela and Vietnam.

*Remarks*: New records to Karnataka and Kerala.

### 16. *Thiara (Thiara) scabra* (Müller, 1774)

(Plate-III, Figs. 19, 20)

1774. *Buccinum scabrum* Müller, *Verm. Terr. et Fluv.*, **2**: 136.

2007. *Thiara (Thiara) scabra* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs* : 153.

*Material examined*: 1 ex., Coorg, Kodagu dist., Karnataka, 14. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2876; 1 ex., Munderi, Nilambur,

Malappuram dist., Kerala, 24. 02. 1992, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2814 and 15 ex., Valayar, Palakkad dist., Kerala, 18. 03. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2865.

**Distribution:** India: Bihar, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Puducherry, Sikkim, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. **Elsewhere:** Bangladesh, Fiji, Guam, Indonesia, Iran, Japan, Kenya, Malaysia, Mauritius, Micronesia, Myanmar, Nepal, New Caledonia, Papua New Guinea, Philippines, Samoa, Seychelles, Solomon Islands, Tanzania, Thailand, Timor, Vanuatu and Yemen.

**17. *Cremnoconchus agumbensis* Reid, Aravind & Madhyastha, 2013**

(Plate-III, Figs. 21, 22)

2013. *Cremnoconchus agumbensis* Reid, Aravind & Madhyastha, *Zool. J. Linn. Soc.*, **167**: 121.

**Material examined:** Holotype, 1 ex., Agumbe, Udupi dist., Karnataka, 13. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2313 and paratypes, 2 ex., ZSI/WGRC/IR/INV/2314, 2315, same data as holotype.

**Distribution:** India : Western Ghats : Karnataka (Udupi).

**Remarks:** Family Littorinidae Children, 1834 is almost exclusively marine but for the freshwater genus *Cremnoconchus* Blanford, 1869. The genus and its species are restricted to streams of the Western Ghats in India (Reid *et al.*, 2013).

**18. *Cremnoconchus canaliculatus***

Blanford, 1870

(Plate-III, Figs. 23, 24)

1870. *Cremnoconchus conicus* var. *canaliculatus* Blanford, *J. Asiat. Soc. Bengal*, **XXXIX**(II) : 11.

2013. *Cremnoconchus canaliculatus* Reid, Madhyastha & Aravind, *Zool. J. Linn. Soc.*, **167**: 116.

**Material examined:** 1 ex., 5 km south of Mahabaleshwar, Satara dist., Maharashtra, 15. 10. 2010, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2302; 2 ex., 10 km west of Mahabaleshwar,

Raigad dist., Maharashtra, 16. 10. 2010, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2300 & ZSI/WGRC/IR/INV/2301 and 1 ex., Dongarwadi, Tamhini, Pune dist., Maharashtra, date of collection unknown, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2299.

**Distribution:** India: Western Ghats: Maharashtra (Pune, Raigad and Satara).

**19. *Cremnoconchus castanea* Reid, Aravind & Madhyastha, 2013**

(Plate-III, Figs. 25, 26)

2013. *Cremnoconchus castanea* Reid, Aravind & Madhyastha, *Zool. J. Linn. Soc.*, **167**: 126.

**Material examined:** Holotype, 1 ex., Belkal Thirtha Falls, Udupi dist., Karnataka, 16. 03. 2008, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2321; paratype, 1 ex., ZSI/WGRC/IR/INV/2320, same data as holotype and 1 ex., locality unknown, district unknown, Karnataka, date of collection unknown, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2322.

**Distribution:** India : Western Ghats : Karnataka (Udupi).

**20. *Cremnoconchus cingulatus* Reid, Aravind & Madhyastha, 2013**

(Plate-III, Figs. 27, 28)

2013. *Cremnoconchus cingulatus* Reid, Aravind & Madhyastha, *Zool. J. Linn. Soc.*, **167**: 124.

**Material examined:** Holotype, 1 ex., Hulikal Ghat, Udupi dist., Karnataka, 13. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2316 and paratypes, 3 ex., ZSI/WGRC/IR/INV/2317, 2318, 2319, same data as holotype.

**Distribution:** India : Western Ghats : Karnataka (Udupi).

**21. *Cremnoconchus conicus* Blanford, 1870**

(Plate-III, Figs. 29, 30)

1870. *Cremnoconchus conicus* Blanford, *J. Asiat. Soc. Bengal*, **XXXIX**(II) : 10.

2013. *Cremnoconchus conicus* Reid, Madhyastha & Aravind, *Zool. J. Linn. Soc.*, **167**: 111.

**Material examined:** 1 ex., 6 km west of

Mahabaleshwar, Satara dist., Maharashtra, 16. 10. 2010, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2295 and 3 ex., 44 km west of Bhor, Pune dist., Maharashtra, 16. 10. 2010, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2296, 2297, 2298.

*Distribution*: India: Western Ghats: Maharashtra (Pune and Satara).

22. ***Cremnoconchus dwarakii*** Reid, Aravind & Madhyastha, 2013

(Plate-III, Figs. 31, 32)

2003. *Cremnoconchus syhadrensis* Williams, Reid & Littlewood, *Mol. Phylogenet. Evol.*, **28**: 63 (not *Cremnoconchus syhadrensis* Blanford, 1863).

2013. *Cremnoconchus dwarakii* Reid, Aravind & Madhyastha, *Zool. J. Linn. Soc.*, **167**: 128.

*Material examined*: Holotype, 1 ex., Hulikal Ghat, Udipi dist., Karnataka, 13. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2323 and paratypes, 4 ex., ZSI/WGRC/IR/INV/2324, 2325, same data as holotype.

*Distribution*: India : Western Ghats : Karnataka (Udipi).

23. ***Cremnoconchus globulus*** Reid, Aravind & Madhyastha, 2013

(Plate-IV, Figs. 1, 2)

2013. *Cremnoconchus globulus* Reid, Aravind & Madhyastha, *Zool. J. Linn. Soc.*, **167**: 121.

*Material examined*: Holotype, 1 ex., Lesser Kadambi Falls, Kudremukh National Park, Chikkamagaluru dist., Karnataka, 12. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2310; paratypes, 2 ex., ZSI/WGRC/IR/INV/2311, 2312, same data as holotype and 2 ex., Greater Kadambi Falls, Kudremukh National Park, Chikkamagaluru dist., Karnataka, 12. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2308, 2309.

*Distribution*: India : Western Ghats : Karnataka (Chikkamagaluru).

24. ***Cremnoconchus hanumani*** Reid, Aravind & Madhyastha, 2013

(Plate-IV, Figs. 3, 4)

2013. *Cremnoconchus hanumani* Reid, Aravind & Madhyastha, *Zool. J. Linn. Soc.*, **167**: 118.

*Material examined*: Holotype, 1 ex., Hanuman Gundi Falls, Kudremukh National Park, Chikkamagaluru dist., Karnataka, 12. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2303; paratype, 1 ex., ZSI/WGRC/IR/INV/2304, same data as holotype and 3 ex., Greater Kadambi Falls, Kudremukh National Park, Chikkamagaluru dist., Karnataka, 12. 10. 2010, Coll. N.A. Aravind & N.A. Madhyastha, ZSI/WGRC/IR/INV/2305, 2306, 2307.

*Distribution*: India : Western Ghats : Karnataka (Chikkamagaluru).

25. ***Cremnoconchus syhadrensis***

(Blanford, 1863)

(Plate-IV, Figs. 5, 6)

1863. *Cremnobates syhadrensis* Blanford, *Ann. Mag. Nat. Hist.*, (3)**XII** : 184.

2013. *Cremnoconchus syhadrensis* Reid, Madhyastha & Aravind, *Zool. J. Linn. Soc.*, **167**: 103.

*Material examined*: 2 ex., Matheran, Raigad dist., Maharashtra, 17. 10. 2010, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2290, 2291 and 3 ex., Khandala, Pune dist., Maharashtra, 17. 10. 2010, Coll. N.A. Aravind, ZSI/WGRC/IR/INV/2292, 2293, 2294.

*Distribution*: India: Western Ghats: Maharashtra (Nashik, Pune and Raigad).

*Remarks*: Type locality was corrected to Matheran by Reid *et al.* (2013) from Khandala earlier mentioned by Subba Rao & Mitra (1979).

26. ***Radix luteola*** (Lamarck, 1822)

(Plate-IV, Figs. 7, 8)

1822. *Lymnaea luteola* Lamarck, *Hist. nat. Anim. Sans Vert.*, **6**(2): 160.

2007. *Lymnaea (Pseudosuccinea) luteola* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs*: 208.

2010. *Radix luteola* Correa, Escobar, Durand, Renaud, David, Jarne, Pointier & Hurtrez-Boussès, *BMC Evolutionary Biology*, **10**: 381.

*Material examined*: 1 ex., Sampaje, Kodagu dist., Karnataka, 07. 01. 1985, Coll. K.N. Nair

& Party, ZSI/WGRC/IR/INV/2836 and 4 ex., Hipla/Hebbae, Muthodi Range, Bhadra W.L.S., Chikkamagaluru dist., Karnataka, 12. 11. 2006, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2828.

*Distribution*: India: Common throughout the country including Karnataka. *Elsewhere*: Bangladesh, China, Iran, Malaysia, Myanmar, Pakistan, Sri Lanka and Thailand.

**27. *Indoplanorbis exustus* (Deshayes, 1834)**

(Plate-IV, Figs. 9–11)

1834. *Planorbis exustus* Deshayes, in Bélanger, *Voy. Ind. Orient. Zool.*: 417.

2007. *Indoplanorbis exustus* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs*: 208.

*Material examined*: 95 ex., Mercara (Madikeri), State Fisheries Office Tank, Kodagu dist., Karnataka, 05. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2787; 20 ex., Maduyikavu, Kannur dist., Kerala, 23. 11. 1994, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2847; 3 ex., Kuruva, Wayanad dist., Kerala, 25. 12. 1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2873; 15 ex., Velloor, Kottayam dist., Kerala, 31. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2816; 6 ex., Engapuzha, Kozhikode dist., Kerala, 24. 04. 2002, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2824 and 22 ex., Hipla/Hebbae, Muthodi Range, Bhadra W.L.S., Chikkamagaluru dist., Karnataka, 12. 11. 2006, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2827.

*Distribution*: India: Common throughout the country including Karnataka and Kerala. *Elsewhere*: Bangladesh, China, Indonesia, Iran, Malaysia, Myanmar, Nepal, Oman, Pakistan, Saudi Arabia, Sri Lanka, Thailand, Vietnam and Yemen.

**28. *Lamellidens consobrinus* (Lea, 1859)**

(Plate-IV, Figs. 12, 13)

1859. *Unio consobrinus* Lea, *Proc. Acad. Nat. Sci. Philadelphia*, **11**: 331.

2007. *Lamellidens consobrinus* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs*: 281.

*Material examined*: 4 ex., Valayar, Palakkad

dist., Kerala, 18. 03. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2863.

*Distribution*: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Jharkhand, Kerala, Maharashtra, Puducherry, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Bangladesh, China? Nepal and Sri Lanka.

*Remarks*: New record to Kerala.

**29. *Lamellidens marginalis* (Lamarck, 1819)**

(Plate-IV, Figs. 14, 15)

1819. *Unio marginalis* Lamarck, *Hist. Nat. Anim. Sans Vert.*, **6**(1): 79.

2007. *Lamellidens marginalis* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs*: 288.

*Material examined*: 2 ex., Kakkathavil River, Kodagu dist., Karnataka, 02. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2848; 1 ex., Nedupuzha, Trichur, Thrissur dist., Kerala, 20. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2775; 1 ex., Nedupuzha, Thrissur dist., Kerala, 20. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2866; 1 ex., Killiyar, Panood Bridge, Thiruvananthapuram dist., Kerala, 18. 02. 1987, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2849; 1 ex., Benne Block, Jodipalam Hill Stream, Mudumalai W.L.S., Nilgiri Biosphere, Nilgiri dist., Tamil Nadu, 30. 12. 1987, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2878; 1 ex., Parambikulam Tunnel, Parambikulam W.L.S., Palakkad dist., Kerala, 21. 03. 1996, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2858; 1 ex., Chulliyar, Palakkad dist., Kerala, 23. 03. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2784 and 3 ex., Kidangoor/Periyar, Kottayam dist., Kerala, 30. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2850.

*Distribution*: India: Common throughout the country including Karnataka, Kerala and Tamil Nadu. *Elsewhere*: Bangladesh, Myanmar, Nepal and Sri Lanka.

**30. *Parreysia (Parreysia) corrugata***

(Müller, 1774)

(Plate-IV, Figs. 16, 17)

1774. *Mya corrugata* Müller, *Verm. Terr. et Fluv.*, **2**: 214.

2007. *Parreysia (Parreysia) corrugata* Ramakrishna and Dey, *Handbook on Indian Freshwater Molluscs*: 296.

**Material examined:** 5 ex., Bethri, Coorg, Kodagu dist., Karnataka, 05. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2859; 4 ex., Coorg, Kodagu dist., Karnataka, 14. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2877; 1 ex., Nedupuzha, Trichur, Thrissur dist., Kerala, 20. 02. 1985, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2776; 2 ex., Rodiyar, Kanyakumari dist., Tamil Nadu, 02. 05. 1994, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2861; 2 ex., Kuruva, Wayanad dist., Kerala, 25. 12. 1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2871; 1 ex., Athirapally, Thrissur dist., Kerala, 23. 02. 1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2869; 1 ex., Valayar, Palakkad dist., Kerala, 18. 03. 1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2864; 1 ex., Idamaruku, Kottayam dist., Kerala, 29. 10. 2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2845 and 1 ex., Karadipara, Athirapally, Thrissur dist., Kerala,

28. 02. 2013, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2940.

**Distribution:** India: Common throughout the country including Karnataka, Kerala and Tamil Nadu. *Elsewhere:* Bangladesh, Myanmar and Sri Lanka.

## RESULTS AND DISCUSSION

From the holdings of WGRC, ZSI, Kozhikode, 30 species of molluscs (6 land molluscs and 24 freshwater molluscs) under 18 genera, 12 subfamilies of 13 families, 11 superfamilies, 4 orders and an unassigned order, 3 subclasses and 2 classes, were identified. The class Gastropoda was represented by as many as 27 species whereas the class Bivalvia was having only 3 species. All the molluscs except the genus *Cremnoconchus* Blanford, 1869 and *Radix luteola* (Lamarck, 1822) were recorded from Kerala (total 20 species) whereas Karnataka was represented by 13 species; Tamil Nadu by 5 species and Maharashtra by 3 species (Table-1).

**Table 1.** State and district-wise distribution of land and freshwater molluscs studied from the collection of WGRC, ZSI, Kozhikode

| Species                                     | Karnataka      |        |       | Kerala    |           |        |        |           |          |           |            |          |                |                    |          | Maharashtra |      |        | Tamil Nadu |            |             | Specimens studied |         |
|---------------------------------------------|----------------|--------|-------|-----------|-----------|--------|--------|-----------|----------|-----------|------------|----------|----------------|--------------------|----------|-------------|------|--------|------------|------------|-------------|-------------------|---------|
|                                             | Chikkamagaluru | Kodagu | Udupi | Alappuzha | Ernakulam | Idukki | Kannur | Kasaragod | Kottayam | Kozhikode | Malappuram | Palakkad | Pathanamthitta | Thiruvananthapuram | Thrissur | Wayanad     | Pune | Raigad | Satara     | Coimbatore | Kanyakumari |                   | Nilgiri |
| <i>Cyclophorus (Litostylus) nilagiricus</i> | -              | -      | -     | -         | -         | -      | -      | -         | -        | +         | -          | -        | -              | -                  | -        | -           | -    | -      | -          | -          | -           | -                 | 2       |
| <i>Achatina (Lissachatina) fulica</i>       | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | +        | -              | -                  | -        | -           | -    | -      | -          | -          | -           | -                 | 1       |
| <i>Corilla anax</i>                         | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | +        | -           | -    | -      | -          | -          | -           | -                 | 1       |
| <i>Euplecta subcastor</i>                   | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | +        | -           | -    | -      | -          | -          | -           | -                 | 1       |
| <i>Hemiplecta basileus</i>                  | -              | -      | -     | -         | +         | +      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -           | -    | -      | -          | +          | -           | -                 | 8       |
| <i>Indrella ampulla</i>                     | -              | -      | -     | -         | +         | -      | -      | -         | -        | +         | -          | -        | -              | -                  | +        | +           | -    | -      | -          | -          | -           | -                 | 10      |
| <i>Pila virens</i>                          | -              | -      | -     | +         | +         | -      | +      | -         | +        | -         | -          | -        | -              | -                  | +        | -           | -    | -      | -          | -          | -           | -                 | 37      |
| <i>Bellamyia bengalensis</i>                | -              | -      | -     | -         | -         | -      | -      | -         | +        | -         | -          | +        | -              | -                  | +        | -           | -    | -      | -          | -          | -           | -                 | 15      |
| <i>Bellamyia dissimilis</i>                 | -              | -      | -     | -         | -         | -      | -      | -         | +        | -         | -          | +        | -              | -                  | -        | -           | -    | -      | -          | -          | -           | -                 | 15      |
| <i>Paracrostoma huegeli</i>                 | +              | +      | -     | -         | -         | -      | +      | +         | -        | +         | -          | +        | -              | -                  | -        | +           | -    | -      | -          | -          | +           | -                 | 368     |
| <i>Paludomus (Paludomus) annandalei</i>     | -              | -      | -     | -         | +         | +      | -      | -         | +        | +         | -          | +        | -              | -                  | +        | +           | -    | -      | -          | -          | -           | -                 | 212     |
| <i>Paludomus (Philopotamis) sulcatus</i>    | -              | -      | -     | -         | +         | -      | -      | -         | +        | -         | -          | +        | +              | -                  | +        | -           | -    | -      | -          | -          | -           | -                 | 73      |

Table 1. contd.

| Species                                | Karnataka      |        |       | Kerala    |           |        |        |           |          |           |            |          |                |                    |          |         | Maharashtra |        |        | Tamil Nadu |             |         | Specimens studied |
|----------------------------------------|----------------|--------|-------|-----------|-----------|--------|--------|-----------|----------|-----------|------------|----------|----------------|--------------------|----------|---------|-------------|--------|--------|------------|-------------|---------|-------------------|
|                                        | Chikkamagaluru | Kodagu | Udupi | Alappuzha | Ernakulam | Idukki | Kannur | Kasaragod | Kottayam | Kozhikode | Malappuram | Palakkad | Pathanamthitta | Thiruvananthapuram | Thrissur | Wayanad | Pune        | Raigad | Satara | Coimbatore | Kanyakumari | Nilgiri |                   |
| <i>Paludomus (Tanalia) neritoides</i>  | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | +        | -              | -                  | +        | -       | -           | -      | -      | +          | -           | -       | 22                |
| <i>Melanoides tuberculata</i>          | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | +          | +        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 22                |
| <i>Tarebia granifera</i>               | -              | +      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | +       | -           | -      | -      | -          | -           | -       | 8                 |
| <i>Thiara (Thiara) scabra</i>          | -              | +      | -     | -         | -         | -      | -      | -         | -        | -         | +          | +        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 17                |
| <i>Cremnoconchus agumbensis</i>        | -              | -      | +     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 3                 |
| <i>Cremnoconchus canaliculatus</i>     | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | +           | +      | +      | -          | -           | -       | 4                 |
| <i>Cremnoconchus castanea</i>          | -              | -      | +     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 3                 |
| <i>Cremnoconchus cingulatus</i>        | -              | -      | +     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 4                 |
| <i>Cremnoconchus conicus</i>           | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | +           | -      | +      | -          | -           | -       | 4                 |
| <i>Cremnoconchus dwarakii</i>          | -              | -      | +     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 5                 |
| <i>Cremnoconchus globulus</i>          | +              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 5                 |
| <i>Cremnoconchus hanumani</i>          | +              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 5                 |
| <i>Cremnoconchus syhadrensis</i>       | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | +           | +      | -      | -          | -           | -       | 5                 |
| <i>Radix luteola</i>                   | +              | +      | -     | -         | -         | -      | -      | -         | -        | -         | -          | -        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 5                 |
| <i>Indoplanorbis exustus</i>           | +              | +      | -     | -         | -         | -      | +      | -         | +        | +         | -          | -        | -              | -                  | -        | +       | -           | -      | -      | -          | -           | -       | 161               |
| <i>Lamellidens consobrinus</i>         | -              | -      | -     | -         | -         | -      | -      | -         | -        | -         | -          | +        | -              | -                  | -        | -       | -           | -      | -      | -          | -           | -       | 4                 |
| <i>Lamellidens marginalis</i>          | -              | +      | -     | -         | -         | -      | -      | -         | +        | -         | -          | +        | -              | +                  | +        | -       | -           | -      | -      | -          | -           | +       | 11                |
| <i>Parreysia (Parreysia) corrugata</i> | -              | +      | -     | -         | -         | -      | -      | -         | +        | -         | -          | +        | -              | -                  | +        | +       | -           | -      | -      | -          | +           | -       | 18                |
| Specimens studied                      | 38             | 175    | 14    | 10        | 26        | 125    | 130    | 45        | 83       | 161       | 19         | 88       | 15             | 1                  | 78       | 20      | 7           | 4      | 2      | 2          | 4           | 1       | 1049*             |

\* 1 specimen from Karnataka with unknown locality

Among the freshwater gastropods, *Paludomus (Tanalia) neritoides* Reeve, 1847 is a new record to Tamil Nadu whereas *Tarebia granifera* (Lamarck, 1822) is reported for the first time from Karnataka and Kerala. The bivalve, *Lamellidens consobrinus* (Lea, 1859) stood as a new record to Kerala.

### SUMMARY

This paper is a first list of land and freshwater molluscs (6 land forms and 24 freshwater species) in the holdings of Western Ghat Regional Centre, Zoological Survey of India, Kozhikode. Both type (20 specimens) and non-type (1029 specimens) materials are included in the present

study, collected mainly from Western Ghats of Karnataka, Kerala, Maharashtra and Tamil Nadu over a period of 33 years from 1981 to 2013. A total of 30 species under 18 genera, 12 subfamilies of 13 families, 11 superfamilies, 4 orders and an unassigned order, 3 subclasses and 2 classes were identified. Systematic list and account of all the identified species are provided along with data on their distribution patterns. Some new records were also encountered during the present study: *Paludomus (Tanalia) neritoides* Reeve, 1847 new record to Tamil Nadu; *Tarebia granifera* (Lamarck, 1822) first report to Karnataka and Kerala, and *Lamellidens consobrinus* (Lea, 1859) new report to Kerala.

**ACKNOWLEDGEMENTS**

We are grateful to Dr. K. Venkatraman, Director, Zoological Survey of India, Kolkata for facilities, constant encouragement and support. We are thankful to the scientists and staff of Western

Ghat Regional Centre, Zoological Survey of India, Kozhikode for support and help during the study. Special thanks are extended to all the collectors of molluscan specimens deposited at WGRC, ZSI, Kozhikode.

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## PLATE-I



Plate-I. Land molluscs : 1–3. *Cyclophorus (Litostylus) nilagiricus*; 4, 5. *Achatina (Lissachatina) fulica*; 6–8. *Corilla anax*; 9–11. *Euplecta subcastor*; 12–14. *Hemiplecta basileus*; 15, 16. *Indrella ampulla*. 1, 6, 9, 12, apical views; 2, 7, 10, 13, basal views; 3, 5, 8, 11, 14, 16, apertural views; 4, 15, abapertural views. Scale bar = 10 mm.

## PLATE-II

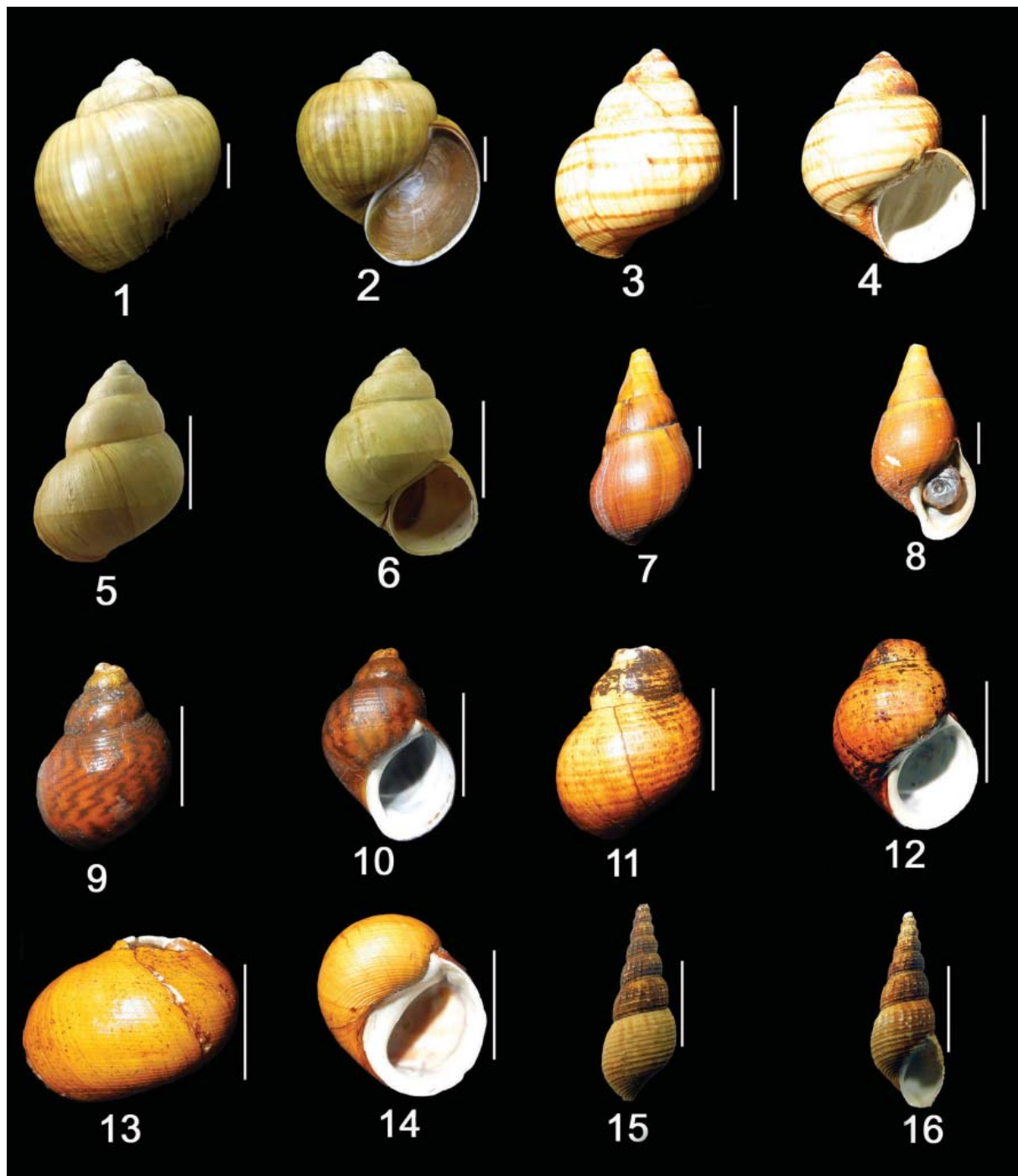


Plate-II. Freshwater molluscs : 1, 2. *Pila virens*; 3, 4. *Bellamya bengalensis*; 5, 6. *Bellamya dissimilis*; 7, 8. *Paracrostoma huegelii*; 9, 10. *Paludomus (Paludomus) annandalei*; 11, 12. *Paludomus (Philopotamis) sulcatus*; 13, 14. *Paludomus (Tanalia) neritoides*; 15, 16. *Melanoides tuberculata*, 1, 3, 5, 7, 9, 11, 13, 15, abapertural views; 2, 4, 6, 8, 10, 12, 14, 16, apertural views. Scale bar = 10 mm.

## PLATE-III

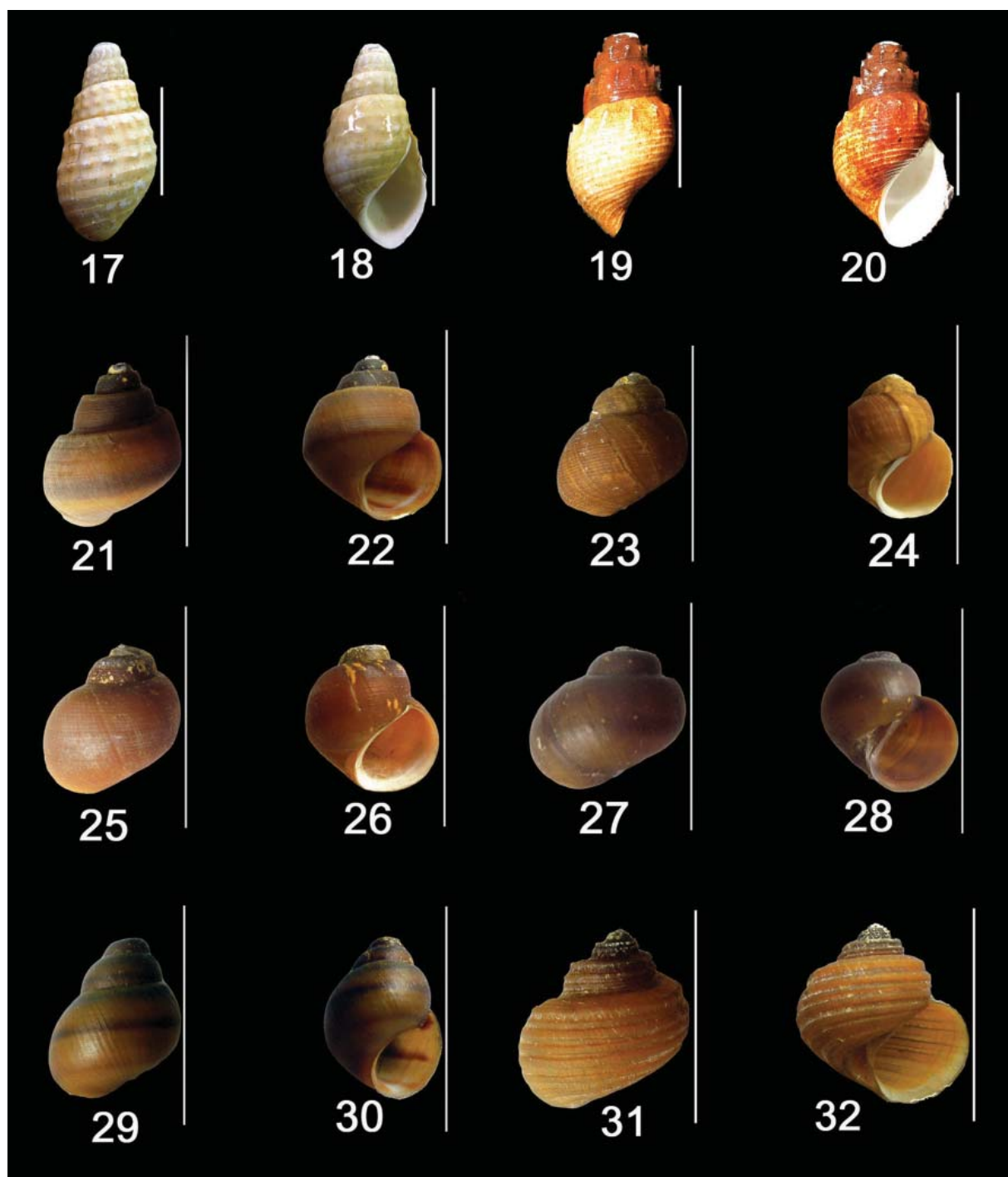


Plate-III. Freshwater molluscs : 17, 18. *Tarebia granifera*; 19, 20. *Thiara (Thiara) scabra*; 21, 22. *Cremanoconchus agumbensis* (holotype); 23, 24. *Cremanoconchus canaliculatus*; 25, 26. *Cremanoconchus castanea* (holotype); 27, 28. *Cremanoconchus cingulatus* (holotype); 29, 30. *Cremanoconchus conicus*; 31, 32. *Cremanoconchus dwarakii* (holotype). 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, abapertural views; 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, apertural views. Scale bar = 10 mm.

## PLATE-IV

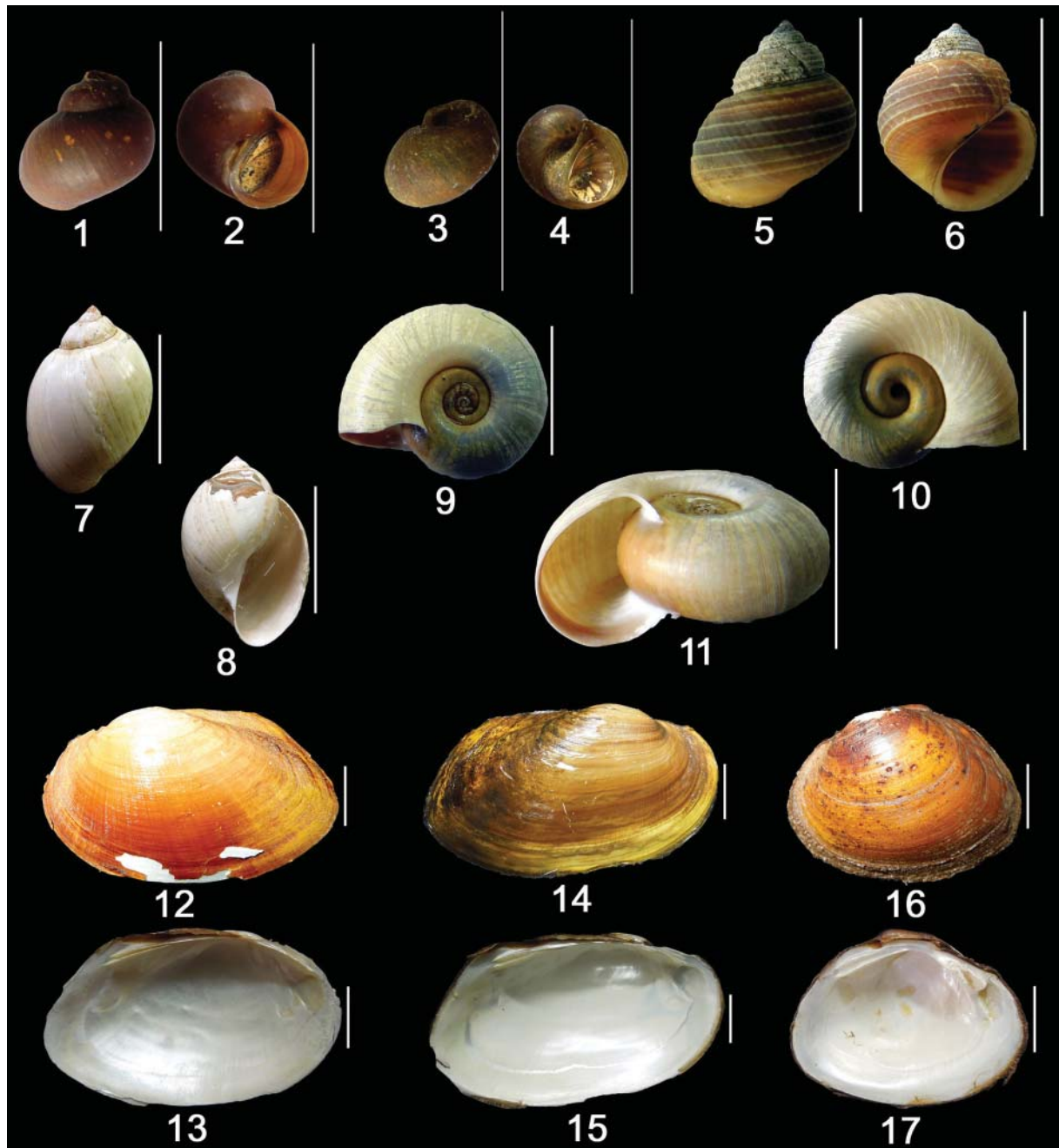
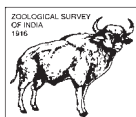


Plate-IV. Freshwater molluscs : 1, 2. *Cremnoconchus globulus* (holotype); 3, 4. *Cremnoconchus hanumani* (holotype); 5, 6. *Cremnoconchus syhadrensis*; 7, 8. *Radix luteola*; 9–11. *Indoplanorbis exustus*; 12, 13. *Lamellidens consobrinus*; 14, 15. *Lamellidens marginalis*; 16, 17. *Parreysia* (*Parreysia*) *corrugata*. 1, 3, 5, 7, abapertural views; 2, 4, 6, 8, 11, apertural views; 9, apical view; 10, basal view; 12, 16, exterior views of left valve; 14, exterior view of right valve; 13, 15, 17, interior views of left valve. Scale bar = 10 mm.



## OLIGOCHAETE DIVERSITY IN GOBINDSAGAR AND NANGAL DAM WETLANDS (H.P. & PB.) INDIA

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### INTRODUCTION

The oligochaetes are elongated, soft bodied, metamerically segmented, invertebrate animals. They are divided into two convenient groups on the basis of their body size: Microdrili (small, mainly aquatic worms including terrestrial pot worms of the family Enchytraeidae), and Megadrili (larger, mostly terrestrial worms, the earthworms, and their aquatic representatives). Oligochaetes are found in all aquatic and terrestrial habitats with sufficient moisture and food.

Wetlands are transitional areas between terrestrial and aquatic environments. These are biologically most productive ecosystems and harbours very rich biodiversity beside their socio-economic usefulness to mankind. Natural wetlands are increasingly facing various anthropogenic pressures resulting in their deterioration and degradation. The man-made wetlands have gained importance in recent times as they are supporting and sustaining considerable biodiversity. Species diversity of Indian wetlands includes 17,853 animal species belonging to 34 groups (Alfred and Nandi, 2001), and more than 1,200 species of aquatic plants (Gopal, 1995). The wet soil in marshes and along the margins of wetland provide suitable habitat for the propagation of both freshwater and terrestrial oligochaetes.

Aquatic oligochaetes are significant component of complex food web of the wetland ecosystem. They improve the quality of detritus deposited at the bottom of freshwater ecosystems. They are

a source of food to some aquatic insect larvae, amphibians, fishes and water birds inhabiting the wetlands.

Famous Greek philosopher Aristotle has described earthworms as “Intestine of Earth”. Earthworms consume the soil and help in disappearance of surface plant litter, its breakdown, redistribution and incorporation in the soil. Organic matter extracted from the soil is pulverized and subjected to digestive enzymes in their alimentary canal. The excreta rich in nutrient are deposited on the soil surface in the form of castings. A considerable quantity of nutrients released during this process is washed into nearby wetlands, thus influencing their productivity.

Earlier important taxonomic monographs by Stephenson (1923), Brinkhurst and Jamieson (1971), Gates (1972), Julka (1988) and Naidu (2005) on Indian oligochaetes provide information on the distribution of oligochaetes in the region. However, study of oligochaete diversity in wetlands has not attracted much attention in our country. Julka and Paliwal (2000) published a detailed account on the Oligochaeta of Renuka wetland in the outer Himalaya of Himachal Pradesh. Paliwal and Julka (2009) explored earthworm diversity of the man-made Pong Dam wetland in district Kangra of Himachal Pradesh and reported 12 species of earthworms. Paliwal and Julka (2005) have listed earthworms of western Himalaya which provides some information on the distribution of oligochaetes in the localities

close to the wetlands and surrounding areas. Oligochaetes of Gobindsagar and Nangal Dam wetlands that spread in the states of Himachal Pradesh and Punjab have not yet been explored.

Present communication lists nine species of oligochaetes from Gobindsagar and Nangal Dam wetlands including one aquatic microdrile oligochaete. The aquatic oligochaete *Branchiura sowerbyi* is a widely distributed species in India and other parts of the world. In the northwest India, the species is reported from neighbouring states of Jammu & Kashmir, Punjab, Chandigarh, Haryana, and Uttarakhand (Naidu, 2005). It is being recorded for the first time from Himachal Pradesh. Present record of *Branchiura sowerbyi* displays its continuous distribution in the northern region of India along western Himalaya. Material examined under each species shows the number of juvenile, acitellate and clitellate worms separated by hyphen, respectively.

#### Key to the oligochaetes of Gobindsagar and Nangal Dam Wetlands

1. Setae in bundles, posterior segments with paired gills on dorsal and ventral sides.....  
.....*Branchiura sowerbyi*  
Setae not in bundles, gills absent ..... 2
2. Male pores in segment 15.....  
.....*Bimastos parvus*  
Male pores behind segment 15..... 3
3. Setae lumbricine..... 4  
Setae perichaetine..... 9
4. Male pores paired, in seminal grooves, on segment 18..... 5  
Male pores paired, just posterior to prostatic pores, on segment 17, seminal grooves absent..... 6
5. Spermathecal pores one pair, on segment 8, setae *a* on segment 8 copulatory; typhlosole lamelliform, simple ..... *Lennogaster chittagongensis*  
Spermathecal pores two pairs, on segment 8 and 9; typhlosole lemmeliform, bifid .....  
.....*Octochaetona beatrix*

6. Bivestibulate, male pores discharge into, paired, deep, well-like vestibula..... 7  
Avestibulate, male pores discharge on body surface in fissures on low, circular, paired porophores ..... *Eutyphoeus incommodus*
7. Spermathecal pores at *ab*, genital markings closely paired, intraclitellar, additional postclitellar genital marking may be present ..... *Eutyphoeus nicholsoni*  
Spermathecal pores at *bc*, genital markings paired, postsetal on segment 9, intersegmental on 14/15/16, 18/19, occasionally one of the paired marking may be absent .....  
.....*Eutyphoeus waltoni*
9. Male pores discharge directly onto body surface, spermathecal pores four pairs in furrows 5/6/7/8/9, genital markings present .  
..... *Amyntas corticis*  
Male pores discharge into copulatory pouches opening onto body surface through secondary male pores, spermathecal pores four pairs in furrows 5/6/7/8/9, genital markings paired on equators of segments 17 and 19 .....  
..... *Metaphire posthuma*

#### SYSTEMATIC LIST

##### Family TUBIFICIDAE

Genus *Branchiura* Beddard, 1892

1. *Branchiura sowerbyi* Beddard, 1892

*Material examined:* 0-0-1 Kodra, district Una (H.P.), 17 April 2005, R. Paliwal.

*Distribution:* Andhra Pradesh, Assam, Bihar, Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Tamil Nadu, Uttaranchal, Uttar Pradesh, West Bengal. *Elsewhere:* Cosmopolitan.

*Remarks:* It is found in mud. This aquatic oligochaete species is being reported for the first time from Himachal Pradesh.

##### Family LUMBRICIDAE

Genus *Bimastos* Moore, 1893

2. *Bimastos parvus* (Eisen, 1874)

*Material examined:* 0-0-2 Barnla, district

Ropar (Punjab), 12 Jan 2002, R. Paliwal; 0-0-1 Tarkhanka, district Una (H.P.), 18 Jan 2002, R. Paliwal; 2-2-13 Kodra, district Una (H.P.), 17 April 2005, R. Paliwal.

*Distribution:* India: Himalayan states, Uttar Pradesh, Bihar, Rajasthan, Tamil Nadu, West Bengal. *Elsewhere:* Endemic in North America, distributed worldwide in temperate climate areas.

*Remarks:* It is a very small worm of reddish colour, generally found in decaying wood and forest litter.

#### Family OCTOCHAETIDAE

Genus *Eutyphoeus* Michaelsen, 1900

#### 3. *Eutyphoeus incommodus* (Beddard, 1901)

*Material examined:* 0-0-3 Nanaksar, district Ropar (Punjab), 11 Sep 2003, R. Paliwal.

*Distribution:* India: Gangetic Plains, foot hills of the Himalaya, Madhya Pradesh. *Elsewhere:* Pakistan.

*Remarks:* It is a geophagous species and lives in deeper soil layers.

#### 4. *Eutyphoeus nicholsoni* (Beddard, 1901)

*Material examined:* 0-0-1 Lakhanpur, district Bilaspur (H.P.), 17 Sep 2003, R. Paliwal.

*Distribution:* India: Gangetic Plains, foot hills of the Himalaya, Madhya Pradesh. *Elsewhere:* Not recorded.

*Remarks:* It is a geophagous species and lives in deeper alluvial soil layers.

#### 5. *Eutyphoeus waltoni* Michaelsen, 1907

*Material examined:* 3-3-1 Jeori Pattan, district Bilaspur (H.P.), 26 June 2001, L.P. Dubey; 0-0-1 Nanaksar, district Ropar (Punjab), 11 Sep 2003, R. Paliwal; 0-0-2 Kodra, district Una (H.P.), 13 Sep 2003, R. Paliwal.

*Distribution:* India: Gangetic Plains, foot hills of the Himalaya, Gujarat, Madhya Pradesh. *Elsewhere:* Pakistan.

*Remarks:* *Eutyphoeus waltoni* inhabits deeper soil layers and deposits large-sized tower-like casts

on the soil surface. It is generally found under trees and bushes.

Genus *Lennogaster* Gates, 1939

#### 6. *Lennogaster chittagongensis* (Stephenson, 1917)

*Material examined:* 0-0-5 Lathiani, district Una (H.P.), 24 Sep 1991, A.S. Mahabal.

*Distribution:* India: Jammu & Kashmir, Himachal Pradesh. *Elsewhere:* Bangladesh, Myanmar.

*Remarks:* It is found within top 5 cm sandy loam soil layer with rich organic matter in grasslands, under stones and decaying leaves.

Genus *Octochaetona* Gates, 1962

#### 7. *Octochaetona beatrix* (Beddard, 1902)

*Material examined:* 0-0-1 Babkhal Pul, district Bilaspur (H.P.), 28 June 2001, L.P. Dubey; 0-0-1 Nanaksar, district Ropar (Punjab), 11 Sep 2003, R. Paliwal.

*Distribution:* India: Gangetic Plains, foot hills of the Himalaya, Odisha, Madhya Pradesh, Gujarat, Maharashtra, Goa, Karnataka, Kerala. *Elsewhere:* Pakistan, Nepal, Myanmar, Malay Peninsula, Philippines.

*Remarks:* It commonly occurs in sandy loam and clay loam soils with low organic matter usually in grassy patches.

#### Family MEGASCOLECIDAE

Genus *Amyntas* Kinberg, 1867

#### 8. *Amyntas corticis* (Kinberg, 1867)

*Material examined:* 0-0-1 Barmla, district Ropar (Punjab), 12 Jan 2002, R. Paliwal.

*Distribution:* India: Himalaya, NE Hill Ranges, hilly parts of Tamil Nadu and Karnataka. *Elsewhere:* South and Southeast Asia, Australia, New Zealand, South Africa, Madagascar, Europe, North and South America.

*Remarks:* It is a widely distributed anthropochorous species with endemism believed to be in east and south-east Asia. It is a very agile earthworm and when disturbed responds in serpentine manner. This species can be utilized for vermi-composting.

Genus *Metaphire* Sims & Easton, 1972

9. *Metaphire posthuma* (Vaillant, 1868)

*Material examined:* 0-1-8 Nanaksar, district Ropar (Punjab), 11 Sep 2003, R. Paliwal.

*Distribution:* India: West Himalayan foothills, Gangetic Plains, Odisha, Madhya Pradesh, Gujarat, Maharashtra, Andaman & Nicobar Islands. *Elsewhere:* Pakistan, Bangladesh, Myanmar, Southeast Asia.

*Remarks:* It inhabits subsoil at 10-20 cm depth in sandy loam soil. Its casts are in the form of loose spherical pellets. It prefers poor soils on the banks of water bodies and semi-dried up beds of watercourses.

### SUMMARY

Nine species of oligochaetes belonging to four families *i.e.* Tubificidae (*Branchiura sowerbyi*),

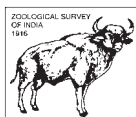
Lumbricidae (*Bimastos parvus*), Octochaetidae (*Eutyphoeus incommodus*, *Eutyphoeus nicholsoni*, *Eutyphoeus waltoni*, *Lennogaster chittagongensis*, *Octochaetona beatrix*) and Megascolecidae (*Amyntas corticis*, *Metaphire posthuma*) are recorded from Gobindsagar and Nangal Dam wetlands of Himachal Pradesh and Punjab with distribution of six species in each wetland. Three species *viz.*, *Bimastos parvus*, *Eutyphoeus waltoni* and *Octochaetona beatrix* were common to both the wetlands. *Branchiura sowerbyi* is recorded for the first time from Himachal Pradesh.

### ACKNOWLEDGEMENTS

Author is grateful to the Director, Zoological Survey of India, Kolkata for his keen interest and facilities during these studies. He is also thankful to the Officer-in-Charge, High Altitude Regional Centre, ZSI, Solan for providing necessary facilities during the project.

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## **TAXONOMIC STUDIES ON VESPID WASPS (HYMENOPTERA: VESPOIDEA: VESPIDAE) OF SUNDERBANS BIOSPHERE RESERVE, WEST BENGAL, INDIA. PART 1**

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### **INTRODUCTION**

The Sunderbans area is composed of a group of Islands from the mouth of the river Hooghly on the west and extending up to the river Meghna in the east, covering North and South 24 Parganas districts of West Bengal in India and Khulna and Barishal districts in Bangladesh. It lies approximately 87° 51'- 91° 30' east longitude and 21° 31'- 22° 30' north latitude. It is considered as the largest single mangrove belt of the world, comprising an area of 9827 sq. km of which 4264 sq. km comes under India. In 1989, the Government of India declared the entire Indian Sunderbans (9630 sq. km; mangrove belt plus nearby villages) as Sunderbans Biosphere Reserve. Due to its unique ecosystem, it has also been declared a World Heritage site in 1989. It is the largest estuary delta in the world with extremely rich diversity of aquatic and terrestrial flora and fauna.

Vespidae is a cosmopolitan family of order Hymenoptera (Insecta) but predominantly found in tropical region. Adults are usually black or brown but are often extensively marked with yellow or white. They are minute to large (6-28 mm) in size. Most species are solitary but many are social. Solitary wasps nesting either in soil, in pre-existing cavities (such as abandoned mud nest of other hymenopterans or beetle tunnels in wood) or in free mud nests which they build themselves. Social wasps often make spectacular paper nests and defend their colony vigorously by stinging.

Bingham (1897) and Das & Gupta (1989) made valuable contributions on Vespidae from India and its adjacent countries. The knowledge on vespid fauna of Sunderbans Biosphere Reserve is very scanty and fragmentary. An attempt has been made here to provide a consolidated account on the fauna of the family Vespidae from Sunderbans Biosphere Reserve.

### **MATERIAL AND METHODS**

The systematic account on the vespid fauna of Sunderbans Biosphere Reserve is given below based on the collections from different localities of the Biosphere Reserve. The entire materials studied here are added to the "National Zoological Collections" of the Zoological Survey of India, Kolkata (NZC).

The following abbreviations used in the text for the Museums: BMNH = Natural History Museum, London, UK; HMUG = Hunterian Museum, University of Glasgow, Scotland, UK; MCZ = Museum of Comparative Zoology, Harvard University, Cambridge, U.S.A.; MNHN = Muséum national d'Histoire naturelle, Paris, France; NHRM = Naturhistoriska Riksmuseet, Stockholm; RMNH = Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands; NZC = National Zoological Collections of Zoological survey of India, Kolkata, India; ZMB = Zoologisches Museum der Humboldt Universität, Berlin, Germany; ZMUC = Zoologisk Museum, Københavns Universitet, Denmark;

ZMUK = Zoological Museum, University of Kiel, Germany; ZMUU = Zoological Museum, Uppsala University, Uppsala, Sweden.

Abbreviations used for the terms: H = Head; M = Mesosoma; S1-S7 = Abdominal sterna 1 to 7; T1-T7 = Abdominal terga 1 to 7.

## SYSTEMATIC ACCOUNT

Family VESPIDAE

Subfamily POLISTINAE

Tribe **Polistini**

Genus **Polistes** Latreille, 1802

Subgenus **Polistes (Gyrostoma)** Kirby, 1828

1. *Polistes (Gyrostoma) olivaceus* (De Geer, 1773)

Subgenus **Polistes (Polistella)** Ashmead, 1904

2. *Polistes (Polistella) stigma tamula* (Fabricius, 1798)

Tribe **Ropalidiini**

Genus **Ropalidia** Guérin-Méneville, 1831

3. *Ropalidia brevita* Das & Gupta, 1989
4. *Ropalidia cyathiformis* (Fabricius, 1804)
5. *Ropalidia jacobsoni* (du Buysson, 1908)

Subfamily VESPINAE

Genus **Vespa** Linnaeus, 1758

6. *Vespa affinis affinis* (Linnaeus, 1764)
7. *Vespa tropica haematodes* Bequaert, 1936

Subfamily EUMENINAE

Genus **Allorhynchium** van der Vecht, 1963

8. *Allorhynchium argentatum* (Fabricius, 1804)
9. *Allorhynchium metallicum* (de Saussure, 1852)

Genus **Anterhynchium** de Saussure, 1863

10. *Anterhynchium (Anterhynchium) abdominale abdominale* (Illiger, 1802)

Genus **Antodynerus** de Saussure, 1855

11. *Antodynerus flavescens flavescens* (Fabricius, 1775)

Genus **Delta** de Saussure, 1855

12. *Delta conoideum* (Gmelin, 1790)
13. *Delta esuriens* (Fabricius, 1787)
14. *Delta pyriforme pyriforme* (Fabricius, 1775)

Genus **Oreumenoides** Giordani Soika, 1961

15. *Oreumenoides edwardsii* (de Saussure, 1852)

Genus **Rhynchium** Spinola, 1806

16. *Rhynchium brunneum brunneum* (Fabricius, 1793)
17. *Rhynchium carnaticum* (Fabricius, 1798)
18. *Rhynchium haemorrhoidale haemorrhoidale* (Fabricius, 1775)

Genus **Subancistrocerus** de Saussure, 1855

19. *Subancistrocerus sichelii* (de Saussure, 1855)

Genus **Xenorhynchium** van der Vecht, 1963

20. *Xenorhynchium nitidulum* (Fabricius, 1798)

1. ***Polistes (Gyrostoma) olivaceus***  
(De Geer, 1773)  
(Image 1)

1773. *Vespa olivacea* De Geer, 582. Type: Sex not mentioned, America (NHRM).

1989. *Vespa hebraeus*: Mandal & Nandi, 32 (Sunderbans).

1989. *Polistes (Megapolistes) olivaceus*: Das & Gupta, 53 (Sunderbans).

1996. *Polistes (Gyrostoma) olivaceus*: Carpenter, 55.

**Diagnosis: Female:** Size (H+M+T1+T2): 13-20 mm. Body yellow with variable black markings and few reddish markings; some are dark form with extensive black markings while others are pale forms with less extensive black markings. Black markings as follows: basal and apical margin of clypeus narrowly, mandibular teeth, a short line on raised part of interantennal space, a mark above each antennal socket, a band on vertex (sometimes narrow line), occiput, a line on scape and flagellum above (often only scape apically above), in front of pronotal carina, a mark on pronotum ventrally towards propleuron (often absent), mesoscutum (except a longer median and

two shorter lateral yellow lines, sometimes an incomplete median line), almost all the thoracic sutures (sometimes faint), a line along the median groove of propodeum (sometimes two marks on sides), T1 narrowly at base (sometimes absent), T2-T5 and S2-S5 with bisinuate marks, a line below coxae (sometimes absent), another line on hind tibiae above (sometimes faint). The reddish markings as follows: pronotum partly dorsally, two curved lines on propodeum on sides, T2 at base and legs partly. Clypeus densely finely punctate, with a few larger scattered punctures interposed; supraclypeal area, interantennal space, inner orbit including ocular sinus almost smooth; frons, vertex and temple with fine scattered punctures; malar space with moderately larger and close punctures; occipital carina incomplete; pronotum sparsely finely punctate; mesoscutum almost impunctate; scutellum, metanotum and metapleuron impunctate; mesopleuron behind epicnemial carina and above sternopleural suture with scattered fine punctures; propodeum with distinct striations without distinct lateral edge; gaster almost impunctate, covered with short velvety pubescence; S1 transversely striated.

**Male:** Size (H+M+T1+T2): 17 mm. Similar to female except clypeus not touching eye; temple wider; proximal tooth of mandible short; apical gastral sternite with bluntly projecting tubercle on each side; apophyses long, narrow and flattened at apex like a spatula, shiny and devoid of pubescence.

**Material examined:** INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Canning, 1♂, 11.xi.1993, Coll. N.P. Debdutt, NZC Regd. No. 12176/H3; Bagabadpur, 1♀, 25.xi.2007, Coll. P. Girish Kumar, NZC Regd. No. 12179/H3; Murir Jhabri, 1♀, 30.iii.2008, Coll. P. Girish Kumar, NZC Regd. No. 12180/H3; Netidhopani, 1♀, 31.iii.2008, Coll. P. Girish Kumar, NZC Regd. No. 12181/H3; Canning, 9♀, 29.vii.2013 to 6.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14491/H3 to 14599/H3; Pakhirala, 2♀, 2.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14600/H3 & 14601/H3;

Dobanki, 1♀, 3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14602/H3; Birajnagar, 1♀, 5.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14603/H3.

**Distribution:** India: Andhra Pradesh, Arunachal Pradesh, Assam, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Odisha, Rajasthan, Sikkim, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Afghanistan, Amirantes, Australia, Bangladesh, Cambodia, Chagos Archipelago, Chile (introduced), China, Egypt, Fiji, Indonesia, Iran, Japan (?), Laos, Madagascar, Malaysia, Marianas, Marquesas, Mauritius, Myanmar, Nepal, New Caledonia, New Zealand, Oman, Pakistan, Philippines, Reunion, Samoa, Seychelles, Singapore, Society Is., Sri Lanka, Tanzania, Thailand, Tongas, Tuamotu Archipelago, U.S.A., Vietnam.

## 2. *Polistes (Polistella) stigma tamula*

(Fabricius, 1798)

(Image 2)

1798. *Vespa tamula* Fabricius, 263. Type Female, "in India Orientali, Dom Daldorff" (ZMUK).

1983. *Polistes (Polistella) stigma tamula*: Das & Gupta, 414.

**Diagnosis:** *Female:* Size (H+M+T1+T2): 10-11 mm. Body predominantly reddish with some black markings and the following yellow markings: clypeus, mandible, a broad line along inner orbit up to lower half of ocular sinus, a line on temple bordering eye margin, malar space, basal and apical margin of pronotum narrowly, a line on scutellum at base, another on metanotum at base, a mark on subtegular area, an elongated mark on mesepisternum at top and another in the middle of apico-lateral margin in front of metapleuron, raised ventral margin of mesepisternum and ventral metapleuron each, a mark on dorsal metapleuron, two lines on mesosternum, two broad curved marks on propodeum, apical valvula entirely, fore coxa in front entirely, marks on middle coxa in front and two lines on hind coxa below, T1 except broad reddish mark at base, apical broad band on T3 and S3, fourth gastral segment almost

entirely, S1 and a narrow band on T2 apically. S1 without distinct margin at base; T1 about as long as wide.

*Material examined:* INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Bagmara, 1 ♀, 12.iii.1990, Coll. R.A. Khan & Party, NZC Regd. No. 14735/H3; Sudhanyakhali, 1 ♀, 1.iv.2008, Coll. P. Girish Kumar, NZC Regd. No. 14736/H3; Dobanki, 2 ♀, 3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14604/H3 & 14605/H3.

*Distribution:* India: Chhattisgarh, Delhi, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Meghalaya, Odisha, Pondicherry, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Sri Lanka.

*Remarks:* It is the first record of this species from Sunderbans Biosphere Reserve.

### 3. *Ropalidia brevita* Das & Gupta, 1989 (Image 3 & 21)

1989. *Ropalidia (Anthreneida) brevita* Das & Gupta, 121.

Holotype Male, Delhi: University ridge (NZC).

*Diagnosis: Female:* Size (H+M+T1+T2): 11-13 mm. Body red with the following yellow portions: antennal scape below, a band on clypeus at apex, mandible (except at tip), inner orbit below ocular sinus (sometimes faint), pronotum anteriorly, two marks on metanotum (sometimes fused), two enlarged marks on apical half of propodeum, a faint mark on sides of mesosternum, fore and middle coxae in front, a line on lateral side of hind coxa, tarsal segments of all legs (highly variable), a narrow apical band on T1 and a broad apical band on T2. In some portions black patches are mixed with reddish body. The extents of yellow and black markings are variable. T1 proportionally wider with its maximum width in dorsal view nearly half as wide as that of T2.

*Male:* Similar to female in size and general appearance. Clypeus, supraclypeal area, inter antennal space, inner orbit below ocular sinus are completely yellow. Male terminal antennal flagellomeres less strongly curved and bluntly

pointed at apex, approximately twofold as long as its basal width; aedeagus not spatulate apically.

*Material examined:* INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Haldibari, 1 ♂, 11.ix.1983, Coll. S.S. Saha & Party, NZC Regd. No. 14746/H3; Burirdabri, 2 ♀, 29.iii.2008, Coll. P. Girish Kumar, NZC Regd. Nos. 14747/H3 & 14748/H3; Dobanki, 2 ♀, 3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14606/H3 & 14607/H3.

*Distribution:* India: Assam, Delhi, Goa, Haryana, Himachal Pradesh, Karnataka, Kerala, Odisha, Rajasthan, Sikkim, Uttarakhand, Uttar Pradesh, West Bengal.

*Remarks:* It is the first record of this species from Sunderbans Biosphere Reserve.

### 4. *Ropalidia cyathiformis* (Fabricius, 1804) (Image 4 & 22)

1804. *Eumenes cyathiformis* Fabricius, 289. Type: Female, Java (ZMUC).

1941. *Ropalidia cyathiformis*: Vecht, 104, 112, 158.

*Diagnosis: Female:* Size (H+M+T1+T2): 6.5-7 mm. Body reddish brown with the following yellow markings: mandible except a reddish brown spot at base and at teeth, clypeus except a median irregular transverse mark, supraclypeal area, inter antennal space continued up to a short distance on frons, a broad line along inner orbit up to ocular sinus, a broad line on temple, ventral side of antenna, pronotum broadly at base and at apical margin towards mesoscutum, two large marks on sides of scutellum and metanotum, an elongated spot on the upper half of mesopleuron, two large marks on propodeum separated by median dark brown line, inner side of tegula, fore and middle coxae almost entirely, hind coxa on sides, a line on all femora and tibia, metatarsi of all legs, rest of the legs partly, apical margin and lateral sides of gastral petiole, T2 and S2 narrowly at apex, and a large mark on each side of T2 at base. Wings transparent hyaline with stigma yellow and apical half of radial cell dark reddish brown. First metasomal segment short, in lateral view with dorsal margin arising from posterior margin of

basal slit for reception of metasomal suspensory ligament; second segment in lateral view vertically cut off posteriorly.

*Material examined:* INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Baradapur, 3 ♀, 25.xi.2007, Coll. P. Girish Kumar, NZC Regd. Nos. 14743/H3 to 14745/H3.

*Distribution:* India: Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Karnataka, Kerala, Maharashtra, Uttarakhand, West Bengal (new record). *Elsewhere:* Bali, Java, Lombok, Malay Peninsula, Myanmar, Nepal, Pakistan, Philippine Islands, Sri Lanka, Sulawesi, Sumba, Thailand, Vietnam.

*Remarks:* It is the first record of this species from West Bengal.

#### 5. *Ropalidia jacobsoni* (du Buysson, 1908) (Image 5 & 23)

1908. *Icaria jacobsoni* du Buysson, 123. Type: Female, Java: Djakarta (= Batavia) (RMNH).

1983. *Ropalidia jacobsoni jacobsoni*: Das & Gupta, 418.

2007. *Ropalidia jacobsoni*: Kojima *et al.*, 386.

*Diagnosis: Female:* Size (H+M+T1+T2): 6-7 mm. Body reddish brown with yellow and black markings. Yellow markings as follows: mandible except at tip and at base brown, clypeus except the characteristic black mark, a mark on inter antennal space, inner orbit up to ocular sinus broadly, ventral side of antenna, a narrow line along pronotal carina, basal and lateral margin of scutellum broadly, two large marks on metanotum, a small mark on the upper part of mesopleuron just below subtegular area, two broad marks on propodeum separated by broad black line along the median groove, inner side of tegula, fore and mid coxae in front, a line on hind coxa laterally, another line below fore femur, a small mark on middle femur laterally, a narrow line on all tibiae above, fore and mid basi-tarsi above, T2 with a large mark on each side at base and a broad apical band on T2 and S2, become narrow towards middle on S2. Black markings as follows: a mark on clypeus at base, supraclypeal area, a large circular spot above each antennal socket, a

mark around each ocellus, occiput, basal area of anterior face of pronotum, margins of mesoscutum narrowly but apical margin towards scutellum broadly, a narrow vertical line on scutellum up to one-third from base, propleuron, dorsal metapleuron, ventral metapleuron apically towards mesopleuron broadly, mesosternum, a broad median line separating the two yellow marks and basal and apical margin of propodeum narrowly. Wings transparent hyaline with apical half of radial cell brown, stigma yellow. Median furrow of propodeum distinct; T1 in lateral view with dorsal margin more strongly convex in posterior half, highest slightly posterior to level of posterior margin of the sternum.

*Male:* Similar to the female but differs in having clypeus (except its basal margin narrowly) black; supraclypeal area and a line on temple, and mesosternum, yellow. Size (H+M+T1+T2): 6-7 mm.

*Material examined:* INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Gosaba, 1 ♀, 12.iii.1990, Coll. R.A. Khan & Party, NZC Regd. No. 14737/H3; Burirdabri, 3 ♀ & 2 ♂, 29.iii.2008, Coll. P. Girish Kumar, NZC Regd. Nos. 14738/H3 to 14742/H3; Dobanki, 1 ♀, 3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14608/H3; Sudhanyakhali, 15 ♀, 3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14609/H3 to 14623/H3.

*Distribution:* India: Assam, Delhi, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu, Uttarakhand, West Bengal (new record). *Elsewhere:* Bangka, Java, Lombok, Myanmar, Sulawesi, Sumatra.

*Remarks:* It is the first record of this species from West Bengal.

#### 6. *Vespa affinis affinis* (Linnaeus, 1764) (Image 6 & 24)

1764. *Apis affinis* Linnaeus, 417, F, des. "in *Calidis regionibus*" (ZMUU).

1936. *Vespa affinis affinis*: Bequaert, 347.

*Diagnostic characters: Sterile female:* Size: 16-23 mm. Head red with a dark patch between

antennae and at base of clypeus; mesosoma black with large reddish mark on each side of prothorax; T1 & T2 orange yellow, T1 brownish at base and with a small dark spot in the middle of horizontal part close to apical margin; S1 and basal spot on S2 dark brown. Apical margin of clypeus less hairy and with short broadly rounded lobes on each side of the median emargination; punctures on vertex, temple, mesoscutum, scutellum, metanotum, metapleuron and propodeum small and crowded; body hairs fine, shorter and comparatively dense.

**Material examined:** INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Canning, 3♀, 31.vii.2013 to 6.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14625/H3 to 14627/H3; Pakhirala, 1♀, 2.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14628/H3; Gosaba, 2♀, 4.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14629/H3 & 14630/H3.

**Distribution:** India: Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. **Elsewhere:** China, Indonesia, Japan (in Ryukyu Island), Laos, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam, New Zealand.

**Remarks:** It is the first record of this species from Sunderbans Biosphere Reserve.

#### 7. *Vespa tropica haematodes* Bequaert, 1936 (Image 7)

1936. *Vespa tropica* var. *haematodes* Bequaert, 336, 338. Holotype: Female, India: "Kooloo" (MCZ).

1989. *Vespa cincta* Fabricius: Mandal & Nandi, 32. (Sunderbans).

**Diagnosis: Sterile female:** Size (H+M+T1+T2): 20.5 mm. Head and antenna reddish brown; pronotum dorsally and scutellum reddish brown; mesoscutum anteriorly with two short reddish mark; apical margin of clypeus brownish; legs partly reddish brown; gaster blackish brown to black except T2 yellow with a slight brown

area basally and S2 yellow with a large brown area basally. Body rather margin hairy; apical margin of clypeus with a broad emargination, its apico-lateral angle triangular; lower vertical area of pronotum with strong transverse ridges near pronotal pit.

**Material examined:** INDIA, West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Canning, 1♀, 30.vii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14631/H3.

**Distribution:** India: Bihar, Haryana, Himachal Pradesh, Karnataka, Kerala, Odisha, Pondicherry, Sikkim, Tamil Nadu, Tripura, Uttarakhand, West Bengal. **Elsewhere:** China, Myanmar, Nepal, Pakistan, Sri Lanka, Vietnam.

#### 8. *Allorhynchium argentatum* (Fabricius, 1804) (Image 8)

1804. *Vespa argentata* Fabricius, 260. Type: Male, "Sumatra" (ZMUC).

1963. *Allorhynchium argentatum*: Vecht, 60 (list), fig. 5a.

**Diagnosis: Male:** Body length (H+M+T1+T2) 11 mm. Body entirely black except clypeus almost entirely yellow and a yellow line in between antennal toruli and inner eye margin; tarsal claws blackish brown; wings dark with purple reflections. Clypeus broadly pyriform, apex truncate and emarginate; median area of clypeus not strongly punctate, diameter of punctures almost equal or less than the distance between punctures, interspaces not carinate; antenna with last article hooked apically and almost reaches apex of 10<sup>th</sup> segment in curved position; pronotal carina strong, complete; epicnemial carina distinct at lower half; outer vein of third submarginal cell of forewing anteriorly very close to apex of marginal cell; T1 and T2 with medium size, closely arranged and moderately dense punctures, interspaces in average equal to punctures, of almost uniform density and thickness except at lateral and apical portions strongly punctured.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Jibantala, 1♂, 30.vii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14654/H3.

**Distribution:** India: Assam, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Indonesia (Sumatra, Java, Bali, Borneo, Sulawesi), Laos, Malaysia, Nepal, Pakistan, Philippines, Singapore, Thailand.

**Remarks:** It is the first record of this species from Sunderbans Biosphere Reserve.

**9. *Allorhynchium metallicum* (de Saussure, 1852)**  
(Image 9)

1852. *Rygchium metallicum* de Saussure, 114. Lectotype: Female, Bengal (MNHN).

1963. *Allorhynchium metallicum*: Vecht, 60 (list).

**Diagnosis:** *Female:* Body length (H+M+T1+T2) 10-12 mm; Body entirely black except a yellow line in between antennal toruli and inner eye margin; tarsal claws blackish brown; wings fusco-hyaline, broadly dark fuscous with purplish reflections along costal margin of forewing. Median area of clypeus not strongly punctate, diameter of punctures almost equal or less than the distance between punctures, interspaces not carinate; T1 and T2 with very small and sparse punctures except at lateral and apical portions strongly punctured.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Canning, 2 ♀, 31.vii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14652/H3 to 14653/H3.

**Distribution:** India: Assam, Delhi, Gujarat, Lakshadweep Islands, Madhya Pradesh, Maharashtra, Sikkim, Tamil Nadu, West Bengal. *Elsewhere:* Indonesia (Borneo, Moluccas), Maldives Islands, Malaysia (Sarawak), Myanmar, Pakistan, Sri Lanka, Taiwan.

**Remarks:** It is the first record of this species from Sunderbans Biosphere Reserve.

**10. *Anterhynchium (Anterhynchium) abdominale abdominale* (Illiger, 1802)**  
(Image 10)

1802. *Vespa abdominalis* Illiger, 192, Syntype, "Bengalen" (? ZMB).

1963. *Anterhynchium abdominale*: Vecht, 75, fig. 5e.

**Diagnosis:** *Male:* Size (H+M+T1+T2) 10.5 mm. Head and mesosoma black except clypeus almost entirely and scape in front yellow; metasoma dull orange-red with variegated black markings. Brown colouration as follows: ventral side of antenna and tarsal segments. Wings dark fuscous with purple reflections. Antenna with the last segment hooked apically and almost reaches the apex of tenth antennal segment in curved position; clypeus with weak punctures, frons, posterior face and lateral sides of pronotum, mesoscutum and scutellum strongly, closely and rugosely punctate; T1 almost smooth with minute scattered punctures on lateral sides; basal two thirds of T2 very finely and shallowly punctate; the narrow basal part of S1 smooth; apical tip of aedeagus rounded, parallel spines elongate without hairs.

**Material examined:** INDIA: West Bengal: S-24 Parganas district, Sunderbans Biosphere Reserve, Sagar Islands, 1 ♂, 17.vi.1977, Coll. R. C. Basu & Party, 13311/H3.

**Distribution:** India: Chhattisgarh, Kerala, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere:* Myanmar, Pakistan, Sri Lanka.

**11. *Antodynerus flavescens flavescens* (Fabricius, 1775)**  
(Image 11)

1775. *Vespa flavescens* Fabricius, 370. Lectotype: Male, "In India Orientali" (ZMUC).

2013. *Antodynerus flavescens flavescens* (Fabricius, 1775): Girish Kumar & Carpenter, 271 (Sunderbans: Sagar Island).

**Diagnosis:** *Female:* Size (H+M+T1+T2) 9-11 mm. Body brownish red with yellow, white and black marks. Usually brownish red colour mixed with yellow and white marks in many areas. Generally the yellow colour as follows: mandible except at lateral and apical margins brown, basal and lateral sides of clypeus (rarely entirely yellow), interantennal space (rarely brown or black), inner and outer eye margins, lower sides of temple and occiput, ventral side of scape, tegula

except inner white margin (sometimes entirely yellow or yellowish brown), T2 except at base black, S2 almost entirely. Generally the white (sometimes whitish yellow) markings as follows: throughout pronotal carina, inner side of tegula, sides of scutellum, posterior side of metanotum, a spot on mesopleuron below tegula. Black markings as follows: inner side of ocellar area (sometimes absent), basal area of tergites which are more prominent on T2 and T3, area in between S1 and S2. Legs pale brown inter mixed with yellow. Wings hyaline with pterostigma and apex of median cell yellow and a dark infumation at apex of radial cell. Median area of propodeum with a shallow narrow fovea from which median carina runs to orifice, without distinct transverse striae; postero-lateral margin of propodeum rounded, without a strong transversely carinate projection, below that with evanescent transverse striae; frons sparsely punctured, diameters of punctures less than distance between punctures; ocellar area almost smooth without punctures; vertex with moderately strong punctures except at middle and area towards occipital carina smooth.

**Male:** Size (H+M+T1+T2) 8.5-9.5 mm. Colour pattern is almost same as that of female except clypeus entirely and a transverse band at lower frons yellow. Antenna with last atricle hook-like, almost reaching to the base of eleventh antennal segment in curved position; apical tip of aedeagus rounded, parallel spines elongate without hairs. Other characters almost same as in female.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Sagar Island, 1 ♀, 17.vi.1977, Coll. R.C. Basu & Party, NZC Regd. No. 14161/H3; Canning, 3 ♀ & 4 ♂, 31.vii.2013 to 6.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14645/H3 to 14651/H3.

**Distribution:** India: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Manipur, Odisha, Pondicherry, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Bangladesh.

## 12. *Delta conoideum* (Gmelin, 1790) (Image 12)

1787. *Vespa conica* Fabricius, 293. Syntype: Female. China (BMNH).

2006. *Delta conoideum*: Gusenleitner, 694.

**Diagnosis: Female:** Size 23-26 mm. Head yellow except mandibles and antenna reddish, a broad transverse band across the apex between the top of eyes black, black mark extends behind the vertex to occiput; thorax dark red with black patches on mesoscutum, metapleuron and median area of propodeum, propleuron entirely black; legs pale reddish; gaster dark red with base of the T2 and a short transverse medially interrupted band on its middle above black; forewing basally flavohyaline and apically fuscohyaline, with a slight purplish reflection. Clypeus pyriform, its apex truncate; gaster smooth and shining with the surface minutely aciculate.

**Male:** Size (H+M+T1+T2) 22 mm. Colour pattern is almost same as that of female. Antenna with last atricle hook-like.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Pakhirala, 2 ♀, 2-3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14634/H3 & 14635/H3; Birajnagar, 2 ♀ & 1 ♂, 5.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14636/H3 to 14638/H3.

**Distribution:** India: Arunachal Pradesh, Maharashtra, Odisha, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal. *Elsewhere:* China, Myanmar, Nepal, Pakistan, Sri Lanka.

**Remarks:** It is the first record of this species from Sunderbans Biosphere Reserve.

## 13. *Delta esuriens* (Fabricius, 1787) (Image 13)

1787. *Vespa esuriens* Fabricius, 293, Syntype, Sex not mentioned, India (BMNH).

1992. *Delta esuriens*: Giordani Soika, 62.

2012. *Delta esuriens* (Fabricius): Girish Kumar, 58 (Matla: Gorosthan Ghor; Agarhati).

**Diagnosis: Female:** Size (H+M+T1+T2)

17 mm. Head yellow to brownish yellow with following black markings: a broad band on vertex including upper half of frons extending behind vertex to outer side of temple and to occiput, a black mark on anterior tentorial pit extending to subantennal suture to dorsal side of antennal scrobe and touches to the black band on frons and vertex; antennae light reddish; mandible yellow except at margins yellowish brown; pronotum almost entirely yellow except at anterior apex of anterior face of pronotum black; mesoscutum black except a large brown area posteriorly; scutellum light red; metanotum yellow, propleuron black or blackish brown; mesopleuron yellow to brownish yellow except mesepimeron brown to blackish brown and mesosternum black; metapleuron light red to reddish brown; propodeum light red except at basolateral apex near to lateral corner with yellow markings; legs light reddish with highly variable yellow markings; petiole light reddish except at base black, at subapically a black band and then a yellow band; T2 basally light reddish then a black band and remaining apical half yellow; S2 light red except at apex with a yellow band; all remaining visible part of gastral segments yellow, with their bases (when drawn out) black. Wings flavohyaline with a narrow subapical dark infumation on forewing. Clypeus smooth; frons and ocular sinus closely and strongly punctured; pronotum strongly and closely punctured except anterior face almost smooth; mesoscutum, scutellum and metanotum strongly and closely punctured; mesepisternum densely punctate; metapleuron almost smooth; propodeal dorsum strongly punctured except at dorsolateral angle with scattered punctures; ventral area of propodeum strongly punctured except the inner concavity with scattered punctures; lateral areas of propodeum almost smooth; petiole and gaster almost smooth.

**Male:** Size (H+M+T1+T2) 15.5 mm. Last antennal segment hooked apically, hook long, curved and pointed, in curved position it almost reaches the apex of ninth antennal segment; 3<sup>rd</sup>-6<sup>th</sup> gastral sternites with few large hairs; 7<sup>th</sup> with a deep median longitudinal groove; Genitalia with

apical tip of aedeagus bulb-like; parameral spine elongate with moderately large hairs subapically. Other characters almost same as in female.

**Material examined:** INDIA: West Bengal: S-24 Parganas district, Matla, Gorosthan Ghor, 1♂, 18.x.1965, Coll. A.N.T. Joseph & Party, 5178/H3; S-24 Parganas district, Agarhati, 1♀, 3.vi.1978, Coll. M. Prasad & Party, 13090/H3.

**Distribution:** India: Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal. *Elsewhere:* Arabia, Australia, Indonesia (Borneo, Java), Iran, Iraq, Laos, Mauritius, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Timor.

#### 14. *Delta pyriforme pyriforme*

(Fabricius, 1775)

(Image 14)

1775. *Vespa pyriformis* Fabricius, 371, Syntype, China (?).

1991. *Delta pyriforme pyriforme*: Krombein, 8.

2012. *Delta pyriforme pyriforme*: Girish Kumar & Lambert Kishore, 274 (Sunderbans: Bagabadpur).

**Diagnosis: Female:** Size (H+M+T1+T2) 26 mm. Head yellow, a broad transverse black band between the eyes on the vertex through ocellar area; occiput mostly black; antenna reddish brown; pronotum entirely and mesoscutum anteriorly yellow; tegula, parategula, scutellum and metanotum reddish brown; propleuron black; mesopleuron, metapleuron, propodeum and legs reddish brown with variegated black markings; the sutures between scutellum, metanotum and propodeum black; petiole and basal third of the second gastral segment reddish brown, the former black at base and with a subapical black band, the middle of the later black, its posterior third and the visible part of the remaining abdominal segments yellow. Wings deep flavohyaline with a narrow infumation on the apical margin of forewing. Clypeus smooth; frons and ocular sinus closely and strongly punctured; vertex and temple with

scattered minute punctures; pronotum strongly and closely punctured except anterior face almost smooth; mesoscutum and metanotum strongly and closely punctured; scutellum punctured except at posterior margin smooth; mesepisternum densely punctate; epicnemium, lower margin and posterior margin of mesopleuron smooth; metapleuron almost smooth; upper part of propodeum strongly punctured except at dorsolateral angle smooth; lower part of propodeum strongly punctured except the inner concavity almost smooth; lateral areas of propodeum almost smooth; gaster almost smooth with minute scattered punctures.

*Material examined:* INDIA: West Bengal: S-24 Parganas district, Sunderbans, Bagabadpur 1 ♀, 24.xi.2007, Coll. P. Girish Kumar, NZSI Regd. No. 13219/H3.

*Distribution:* India: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Pondicherry, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Bhutan, Cambodia, China, Hawaii, Hong Kong, Indonesia, Malaysia, Moluccas, Myanmar, Nepal, New Guinea, Sri Lanka, Taiwan, Thailand, Vietnam.

### 15. *Oreumenoides edwardsii*

(de Saussure, 1852)

(Image 15)

1852. *Eumenes edwardsii* de Saussure, 60. Syntype: Female, Les Indes-Orientales, Bombay (MNHN).

1961. *Oreumenoides edwardsii*: Giordani Soika, 245.

2011. *Oreumenoides edwardsii*: Girish Kumar, 16 (Sunderbans Biosphere Reserve: Sudhanyakhal).

*Diagnosis: Female:* Size (H+M+T1+T2) 14-16 mm. Body ferruginous red with yellow and black markings. Yellow markings as follows: at the clypeus, a triangular mark on interantennal space, inner margin of lower eye extends up to ocular sinus, a narrow line on outer margin of eye, a spot on ventral side of antennal attachment, a short line on middle of the pronotum, a spot on tegula

apically, parategula, lower half of metanotum, a small spot on antero-lateral side of propodeum, a small spot on postero-lateral corner of propodeum, propodeal valvula, a streak on outer side of tibiae and basitarsi, a yellow mark on outer side of fore, mid and hind femora, a streak on each side just after middle of petiole, two subapical spots and two spots on postero-lateral corner on the same above, two lateral oval spots basally and a broad band apically on T2, two spots postero-laterally on T3, a narrow band on S2 apically, a broad band on S3 and S4 apically (sometimes fifth and sixth also). Black markings as follows: frons except inner ocular sinus, vertex, temple except ocular margin of eye, occiput, mesoscutum except an M-shaped ferruginous brown marking, apical margin of scutellum, basal half of metanotum, axillary fossa, suture between metanotum and propodeum, median groove of propodeum, mesepimeron largely, ventral side of mesosoma, base and middle of petiole above, middle of second gastral tergite, a broad longitudinal band from base up to middle of S2, two lateral spots on S2 subapically (sometimes faint, appears to be blackish brown). Forewing almost hyaline with some brown infumation anteriorly, a distinct brown infumation on radial cell at distal half. Clypeus apex emarginate with two lateral triangular tooth-like projections, almost smooth, upper margin emarginate.

*Male:* Body length 14-16 mm. Last antennal article minute, not coiled apically; parameral spine with moderately large hairs. Other characters almost same as in female.

*Material examined:* INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Sudhanyakhal, 1 ♀, 1.iv.2008, Coll. P. Girish Kumar, NZC Regd. No. 12395/H3; Birajnagar, 1 ♀ & 2 ♂, 5.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. Nos. 14639/H3 to 14641/H3.

*Distribution:* India: Chhattisgarh, Delhi, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Pondicherry, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere:* Myanmar, Nepal, Pakistan, Thailand.

**16. *Rhynchium brunneum brunneum***

(Fabricius, 1793)

(Image 16)

1793. *Vespa brunnea* Fabricius, 264. Syntype: sex not mentioned, "Tranquebariae, India (HMUG)".

1808. *Rhynchium brunneum*: Spinola, 189.

**Diagnosis: Female:** Body length (H+M+T1+T2) 15 mm. Body brownish red with the following black marks: a spot on interantennal space, a vertical line on lower frons, around ocelli, occiput, a large triangular mark on mesoscutum in front, a transverse line along its apex, propleuron, mesopleuron (except brownish red below tegula), metapleuron, propodeum in the middle and lateral sides below, basal two thirds of T1 and basal half of T2, S1 and S2 almost entirely, base of S3. Legs brownish red with variegated black markings. Wings yellowish hyaline, deeper and darker towards base; apical margin of forewing slightly infumated; clypeus strongly convex, pyriform, apical third with a broad medial vertical groove, extreme apex truncate, apex of truncated portion slightly incised, with moderately deep punctures, larger punctures on middle and smaller on sides.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Pakhirala, 1 ♀, 3.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14633/H3.

**Distribution:** India: Arunachal Pradesh, Bihar, Jharkhand, Maharashtra, Meghalaya, Odisha, Sikkim, Tamil Nadu, Uttarakhand, West Bengal. **Elsewhere:** Afghanistan, Cambodia, China, Guam, Indonesia, Iran, Iraq, Malaysia, Marquesas Island, Myanmar, Nepal, New Britain, Pakistan, Society Islands, Taiwan, Thailand.

**Remarks:** It is the first record of this species from Sunderbans Biosphere Reserve.

**17. *Rhynchium carnaticum* (Fabricius, 1798)**

(Image 17)

1798. *Vespa carnatica* Fabricius, 261. Syntype, sex not mentioned, Tranquebariae, India (ZMUC).

1852. *Rhynchium carnaticum*: de Saussure, 112.

**Diagnosis: Female:** Size (H+M+T1+T2) 13-16 mm. Body brownish red with the following black marks: a spot on interantennal space, a vertical line on lower frons, around ocelli, occiput, a triangular mark on mesoscutum in front, a transverse line along its apex, lateral sides of propleuron, epicnemium, propodeum in the middle, basal area of T1, at the base of T2, in between S1 and S2, base of S3. Legs brownish red with variegated black markings. Wings yellowish hyaline, deeper and darker towards base; apical margin of forewing slightly infumated. Mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially; T2-T5 with very minute sparse and shiny punctures on  $\frac{3}{4}$  area and S2-S4 with distinct punctures, the diameter of most of the punctures less than interspace.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Lakshmikantapur, 1 ♀, 15.x.1965, Coll. S. P. Chakraborty & Party, NZC Regd. No. 5274/H3; Canning, 1 ♀, 6.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14632/H3.

**Distribution:** India: Rajasthan, Tamil Nadu, West Bengal. **Elsewhere:** Indonesia (Sumatra), Sri Lanka.

**18. *Rhynchium haemorrhoidale******haemorrhoidale* (Fabricius, 1775)**

(Image 18)

1775. *Vespa haemorrhoidalis* Fabricius, 366, Type male, "ad Cap. b. Spei" (BMNH).

1852. *Rhynchium haemorrhoidale*: de Saussure, 1852, 109.

**Diagnosis: Female:** Size (H+M+T1+T2) 15 mm. Body black with the following reddish brown marks: antenna, mandibles except at margin, clypeus, a broad transverse mark on lower frons, inner eye margins, extending towards posterior ocelli and towards vertex, temple and lower portion of occiput, pronotum almost entirely except lateral margins, tegula almost entirely, a spot on mesopleuron below tegula, apical half and remaining portions of fore femora, apical margin

of T2 and the visible parts of remaining tergites, apical margins of S2 to S4 and visible parts of S5 & S6. Wings yellowish hyaline, deeper and darker towards base. Clypeus with moderately deep punctures; frons closely, strongly and rugosely punctured; vertex strongly punctured except at shallow postocellar fovea and area towards occipital carina; mesoscutum posteriorly and scutellum almost impunctate with few sparse punctures on posterior sides; metanotum somewhat compressed medially; T1-T5 and S2-S4 with distinct punctures, the diameter of most of the punctures less than interspace.

**Male:** Size (H+M+T1+T2) 13 mm. Colour pattern is almost same as that of female except clypeus, a transverse band at lower frons and scape ventrally yellow. clypeus more elongate and the apex between two teeth slightly emarginate; antenna with the last segment hook like, almost reaches the apex of tenth antennal segment in curved position; mid femur basally emarginate; stiff and stout hairs forms spine-like structures at the apical margin of S7. Other characters almost same as in female.

**Material examined:** INDIA: West Bengal: S-24 Parganas district, Sunderbans Tiger Reserve, Gosaba, 1 ♀ & 1 ♂, 12.ix.1983, Coll. S. S. Saha & Party, NZC Regd. Nos. 13785/H3 & 13851/H3.

**Distribution:** India: Karnataka, Tamil Nadu, West Bengal. *Elsewhere:* Throughout the Oriental Region, from Iran to New Guinea, Australia, Borneo, Indonesia (Batavia, Buitenzorg, Flores, Java, Korinchi Valley, Krakatau, Sumatra), Malaysia (Malaya), Myanmar, New Guinea, Singapore, Sri Lanka, Taiwan. A questionable record from the Cape Province of the Cape of Good Hope of the Republic of South Africa.

#### 19. *Subancistrocerus sichelii*

(de Saussure, 1855)

(Image 19)

1855. *Odynerus sichelii* de Saussure, 206, male, Indes Orientales (MNHN).

1965. *Subancistrocerus sichelii* : Iwata, 105.

**Diagnosis: Female:** Size (H+M+T1+T2) 6.75

mm. Body black with pale yellowish white and brown colouration. Pale yellowish white colouration as follows: mandible towards base, a curved line on the clypeus at base, a spot between the antennae, a thick line on the scape ventrally, a small spot on the ocular sinus, a spot behind the eye on upper surface of temple, two small spots on pronotum dorsally, rarely two spots on tegula, parategula, a small spot on pointed apical lamella of sub marginal carina of propodeum, a transverse band on the apical margin of the T1, a slightly broader band on the apical margin of T2 and S2. Brown colouration as follows: mandible except basal area, pedicel and flagellar segments ventrally; wings hyaline. Clypeus with moderately deep punctures; frons closely, strongly and rugosely punctured; anterior face of pronotum with two close set but well separated deeply impressed fovea at middle; T1 with two transverse carinae, both carinae close together at crest of declivity, the space between them laterally depressed, smooth, shining and marked with stout keels, both carinae strongly pronounced.

**Material examined:** INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Birajnagar, 1 ♀, 5.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14642/H3.

**Distribution:** India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Karnataka, Maharashtra, Meghalaya, Odisha, Sikkim, Tripura, Uttarakhand, West Bengal. *Elsewhere:* Bangladesh, Myanmar, Sri Lanka, Thailand.

**Remarks:** It is the first record of this species from Sunderbans Biosphere Reserve.

#### 20. *Xenorhynchium nitidulum*

(Fabricius, 1798)

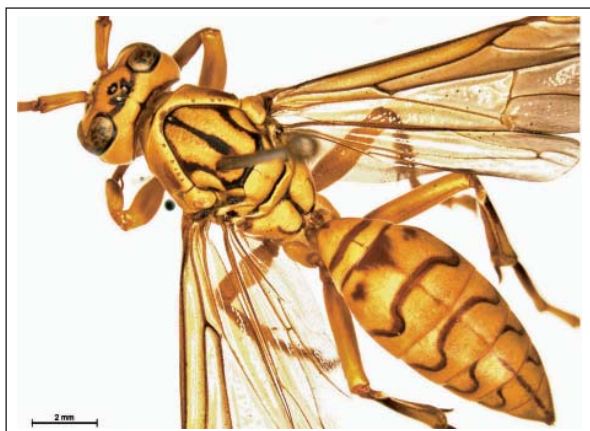
(Image 20)

1798. *Vespa nitidula* Fabricius, 262, Syntype, sex not mentioned, India Orientalis (ZMUK).

1963. *Xenorhynchium nitidulum*: Vecht, 111.

**Diagnosis: Male:** Size (H+M+T1+T2) 14-15 mm. Black except base of clypeus and ventral side of scape whitish yellow, all flagellar segments

PLATE 1



1. *Polistes (Gyrostoma) olivaceus* (De Geer) ♀



2. *Polistes (Polistella) stigma tamula* (Fabricius) ♀



3. *Ropalidia brevita* Das & Gupta ♀



4. *Ropalidia cyathiformis* (Fabricius) ♀



5. *Ropalidia jacobsoni* (Du Buysson) ♀



6. *Vespa affinis affinis* (Linnaeus) ♀

## PLATE 2

7. *Vespa tropica haematodes* Bequaert ♀8. *Allorhynchium argentatum* (Fabricius) ♂9. *Allorhynchium metallicum* (de Saussure) ♀10. *Anterhynchium* (A.) *abdominale abdominale* (Illiger) ♂11. *Antodynerus flavescens flavescens* (Fabricius) ♀12. *Delta conoideum* (Gmelin) ♀

PLATE 3



13. *Delta esuriens* (Fabricius) ♀



14. *Delta pyriforme pyriforme* (Fabricius) ♀



15. *Oreumenoides edwardsii* (De Saussure) ♂



16. *Rhynchium brunneum brunneum* (Fabricius) ♀



17. *Rhynchium carnaticum* (Fabricius) ♀



18. *Rhynchium haemorrhoidale haemorrhoidale* (Fabricius) ♂

## PLATE 4

19. *Subancistrocerus sichelii* (De Saussure) ♀20. *Xenorhynchium nitidulum* (Fabricius) ♂21. Nest of *Ropalidia brevitarsis* Das & Gupta22. Nest of *Ropalidia cyathiformis* (Fabricius)23. Nest of *Ropalidia jacobsoni* (du Buysson)24. Nest of *Vespa affinis affinis* (Linnaeus)

brown ventrally, lower part of ocular sinus brown; antennal hook long and curved, somewhat dilated and flattened in apical half, with rounded apex, in curved position it almost reaches the apex of ninth antennal segment; metanotum strongly raised above the level of adjoining areas of propodeum, the flattened dorsal surface approximately rectangular and about as long as the vertically slopping posterior surface; propodeum with prominent lateral angles, the concave declivity rather sharply separated from dorsal and lateral areas; S7 rather strongly excavated, the concave area finely, granulately punctate and bordered by an arcuate and blunt ridge; parameral spine elongate.

*Material examined:* INDIA: West Bengal, S-24 Parganas district, Sunderbans Biosphere Reserve, Birajnagar, 2♂, 5.viii.2013, Coll. Gaurav Sharma & Party, NZC Regd. No. 14643/H3 & 14644/H3.

*Distribution:* India: Andhra Pradesh, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Maharashtra,

Odisha, Pondicherry, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal. *Elsewhere:* Pakistan.

*Remarks:* It is the first record of this species from Sunderbans Biosphere Reserve.

### SUMMARY

The present paper includes the systematic account of the family Vespidae from Sunderbans Biosphere Reserve. It consists of 20 species belonging to 11 genera and 3 subfamilies. Out of these, 2 species are newly recorded here from West Bengal and 11 species are newly recorded here from Sunderbans Biosphere Reserve.

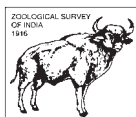
### ACKNOWLEDGEMENTS

The authors are grateful to Dr. K. Venkataraman, Director, Zoological Survey of India, Kolkata and Dr. Kailash Chandra, Scientist-F & Divisional-in-Charge of Entomology Division (A), Zoological Survey of India, Kolkata for providing facilities and encouragements.

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## LEECH FAUNA OF BIBHUTI BHUSAN NATIONAL PARK, WEST BENGAL INDIA

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### INTRODUCTION

Bibhuti Bhusan National Park (Latitude 22° 11' 16" North to 23° 15' 12" North and Longitude 88° 20' East) is situated in the district of North 24 Parganas, West Bengal. Previously it was named as Parmadan Park. Principally it is a deer park. But most of other faunas are found in this park. There is a canal just outside border of the park. Medicinal plants and different types of trees of this park attract the people. So, fascinating beauties of the flora and fauna of the area lure the travelling loving people of India. These aquatic and terrestrial faunas are not only for the common people but also for the scientists. Aquatic and terrestrial Leech fauna of this National Park attract the Taxonomists very much.

Throughout the world, 700 species of leeches are sustaining with 64 species occurring in India, out of 30 species of leeches in West Bengal, only 9 species are recorded from North 24 Parganas (Mandal, 2010). In a comprehensive account of the leech fauna of India, Harding and Moore (1927) recorded most of the leeches of India. Soota, and Ghosh (1977) worked on leeches of India. Ghosh (1998) found 18 leech species from West Bengal. There was no collection from Bibhutibhusan Park in North 24 Parganas district before this survey. The present work records 6 leeches from the park area. One species, *Placobdella fulva* is recorded here for the first time from this district. The species was previously recorded from Purulia, Calcutta,

Howrah, Midnapur, Bankura, South 24 Parganas, Nadia, Murshidabad, Jalpaiguri (Mandal, 2010).

### MATERIAL AND METHODS

In course of survey almost all niches are taken into consideration to find out the leech individuals occurring in the habitat/ ecosystem. In case of free-living species 5 sites from a selected ecosystem (water body) are taken into consideration to note the number of leeches occurring in the system. From each site/station an area of 30<sup>2</sup> cm has been selected at random and the numbers of leeches occurring there are counted. The mean of such five readings are considered for actual population density per 30<sup>2</sup> cm which is computed into no/m<sup>2</sup>. In case of parasitic and malacophagous leeches, attempt is made to note the number of leeches attached with the host body. In such case five or more host individuals are taken into account at random and mean would be considered for population density of this external parasite per host. The malacophagous leeches are counted on the basis of samplings of pelagic molluscs from an area of 30<sup>2</sup> cm from the concerned water body. Also in this case five such samplings are taken and the leeches attached/infested with snails are counted and mean of the five readings were considered for the final data. Preserved samples were sorted very carefully using binocular microscope. After the collection, the material was washed in fresh water and then allowed to relax in water by slowly mixing many drops of 70%

alcohol at frequent intervals for about 2 hours to avoid twisting or breaking of the specimens and then transferred to 70% alcohol for preservation. All the specimens are deposited with National Zoological collections of Z.S.I., Kolkata.

### SYSTEMATIC ACCOUNT

Phylum ANNELIDA

Class HIRUDINEA

Order RHYNCHOBDELLAE

I. Family GLOSSIPHONIDAE

1. Genus *Glossiphonia* Johanson, 1816

*Glossiphonia weberi* Blanchard, 1897

2. Genus *Hemiclepsis* Vejdovsky, 1883.

*Hemiclepsis marginata asiatica* Moore, 1924.

3. Genus *Placobdella* Blanchard, 1893

\* *Placobdella fulva* Harding, 1920.

Order ARHYNCHOBDELLAE

II. Family ERPOBDELLIDAE

4. Genus *Herpobdelloidea* Kaburaki, 1921.

*Herpobdelloidea lateroculata* Kaburaki, 1921

5. Genus *Nematobdella* Kaburaki, 1921

*Nematobdella indica* Kaburaki, 1921

III. Family HAEMADIPSIDAE

6. Genus *Haemadipsa* Tennent, 1859.

*Haemadipsa sylvestris* Balanchard, 1894.

### Diagnostic characters of family Glossiphonidae

Mouth is a small pore on the oral sucker from which proboscis may be protruded; jaws absent; blood colourless. Mouth large, occupying entire cavity of the oral sucker; Proboscis absent; blood is red. Body ovate, flattened; anterior sucker ventrally fixed and fused with the body; posterior sucker cupuliform, distinct from rest of the body; eyes confined to head; three annuli per mid-body segment; gastric caeca present. Dorsoventrally flattened leeches confined to fresh-water; anterior sucker ventral and fused with the body while posterior sucker cupuliform; crop with paired lateral caeca; intestine always with four pairs.

***Glossiphonia weberi*** Blanchard, 1897

*Material examined:* 2 exs., Bibhutibhushan Park, District 24 Parganas (N), West Bengal, 18.12.2008, Coll: C. K. Mandal, Reg.No. An 3729/1.

*Diagnostic character:* Body is ovate-acuminate. It is triangular in contraction. Larger form of this species, commonly called as bitten rice or Sumatra leech, attains a length of about 12 mm, general colour varies from grayish-white to light orange but usually white in preserved state; five longitudinal rows of dark brown spots; dorsal surface bears seven longitudinal rows of prominent papillae. Dorsal surface is rough due to the presence of tubercles on every ring. Eyes are three pairs on rings 6, 7 and 8; male and female genital ducts open by a common pore between rings 27/28; rings 70; mouth opens within the anterior sucker; crop with six pairs of sublobate lateral caeca, the last and the longest pair reflected posteriorly.

*Distribution:* India: Widely distributed throughout India. Outside India: Pakistan, Nepal, Myanmar and Sumatra.

Genus ***Hemiclepsis*** Vejdovsky, 1883

*Diagnostic characters:* Size medium with two pairs of eyes; complete somite formed of three rings; head region distinct from rest of the body; crop with more than seven pairs of lateral diverticula; mouth opens within anterior sucker.

***Hemiclepsis marginata asiatica***  
Moore, 1924

*Material examined:* 2 exs., Canal of Bibhutibhushan Park, District 24 Parganas (N), West Bengal, 18.12.2008. Coll: C K. Mandal, Reg. No. An 3730/1.

*Diagnostic characters:* Body of the improporportioned eyed leech (common name) is translucent, attains a length of about 16 mm and the greatest width of about 6 mm; head region dilated and distinct from rest of the body. Colour reddish brown but generally white in preserved state; transverse stripes broken, pale- yellow in colour found on the dorsal surface; eyes two pairs on rings 3 and 4 but the anterior pair very minute; male and female pores

open between rings 29/30 and 31/32 respectively; crop with eleven pairs of lateral diverticula; somite III is uniannulate.



*Hemiclepsis marginata asiatica* (Dorsal)

**Distribution:** India: Himachal Pradesh; Jammu and Kashmir; Meghalaya; Uttar Pradesh and West Bengal. Outside India: Canada; U.S.A; Paraguay; Andes; and western Asia.

Genus *Placobdella* Blanchard, 1893

**Diagnostic characters:** Body is flattened. One pair of eyes; anterior sucker imperforate and mouth opens upon its anterior ring, crop with seven pairs of branching diverticula.

*Placobdella fulva* Harding, 1920.

**Material examined:** 1 ex., Canal of Bibhutibhushan Park, District 24 Parganas (N), West Bengal, 18.12.2008, Coll: C. K. Mandal, Reg. No. An 3731/1.

**Diagnostic characters:** Body flattened but very slender anteriorly, head region continuous with the body; upper surface bright reddish-yellow but ventral surface white; each ring bears a large median papilla while middle ring of each somite bears on an intermediate and a marginal pair of papillae; rings 67: eyes one pair on ring 2, male and female pores open between rings 26/27 and 28/29 respectively.



*Placobdella fulva* (Dorsal)



*Placobdella fulva* (Ventral)

**Distribution:** India: Rajasthan; Bihar and West Bengal. Outside India: Java Sumatra.

#### **Diagnostic characters of family Erpobdellidae**

First pair of eyes on III or on IV, gonopores separated by three to five annuli.

*Nematobdella indica* Kaburaki, 1921

**Material examined:** 1 ex., Canal of Bibhutibhushan Park, District 24 Parganas (N), West Bengal, 18.12.2008, Coll: C. K. Mandal, Reg. No. An 3732/1.

**Diagnostic characters:** Larger forms attain a length of about 20 mm and width about 3 mm; form very slender, attenuated anteriorly; colour bright buff when alive but fades away in preserved state; eyes six pairs, the first pair larger and dorsal on somite III, remaining five pairs smaller, submarginal on somites V to XI; gonopores separated by five annuli.



*Nematobdella indica* (Dorsoventral)

**Distribution:** West Bengal; Himachal Pradesh; Madhya Pradesh; Rajasthan; Uttar Pradesh; Punjab, and Maharashtra.

Genus *Herpobdelloidea* Kaburaki, 1921

**Diagnostic characters:** Eyes one pair on head and five pairs on somites IV to IX; gonopores separated by five annuli.

*Herpobdelloidea lateroculata* Kaburaki, 1921

**Material examined:** 2 exs., Canal by the side of Bibhutibhushan Park, District 24 Parganas (N), West Bengal, 18.12.2008, Coll: C. K. Mandal, Reg. No. An 3733/1.

**Diagnostic characters:** Larger forms attain a length of about 27 mm and width of about 3 mm; form very slender, attenuated anteriorly; colour pale buff when alive but generally white in preserved state; eyes five or six pairs, the first pair larger and dorsal on somite IV; the remaining submarginal on somites V to VIII; gonopores separated by two and one-half to three annuli.

**Distribution:** India: Manipur; Assam; Rajasthan; Madhya Pradesh; Maharashtra; Odisha and West Bengal.

#### **Diagnostic characters of family Haemadipsidae:**

All the species are terrestrial; five pair of eyes

and gonopores usually separated by five annuli, jaws is three, teeth acute.

Genus *Haemadipsa* Tennent, 1859

**Diagnostic characters:** Third and fourth pair of eyes usually on continuous annuli, auricle present.

*Haemadipsa sylvestris* Blanchard, 1894

**Material examined:** 2 exs., Bushes of Bibhutibhushan Park, District 24 Parganas (N), West Bengal, 18.12.2008, Coll: C. K. Mandal, Reg.No. An 3734/1.



*Haemadipsa sylvestris* (Dorsal)



*Haemadipsa sylvestris* (Ventral)

**Diagnostic characters:** This species of leech is called 'the largest and robust land leech of India. Colour is plain yellow, with three dark brown stripes. The median line is narrower. Marginal stripes are bright yellowish orange. Number of sucker rays varying between 69 and 80. Prehensile papillae are little developed. Furrow pits are five pairs on VIII to XII.

**Distribution:** India: West Bengal; Sikkim; Assam; Arunachal Pradesh; Andaman and Nicobar Island; Meghalaya and Uttar Pradesh. Outside India: Myanmar, Java and Sumatra.

### SUMMARY

6 species of leeches under 6 genera and 3 families collected from Bibhutibhushan Park are

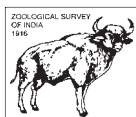
described. Out of six, one species is reported for the first time from this District. The total number of leech species reported from 24 Parganas (North) district of West Bengal so far has reached 10.

### ACKNOWLEDGEMENTS

We express our most sincere thanks to Dr. Venkataraman, Director Z.S.I. for kindly providing laboratory facilities to carryout the work on Hirudinea. We also express our deep sense of gratitude to Mr. K. C. Gopi, Scientist E, Dr. B.H. C. K. Murthy, Scientist C and Dr. J. G. Pattanayak, Scientist B Zoological Survey of India 'for their valuable guidance, advice and sustained interest throughout the course of this investigation.

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## OBSERVATIONS ON INDIAN HARE OR BLACK -NAPED HARE (*LEPUS NIGRICOLLIS* F. CUVIER, 1823) IN AND AROUND TROPICAL FOREST RESEARCH INSTITUTE, CAMPUS, JABALPUR, MADHYA PRADESH

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### INTRODUCTION

The Tropical Forest Research Institute (TFRI), Jabalpur is one of the nine institutes under the Indian Council of Forestry Research & Education (ICFRE), Dehra Dun. It lies at the bank of the Gour River on Mandla Road (79°59'23.50°E and 21°08'54.30°N) about 10 km south east of Jabalpur. The campus is spread over an area of 109 ha amidst picture-sque surroundings. The area enjoys semi-arid type of climate with mean annual precipitation of 1358 mm. The more than 57 shrub and tree species are either planted or naturally occur in the institute. The TFRI has several forest nurseries, experimental fields and plantations sites. The campus is surrounded by agricultural field with rural inhabitation. The water reservoir and the vegetation planted around the institute have created a very good habitat and source of attraction for many faunal species like insects, reptiles, birds and mammals. Recent years, several species of insects, amphibian, reptiles, birds and mammals were reported from TFRI Campus (Paunikar, 2011; Tiple *et al.*, 2010, 2012).

Among the several wild animals found in and around the TFRI Campus, Indian Hare is one of them. The Indian Hare or Black- Naped Hare (*Lepus nigricollis*, F. Cuvier, 1823) is small mammal belongs to order- Lagomorpha, Family- Leporidae (Hares). The order Lagomorpha is represented by 13 genera and 93 species belonging to 3 families (Ochotonidae, Leporidae, and

Prolagidae) in the world. The family Leporidae (hares, rabbits, and jackrabbits) is composed of 11 genera and 61 species. The genus *Lepus* L., 1758 is represented by 32 species in the world (Wilson and Reeder, 2005). The 14 species of Lagomorphs belong to three genera in two families, Leporidae, Fishcher 1817 (with five species in two genera) and Ochotonidae Thomas, 1897 (with nine species with one genus) known to occur in south Asia (Srinivasulu *et al.*, 2004). It is large grayish-brown animal with long well developed ears and short tail. The hind legs are strong, elongated for speedy bounding gait while running.

They are most common herbivorous small mammal's species of Indian subcontinent. It is found mainly South Asian countries like India, Sri Lanka, Nepal, Bangladesh and Pakistan (Prater, 1965; Alfred *et al.*, 2002, 2006; Pradhan and Talmale, 2012). In India, they are found all places from foothills of Himalaya to Western Ghats and from Thar Desert of Rajasthan to north-east regions of the country (Srinivasulu and Srinivasulu 2012; Sharma *et al.*, 2013). In Madhya Pradesh, they are found in national parks, wild life sanctuaries, biosphere reserves, protected, unprotected forest areas and agricultural fields (Harshey and Chandra 2002; Chandra 2006; Paunikar 2010).

The Indian hare is important member of food chain as a prey of numbers of predators like big cats, Lion, Tiger, Cheetah, Leopards and many small cats. They are also the prey of dog family

members like Jackal, Fox, Dog and others big and small carnivorous animals and predatory birds like Hawks and Eagles (Kirk and Racey, 1992). They are also recognized vertebrate pests of many forestry, agricultural and plantations crops (Hussain *et al.*, 1991; Joyson, 1999).

### MATERIAL AND METHODS

The regular survey of Indian hare on its activities were conducted in forest nurseries, plantations sites, experimental and agricultural fields in and around the TFRI, campus throughout years in 2011 and 2012 by pair of Binoculars 10X50. The observations were taken, whenever sighted hare in the field on their different activities like feeding habits, damage potential to seedlings/saplings, breeding areas and behavior during the presence of predators and hunters were also made in day and night. Each record in the field was photographed by Nikon. Coolpix L 100 (Wide 15 x Optical Zoom).

### OBSERVATION AND DISCUSSION

The Indian hare are one of most common small mammal's species of the TFRI campus after Squirrel, *Funambulus pennanti* and Mongoose *Herpestes edwardsii* (Paunekar 2010). It was observed that they are mostly active at forest nurseries as compared to experimental fields and plantations site due to sowing, germinated seeds, small seedling plants and grasses, where they easily reached and feed. It was observed that they are mostly feeds on the germinated seeds and soft leaves of seedlings of different forest trees species like, Bamboo sp., *Dalbergia latifolia*, *Dalbergia sissoo*, *Delonix regia*, *Moringa oliefera* *Cassia* spp., *Albizia* spp., *Terminalia* spp., etc and medicinal plants like *Asparagus recemosus*, *Annona squamosa*, *Emblica officinalis* *Withania somnifera*, *Gloriosa superba*, *Andrographis paniculata*, *Ranwolfia serpentine*. They caused extensive damage to sowing and germinated seeds, forest tree species, medicinal plants and green vegetations. They were also found surrounding

agricultural fields and near Gour River and mostly feeds on agricultural crops, vegetables and other waste materials of the fields. They cut the seedlings/saplings from the root by their longer incisor and ultimately the plant die. Due to their cutting habitat caused heavy damage to planting stocks of the nursery.

There are several hiding places like slopes, holes near walls and big trees and dense vegetation in and around TFRI campus. These places are used by Indian hare for the breeding purpose and breeds throughout year in the areas. Wherever, the Hare is coming out from their hiding places to search the food in and around the campus. They were always beware after coming out the open areas to their predators. They carefully watched surrounding areas if and no one found, they go for feeding.

In the campus there are several natural enemies of the hare. Their main predators and hunters are Indian Jackal (*Canis aureus indicus*), Jungle cat (*Felis chaus*) and local dogs (*Canis lupus familiaris*). When their hunters and predators and human (*Homo sapiens*) passing through their hiding places or sightings anywhere in and around campus, they suddenly running very fast towards the dense vegetations to took shelter and escaped from hunters and predators. They took shelter in the dense and dried vegetation of the campus, once they entered in the dense vegetations; they were not easily spotted due to their body colour matches with surrounding grasses and vegetations. It was also observed several times, if the dense vegetations were not found by Hispid Hare to nearby areas, they took shelters dried grasses or under trees and remained in standing position in their strong hind. During the period they shiver due to presence of their hunters and predators and they relaxed after their enemies going away from those places on legs (Figs. 1 & 2).

Recent years, it was observed that the population of Indian Hare is declining in and around TFRI campus due to overhunting by their predators,



**Fig. 1.** The Indian Hare shivering due to presence of predator nearby area.



**Fig. 2.** The Indian Hare relaxed position after predators moves on other side.

rapid urbanization, destruction of habitat, dense forest areas and grassland ultimately reducing their feeding and breeding ground in the areas. It is needed to save the species by taking all possible control measures.

### SUMMARY

The Indian hare, *Lepus nigricollis* is one of the most common species of Indian subcontinents. They are most important member of food chain as a prey of number of carnivorous animals. The detailed activities Indian hare were observed in and around Tropical Forest Research Institute, campus, Jabalpur during 2011 and 2012. They are found in forest nurseries, plantation sites, experimental and agricultural fields. They caused extensive damage to nursery stock, other forest tree species and medical plants. Their feeding habits, damage potential to seedlings/saplings, breeding areas and behavior during the presence of predators and hunters were also observed in and around TFRI, Campus, Jabalpur.

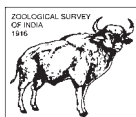
### ACKNOWLEDGMENTS

The author is thankful to Dr. Kailash Chandra, Scientist-‘F’ Zoological Survey of India, Kolkata, for identification of the species and provided the literature.

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## NEW RECORDS OF THRIPS (THYSANOPTERA, TEREBRANTIA, THIRIPIDAE) FROM HIMACHAL PRADESH, INDIA

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### INTRODUCTION

Thrips are very small, fringed insect and belonging to the order Thysanoptera. The order Thysanoptera includes approximately 3500 species of Terebrantia reported across globally (ThripsWiki, 2014). The suborder Terebrantia represented by 290 species of 124 genera in Indian sub-region, of which 29 species are reported from Himachal Pradesh (Bhatti 1990). During the recent surveys in 2012-13 of Himachal Pradesh, 13 species of thrips have been identified and are being added to the fauna of state for the first time. All these new records are belong to subfamily Thripinae of family Thripidae of suborder Terebrantia. The species are *Anaphothrips sudanensis* (Trybom), *Bathrips melanicornis* (Shumsher), *Dendrothripoides innoxious* Karny, *Microcephalothrips abdominalis* D.L. Crawford, *Scirtothrips dorsalis* Hood, *Scirtothrips mangiferae* Priesner, *Stenchaetothrips bambusae* (Shumsher), *Thrips alatus* Bhatti, *Thrips apicatus* Priesner, *Thrips florum* Schmutz, *Thrips hawaiiensis* (Morgan), *Thrips palmi* Karny and *Thrips subnudula* (Karny). Diagnostic features, distribution details, material studied, and registration number as recorded on each slide mounted specimen housed at Zoological Survey of India in National Zoological Collections (NZC), Kolkata are also provided.

Specimens collected by beating method were preserved in collecting fluid (9 parts 10% alcohol + 1 part glacial acetic acid + 1 ml Triton X-100 in 1000ml

of the mixture) and mounted on to the glass slides in Canada balsam (Bhatti 1999). The photographs were taken through a Leica Trinocular Microscope (Leica DM-1000) and using Leica software application suite (LAS EZ 2.1.0). All the species are listed with their valid names, authority and the year of description. Species are listed systematically and alphabetically.

#### 1. *Anaphothrips sudanensis* Trybom (Figs. 1-2)

1911. *Anaphothrips sudanensis* Trybom: 1.

Female (Macropterous and brachypterous). Body bicoloured, mainly brown except prothorax and abdominal segments III-V yellow. Legs yellow except femora and tibiae. Fore wing transparent except light brown band between basal  $\frac{1}{4}$  to about middle. Antenna 8-segmented, III and IV with forked sense cones. Head wider than long; with 3 pair of ocellar setae; postocular setae uniserial. Pronotum about as long as head, without any prominent setae. Abdominal tergites III to VIII without sculpture at middle.

Male (Brachypterous). Body unicoloured or bicoloured. Ocelli absent. Tergite IX with 2 pairs of stout spindle shaped setae on tuberculated bases. Abdominal sternites III-VII each with a C-shaped pore area.

*Material studied:* 1 ♀, Himachal Pradesh: Govindsagar, Chilli leaves, 18.xi.2012, (Reg. No. 5957/H17), Vikas & Kaomud.

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**Distribution:** India: Delhi, Himachal Pradesh (new record), Karnataka, Meghalaya, Punjab, Sikkim, West Bengal. *Elsewhere:* Bangladesh, Sri Lanka, Taiwan.

## 2. *Bathrips melanicornis* (Shumsher)

(Fig. 3-4)

1946. *Taeniothrips melanicornis* Shumsher: 179-181.

1962. *Bathrips melanicornis* (Shumsher); Bhatti: 34-35.

Both sexes macropterous. Body pale with dominant grey patches near to ocellar area, posterior margin of head, two longitudinal patches on pronotum, macrotergite, anterior half of pronotum, abdominal tergites II to VII with dwarf T-shaped patch covering the entire anterior half of tergite. Antennae and fore wing dark. Antennal segments III and IV with forked sense cones; fore wing lower vein with 4 setae, posterior fringes wavy. Abdominal tergites and sternites without craspedum. Male abdominal sternites VII with a single pore area.

**Material studied:** 5 ♀, 2 ♂, Himachal Pradesh: Kangra, *Brassica campestris*, 20.xi.2012; 1 ♀, from Pinkish white flowers of unidentified tree, 22.xi.2012, (Reg. No. 5181/H17-5188/H17); 1 ♀, Chamba, *Cassia fistula* flowers, 6 ♀, 2 ♂, Kangra, from hedge; 1 ♀, 1 ♂, Mandi, general vegetation, 17.x.2013; 2 ♀, *Arundo donax*, 16.x.2013; 6 ♀, 3 ♂, Chamba, general vegetation, 10.x.2013 (Reg. No. 5719/H17-5742/H17), Vikas & Kaomud.

**Distribution:** India: Andhra Pradesh, Delhi, Himachal Pradesh (new record), Karnataka, Madhya Pradesh, Punjab, Tamil Nadu, West Bengal. *Elsewhere:* Burma, Indonesia, Taiwan.

## 3. *Dendrothripoides innoxius* Karny

(Figs. 5-6)

1914. *Euthrips innoxius* Karny: 359-360.

1978. *Dendrothripoides innoxius* (Karny); Bhatti: 10.

Both sexes macropterous. Body pale yellow, including legs. Antennal segment I-V yellow, VI yellow proximally and brown distally, VII-VIII light brown. Body setae pale. Fore wing with 2 brown cross bands. Pronotum with one pair of seta at its posterior angle. Abdominal tergites VI to VII with median pair of large,

sigmoidal setae. Male abdominal tergite IX with a posterolateral expanded setae on each side and abdominal sternites III to VII each with a small linear anteromedian glandular area.

**Material studied:** 2 ♀, 1 ♂, India, Himachal Pradesh: Mandi, general vegetation, 17.x.2013, (5756/H17 to 5758/H17), Vikas & Kaomud.

**Distribution:** India: Delhi, Himachal Pradesh (new record), Karnataka. *Elsewhere:* Nepal, Bangladesh, Burma, Brazil, Malaya, Indonesia, Hong Kong, Taiwan, Philippines, Japan, Australia, Australia, Vanuatu, Fiji, Hawaii, Central and South America, West Indies.

## 4. *Microcephalothrips abdominalis*

D. L. Crawford

(Figs. 7-8)

1910. *Thrips abdominalis* D. L. Crawford: 157-159.

1926. *Microcephalothrips abdominalis* (Crawford); Bagnall: 113-114.

Both sexes macropterous. Body brown including legs. Antennae 7-segmented; segment II without microtrichia, III and IV with forked sense cones. Frontal surface smooth; basantra with two sclerotized plates and with 5-7 setae. Abdominal tergites I-VIII with large pointed triangular teeth at their posterior margin. Abdominal sternites III to VII of male with pore area.

**Material Studied:** 5 ♀, 1 ♂, India, Himachal Pradesh: Mandi, *Arundo donax*, 16-17.x.2013; 5 ♀, 5 ♂, Solan, *Solidago* sp. 19.x.2013, (5812/H17 to 5827/H17), Vikas & Kaomud

**Distribution:** India: Arunachal Pradesh, Delhi, Himachal Pradesh (new record), Karnataka, Meghalaya, Punjab, West Bengal. *Elsewhere:* Bangladesh, Indonesia, Philippines, China, Taiwan, Japan, Pacific Islands, Australia, North America, Central America, Argentina, Egypt.

## 5. *Scirtothrips dorsalis* Hood

(Fig. 9)

1919. *Scirtothrips dorsalis* Hood: 90-91.

Both sexes macropterous. Body pale yellow. Abdominal tergites with median dark patch. Tergites and sternites with dark antecostal ridges.

Head with two pairs of major median postocular setae; ocellar setae III situated between hind ocelli. Antenna 8-segmented. Metanotum medially with elongate reticles or striations, arcuate in anterior third, median setae not at anterior margin. Tergites with dark transverse antecostal ridge, also dark area occupying median third of tergites. Sternites IV to VI with numerous microtrichia. Tergite IX of male without drepanae.

**Material Studied:** 6 ♀, India: Himachal Pradesh, Kangra, *Euphorbia*, 14.xi.2012 (5324/H17-5327/H17, 5661/H17, 5279/H17); 2 ♀, Mandi, general vegetation, 17.x.2013 (5744/H17-5745/H17); 1 ♀, Chamba, unidentified plant, 12.x.2013 (5743/H17); 17 ♀, 1 ♂, Govindsagar, *Ricinus Communis*, 18.xi.2012; 1 ♀, chilli leaves, 18.xi.2012, (5217/H17-5235/H17); 5 ♀, 3 ♂, Kangra, *Mimosa pudica*, 14.x.2013 (5747/H17-5753/H17); 1 ♀, Bilaspur, unidentified tree, 18.xi.2012 (5244/H17), Vikas & Kaomud.

**Distribution:** India: Andhra Pradesh, Assam, Delhi, Gujarat, Himachal Pradesh (new record), Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. **Elsewhere:** Pakistan, Bangladesh, Thailand, Sri Lanka, Sulawesi, Malaya, Indonesia, Taiwan, Japan, Korea, Philippines, Solomon Islands, New Guinea, Australia, South Africa.

#### 6. *Scirtothrips mangiferae* Priesner (Fig. 10)

1932. *Scirtothrips mangiferae* Priesner: 143-145.

Both sexes macropterous. Body pale. Head with two pairs of major median postocular setae; ocellar setae III situated in line with anterior margin of hind ocelli. Antenna 8-segmented. Metanotum with reticulate sculpture; median pair of setae short, inserted along the anterior margin. Fore wing posterior fringe hairs wavy. Tergites VIII and IX with microtrichia medially. Sternites without microtrichia mesad of seta S2. Tergite IX of male with drepanae.

**Material Studied:** 4 ♀, India: Himachal Pradesh, Mandi, Unidentified plant, 15.x.2013 (5754/

H17-5755/H17, 5709/H17, 5718/H17), Vikas & Kaomud.

**Distribution:** India: Delhi, Himachal Pradesh (new record), Karnataka, Madhya Pradesh. **Elsewhere:** Egypt, Middle East, Eastern Africa.

#### 7. *Stenchaetothrips bambusae* (Shumsher) (Figs. 11-12)

1946. *Thrips bambusae* Shumsher: 182-183.

1981. *Stenchaetothrips bambusae* (Shumsher); Bhatti & Mound: 14.

Both sexes macropterous. Body brown; proximal ¼ of fore wing unshaded; Tibiae yellow. Postocular setae III longer than I.

**Material Studied:** 15 ♀, 2 ♂, Himachal Pradesh, Govindsagar, bamboo leaves, 18.xi.2012; 1 ♀, 1 ♂, Bilaspur, from *Ajeratum* sp., 17.xi.2012; 5 ♀, 3 ♂, Hamirpur, from Bamboo, 25.xi.2012; (5193/H17-5216/H17, 5276/H17, 5236/H17-5237/H17).

**Distribution:** India: Himachal Pradesh (new record), Maharashtra, Rajasthan, Tamil Nadu. **Elsewhere:** Myanmar, Japan.

#### 8. *Thrips alatus* Bhatti

1980. *Thrips alatus* Bhatti: 118-120.

Both sexes macropterous. Body yellow including legs and wings. Ocellar III outside the ocellar triangle. Antenna 7-segmented. Abdominal tergite II with 4 lateral marginal setae. Abdominal sternites and laterotergites without accessory setae. Comb on tergite VIII complete. Abdominal tergite III-VI of male with pore area.

**Material Studied:** 1 ♀, 1 ♂, Himachal Pradesh: Bilaspur, from *Ajeratum* sp., 17.xi.2012 (5274/H17-5275/H17), Vikas.

**Distribution:** India: Himachal Pradesh (new record), Uttar Pradesh. **Elsewhere:** Nepal.

#### 9. *Thrips apicatus* Priesner (Fig. 16)

1934. *Thrips apicatus* Priesner: 264, 286.

Both sexes macropterous. Body pale yellow except distal half of abdominal tergite X dark brown, and with median light brown spot on tergites IV-VII. Head broader than long; ocellar

setae III outside the ocellar triangle. Antenna 7-segmented. Metanotum median pair of setae inserted behind anterior margin. Abdominal sternites and laterotergites with accessory setae. Comb of posterior margin of tergite VIII absent in middle, a rudimentary comb present on sides in female and absent in male. Median pair of setae (S1) on sternite VII inserted far ahead of posterior margin. Abdominal sternites III–VII of male each with a narrow distinct pore area.

**Material Studied:** 1 ♀, Himachal Pradesh, Kangra, Hedge with violet flowers, 14.x.2013 (5489/H17), Vikas & Kaomud.

**Distribution:** India: Andhra Pradesh, Delhi, Himachal Pradesh (new record), Karnataka, Kerala, Madhya Pradesh, Tamil Nadu. **Elsewhere:** Thailand.

#### 10. *Thrips florum* Schmutz (Figs. 13-14)

1913. *Thrips florum* Schmutz: 1003.

Both sexes macropterous. Female brown and male pale yellow. Head broader than long; ocellar setae III inserted outside the ocellar triangle, or just on tangent joining the outer margin of fore and hind ocelli. Antenna 7-segmented. Mesonotum with a pair of anterior median campaniform sensilla; area around these sensilla unsculptured. Fore wing clavus with 5 setae; apical veinal seta shorter than subapical veinal seta and basal discal seta longer than apical veinal seta or subequal to it. Abdominal sternites with accessory setae. Posterior margin of abdominal tergite VIII with comb of microtrichia in female and absent in male. Abdominal sternites with accessory setae and laterotergites without accessory setae. Abdominal sternites III–VII of male each with transversely elongated pore area.

**Material Studied:** 9 ♀, India, Himachal Pradesh: Kangra, from *Euphorbia*, 14.xi.2012, (Reg. 5297/H17-5305/h17); 12 ♀, 2 ♂, white rose; 2 ♀, hedge; 12 ♀, Pumpkin, 14.x.2013; 3 ♀, General Vegetation, 10.x.2013; 3 ♀, 6 ♂, *Cassia fistula* flowers, 12.x.2013; 23 ♀, cactus flowers, 10.x.2013; 1 ♀, Mandi, Tea flowers, 13.x.2013;

1 ♀, white flowers, 16.x.2013; 4 ♀, *Arundo donax*, 16.x.2013; 6 ♀, Solan (Reg. 5542/H17-5615/H17); Kangra, 5 ♀, 1 ♂, from Creeping herb, 20.xi.2012, (Reg. 5206/H17-5311/H17); 4 ♀, Chamba, 10.x.2013, general vegetation, (Reg. 5277/H17-5379/H17, 5479/H17), Vikas & Kaomud.

**Distribution:** India: Delhi, Himachal Pradesh (new record), Karnataka, Odisha, Tamil Nadu. **Elsewhere:** Florida, Caribbean, Australia.

#### 11. *Thrips hawaiiensis* (Morgan) (Fig. 15)

1913. *Thrips hawaiiensis* Morgan: 3.

Both sexes macropterous. Female brown or bicoloured and male pale yellow. Head broader than long; ocellar setae III inserted outside the ocellar triangle, much stouter and longer than any other dorsal head setae. Antenna 7- or 8-segmented. Mesonotum with a pair of anterior median campaniform sensilla; area around these sensilla transversely sculptured. Fore wing clavus with 5 setae on anal vein; apical veinal seta longer than subapical veinal seta and basal discal seta shorter than apical veinal seta. Abdominal sternites with accessory setae. Laterotergites without accessory setae. Posterior margin of abdominal tergite VIII with complete comb of microtrichia in female and absent in male. Abdominal sternites III–VII of male each with transversely oblong or medially narrowed pore area.

**Material Studied:** 2 ♀, Chamba, 10.x.2013, general vegetation, (Reg. 5961/H17-5962/H17), Vikas & Kaomud.

**Distribution:** India: Delhi, Maharashtra, Himachal Pradesh (new record), Karnataka. **Elsewhere:** Jamaica, Australia.

#### 12. *Thrips palmi* Karny (Fig. 17)

1925. *Thrips palmi* Karny: 10-15.

Both sexes macropterous. Body bright golden yellow including wings and legs. Head broader than long; ocellar setae III inserted outside the ocellar triangle. Antenna 7-segmented. Mesonotum with campaniform sensilla anteriorly at middle.

Metanotum with longitudinal lines of sculpture at middle; median pair of setae inserted far back of anterior margin; companiform sensilla present. Abdominal sternites and laterotergites without accessory setae. Posterior margin of abdominal tergite VIII with complete comb of microtrichia in female and absent in male. Abdominal sternites III-VII of male each with transversely elongate pore area.

**Material Studied:** 1 ♀, 1 ♂, India: Himachal Pradesh, Govindsagar, From Brinjal Flowers, 18.xi.2012, (5140/H17-5141/H17); 4 ♀, 1 ♂, Bilaspur, mixed herb, 17.xi.2012; 1 ♀, from *Parthenium hysterophorus*, 17.xi.2012, (5143/H17-5148/H17); 1 ♀, *Eucalyptus* leaves, 17.xi.2012 (5333/H17); 6 ♀, 1 ♂, from *Ajeratum* sp., 17.xi.2012 (5269/H17-5270/H17); 1 ♀, Nangil, *Brassica campestris*, 19.xi.2012 (5330/H17); 1 ♀, Solan, general vegetation, 19.x.2013, (5342/H17); 2 ♀, Bilaspur, flowers and leaves of *Ficus racemosa*, 18.xi.2012, (5329/H17,5331/H17); 1 ♀, Kangra, creeping herb with bluish violet flowers, 20.xi.2012 (5332/H17), Vikas & Kaomud.

**Distribution:** India: Andhra Pradesh, Delhi, Himachal Pradesh (new record), Karnataka, Madhya Pradesh, Maharashtra. *Elsewhere:* Pakistan, Bangladesh, Thailand, Singapore, Malaya, Southern China, HongKong, Taiwan, Southern Japan, Indonesia, Philippines, Samoa, Wallis Island, Guam, New Caledonia, Puerto Rico, Martinique, Guadeloupe, Reunion, Sudan.

13. *Thrips subnudula* (Karny)  
(Fig. 18)

1926. *Ramaswamiahiella subnudula* Karny: 208-210.

2010. *Thrips subnudula* (Karny): Mound: 16.

Both sexes macropterous. Body pale yellow. Antennae 7-segmented. Fenna undivided. Basantra membranous. Abdominal sternites and laterotergites with accessory setae and numerous setae at their posterior margin.

**Material Studied:** 1 ♀, India: Himachal Pradesh, Mandi, *Acacia* sp., 17.x.2013, (5390/H17); 1 ♀, Solan, *Solidago* sp. 19.x.2013 (5536/H17).

**Distribution:** India: Delhi, Haryana, Himachal Pradesh (new record), Karnataka, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, West Bengal. *Elsewhere:* Bangladesh, Nigeria, Pakistan, Uganda, Sri Lanka.

## SUMMARY

Thirteen new record of Thrips belonging to the subfamily Thripinae of family Thripidae are recorded first time from the Himachal Pradesh state of India.

## ACKNOWLEDGEMENTS

The authors are grateful to our Director Dr. K. Venkataraman, Director, Zoological Survey of India for his encouragement and moral support and providing necessary facilities. We thank the editor and two referees for comments to improve the manuscript. This study is financially supported by the SERB, Department of Science & Technology through DST Young Scientist Project entitled "Molecular Systematics and Phylogeny of Economically Important Thrips (Thysanoptera: Insecta) of India" (SR/FT/LS-24/2012), to the first author.

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PLATE-I



**Fig. 1.** *Anaphothrips sudanensis*, female

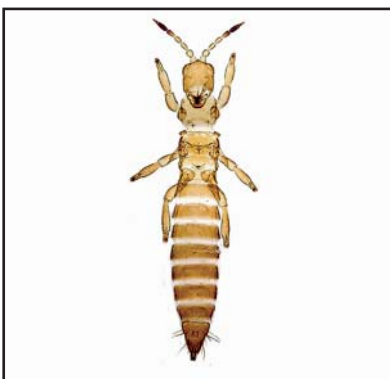


**Fig. 2.** *Anaphothrips sudanensis*, male

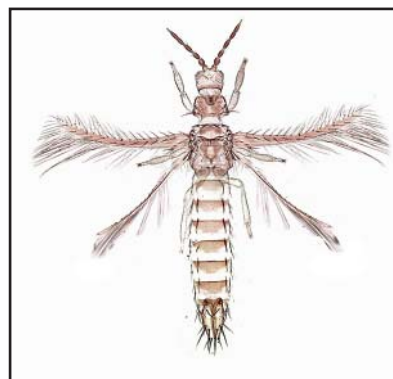


**Fig. 3.** *Bathrips melanicornis*, female

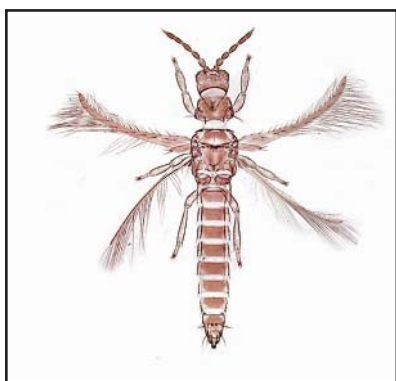


**Fig. 4.** *Bathrips melanicornis*, male

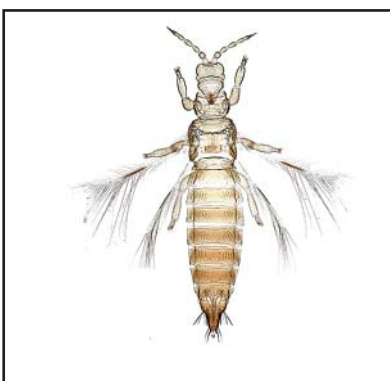


**Fig. 5.** *Dendrothripoides innoxius*, female

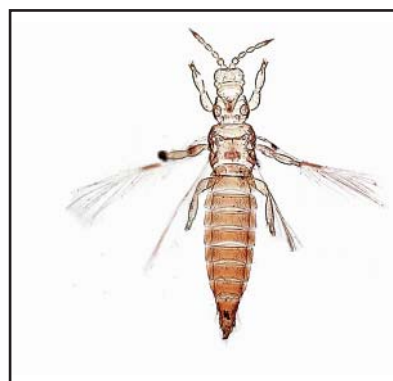


**Fig. 6.** *Dendrothripoides innoxius*, male

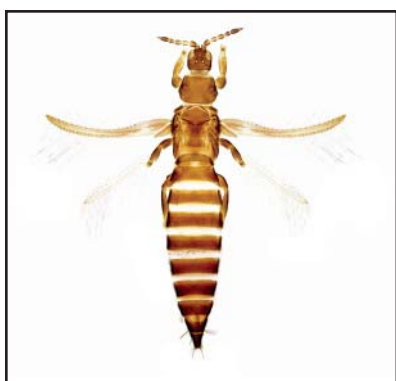


**Fig. 7.** *Microcephalothrips abdominalis*, female



**Fig. 8.** *Microcephalothrips abdominalis*, male

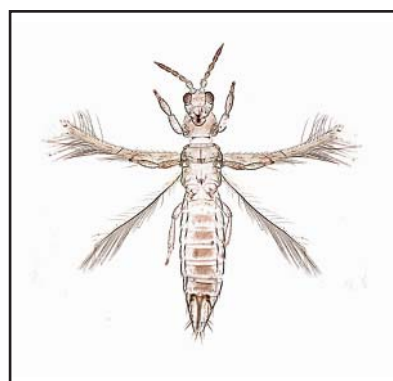


**Fig. 9.** *Scirtothrips dorsalis*, female

## PLATE-II

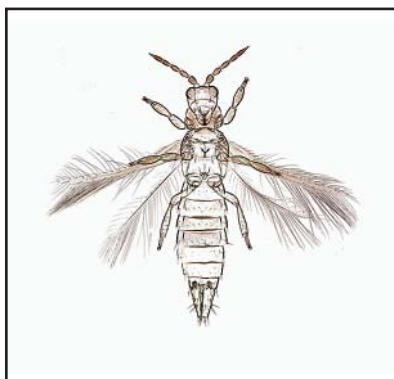


**Fig. 10.** *Scirtothrips mangiferae*, female

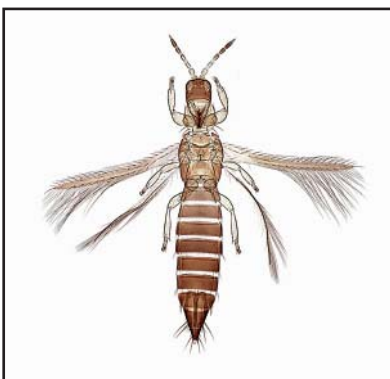


**Fig. 11.** *Stenchaetothrips bambusae*, female

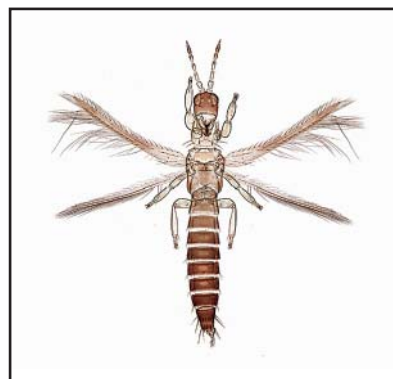


**Fig. 12.** *Stenchaetothrips bambusae*, male

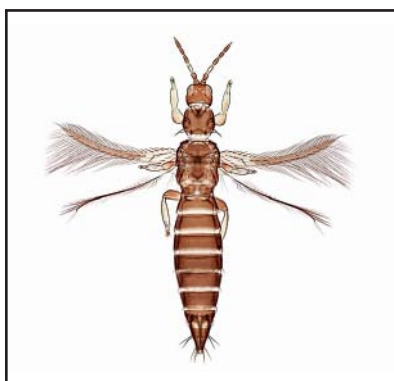


**Fig. 13.** *Thrips florum*, female

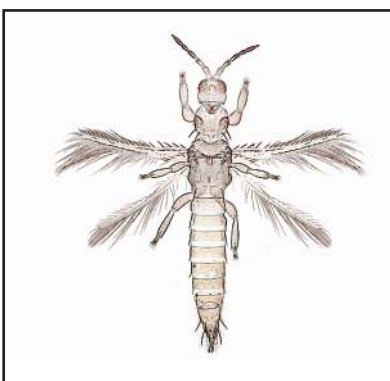


**Fig. 14.** *Thrips florum*, male

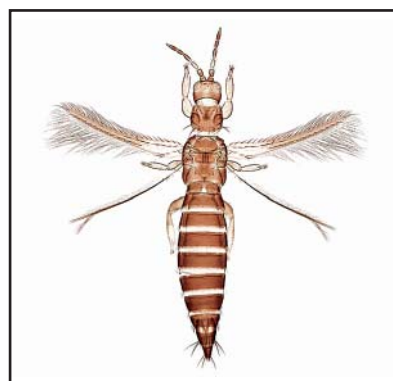


**Fig. 15.** *Thrips hawaiiensis*, female

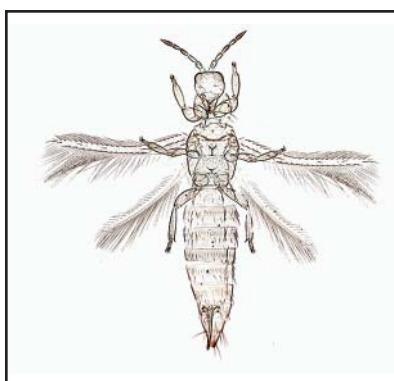


**Fig. 16.** *Thrips apicatus*, female

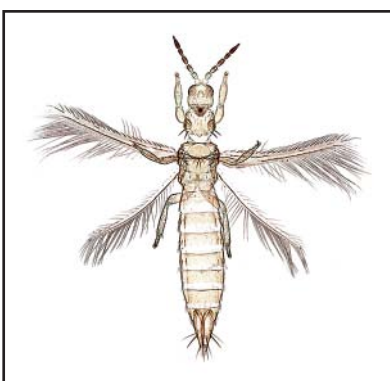


**Fig. 17.** *Thrips palmi*, female

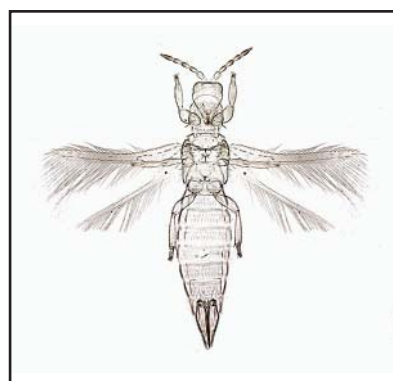


**Fig. 18.** *Thrips subnudula*, female

## NEW RECORD OF THRIPS (INSECTA: THYSANOPTERA) FROM WEST BENGAL, INDIA

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### INTRODUCTION

Thrips are fringed insects, ranging from 1 mm to 15 mm in size, belongs to the order Thysanoptera. The order Thysanoptera is subdivided into two suborders Terebrantia and Tubulifera with 9 families (Mound, Heming and Palmer, 1980). It includes approximately 6000 species across the globe (ThripsWiki, 2014), of which 700 species are reported from India (Ananthakrishnan & Sen 1980, Bhatti 1990). Thrips are one of the sucking pests of many agricultural crops and also have been reported as predators of other insects (Ananthakrishnan & Sen 1980). About 60 species of thrips have economic importance to agricultural and horticultural crops, and cause crop damage either by direct feeding or by transmission of plant pathogenic tospoviruses as vectors (German *et al.*, 1992). So far 124 species of thrips have been reported from West Bengal state of India (Sanyal *et al.*, 2012). During a recent survey (2013-2014) undertaken in West Bengal, three species of thrips have been collected and identified and are being reported here for the first time. The species are *Franklinothrips megalops* Trybom 1912 (Aeolothripidae), *Stenchaetothrips spinulae* Tyagi & Kumar 2008 (Thripidae) and *Androthrips flavitibia* Moulton 1933 (Phlaeothripidae).

### MATERIAL AND METHODS

Specimens were collected by the beating method and preserved in collecting fluid (9 parts 10% alcohol

+ 1 part glacial acetic acid + 1 ml Triton X-100 in 1000ml of the mixture) and mounted in Canada balsam (Bhatti 1999). Photographs were taken through a Leica stereo zoom Microscope (Leica DM-1000) using Leica software application suite (LAS EZ). Species were identified with the help of the keys from Ananthakrishnan & Sen (1980), Mound & Reynaud (2005) and Tyagi and Kumar (2008). Voucher specimens were deposited in the National Zoological Collections of Zoological Survey of India, Kolkata.

Suborder TEREBRANTIA

Family AEOLOTHRIPIDAE

#### 1. *Franklinothrips megalops* Trybom (Figs. 1-2)

1912. *Franklinothrips megalops* Trybom: 147.



Fig. 1. *Franklinothrips megalops*, female

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Fig. 2. *Frankliniothrips megalops*, male

**Diagnosis:** Macropterous, sexually dimorphic, ant- like appearance, bicoloured species. Female with abdominal segments I–IV pale and more or less constricted and with dark line near to anterior margin. Antennal segments III–IV exceptionally long and slender, III at least 8 times as long as wide and with elongate and sinuous or multifaceted sensoria. Head without long setae. Abdominal segment I constricted; tergites III–VI with median setal pair small and wide apart; sternites with two pairs of setae close to posterior margin and one or two pairs of discal setae laterally, tergite X with small paired trichobothria. Male smaller than female, abdomen slender.

**Material Studied:** 2♂, India: West Bengal, Kolkata, New Alipore, *Clerodendron* sp., 8.i.2014 (Reg. No. 5424/H17 to 5425/H17); 6♀, 2♂, 25.ix.2013 (Reg. No. 5428/H17 to 5435/H17), Devkant.

**Distribution:** India: Tamil Nadu, West Bengal, new record; *Elsewhere:* Bhutan.

**Comments:** *Frankliniothrips megalops* has been reported as an ant-mimicking obligate predators on arthropods (Mound & Reynaud, 2005) as many of its congeneric. This species shows remarkable sexual dimorphism in body colour and size, which is also reported among other members of its genus (Tyagi, Mound & Kumar, 2007). *F. megalops* is being used for thrips control in greenhouse (Mulder *et al.*, 1999) and is commercially utilized as a bio-control agent (Lenteren, 2011) in Europe.

## Suborder TEREBRANTIA

### Family THRIPIDAE

#### 2. *Stenchaetothrips spinulae* Tyagi & Kumar (Figs. 3-4)

2008. *Stenchaetothrips spinulae* Tyagi & Kumar: 62.



Fig. 3. *Stenchaetothrips spinulae*, female

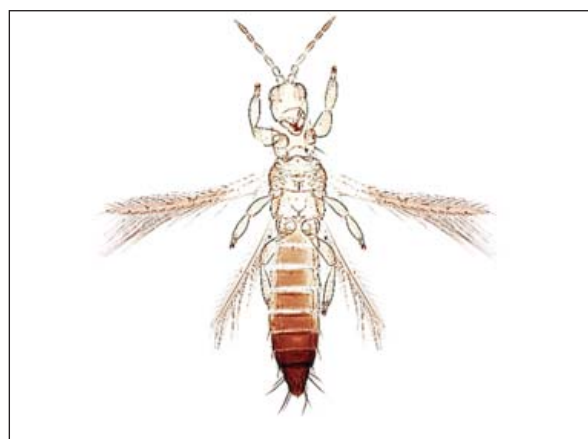


Fig. 4. *Stenchaetothrips spinulae*, male

**Diagnosis:** Female brown. Antennal segments I–II, IV–VII brown, III pale yellow. Fore wing brownish in distal  $\frac{3}{4}$  and yellow in proximal  $\frac{1}{4}$ . Legs pale brownish. Ocellar seta pair III situated just inside the ocellar triangle. Postocular setae III longer than setae I, setae II and setae IV subequal. Metanotum without campaniform sensilla, with closely spaced longitudinal lines of sculpture converging posteriorly at middle; median setae slightly back of anterior margin. Spinula present on mesosternum. *Male* bicoloured, head, thorax, and legs yellow. Abdominal segments I–V yellow but tergites II–V with light brown patch in middle, rest of the segments brown. Antennal segments

I-IV yellow, V-VII light brown. Abdominal tergite VIII without posteromarginal comb. Abdominal sternites III-VII with oval pore areas.

**Material Studied:** 2 ♀, 2 ♂, India: West Bengal, Kolkata, New Alipore, *Bamboo* sp., 31.i.2014 (Reg. No. 5422/H17 to 5423/H17, 5487/H17 to 5488/H17); 7 ♀, 2 ♂, 13.ii.2014 (Reg. No. 5695/H17 to 5703/H17), Devkant.

**Distribution:** India: Karnataka, West Bengal, new record.

**Comments:** *S. spinulae* has been described from Delhi (India) based on specimens collected on bamboo plantations (Tyagi and Kumar 2008). This is the first report of this sexually dimorphic species since its original description and seems to be endemic to India. *S. spinulae* is strictly monophagous on bamboo plantations.

Suborder TUBULIFERA

Family PHLAEOTHRIPIDAE

### 3. *Androthripsflavitibia* Moulton (Fig. 5)

1933. *Androthripsflavitibia* Moulton: 1.



Fig. 5. *Androthripsflavitibia*, female

**Diagnosis:** Body brown; fore femora brown, yellow in anterior third; mid and hind femora brown; all tibiae yellow. Fore tibia with weak and feeble scale. All dorsal prothoracic setae well developed.

**Material Studied:** 2 ♀, India: West Bengal, Kolkata, New Alipore, galls of *Ficus benjamina*, 31.i.2014 (Reg. No. 5422/H17), Devkant.

**Distribution:** India: Andaman Island, Assam, Manipur, Tripura, Uttaranchal, West Bengal, new record.

**Comments:** Members of the genus *Androthrips* have been reported as kleptoparasites or predators. Out of 12 species reported globally under this genus, 5 have been reported from India (Mound & Minaei 2007). *A. flavitibia*, an endemic species to India have been reported as predatory in nature (Singh & Vartharajan 2013).

## SUMMARY

Three new records of thrips species of order Thysanoptera are reported first time from the state of West Bengal, India.

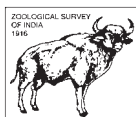
## ACKNOWLEDGEMENTS

The authors are grateful to our Director Dr. K. Venkataraman, Director, Zoological Survey of India for his encouragement and moral support and providing necessary facilities. The study is financially supported by the SERB, Department of Science & Technology, Delhi through DST Young Scientist Project entitled “Molecular Systematics and Phylogeny of Economically Important Thrips (Thysanoptera: Insecta) of India” (SR/FT/LS-24/2012) to the second author.

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## A NEW RECORD OF ACRIDIDAE (ORTHOPTERA) FROM JHARKHAND, INDIA

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### INTRODUCTION

Jharkhand is a state in eastern India. Jharkhand shares its border with the states of Bihar to the north, Uttar Pradesh and Chhattisgarh to the west, Orissa to the south, and West Bengal to the east. It is situated between 23.3500° N Latitude and 85.3300° E Longitude. The Jharkhand state is very rich in biodiversity and is the part of the Chhotanagpur plateau, province of the peninsula biogeographic zone. The recorded forest area is 2.36 million hectares, which constitutes 29.61% of the geographical area of the state. Reserve forests constitute 18.59%, protected forests 81.27% and unclassed forest a mere 0.14%. there are three types of forest viz., Tropical moist deciduous, Tropical dry deciduous and Subtropical broad leaved hill forests, Sal (*Shorea robusta*) being the major forest tree species. Soil content of Jharkhand state mainly consist of soil formed from disintegration of rocks and stones, and soil composition is further divided into Red Soil, found mostly in the Damodar valley and Rajmahal area; Micacious soil (containing particles of mica), found in Koderma, Jhumeritilaiya, Barkagaon and areas around the Mandar hill; Sandy soil, generally found in Hazaribagh and Dhanbad; Black soil, found in Rajmahal area and finally Laterite soil, found in western part of Ranchi, Palamu, and parts of Santhal Parganas and Singhbhum.

The present communication is based on a

survey conducted by the author in June-July, 2014, from Barkhela, Kolhan Forest Range, Chaibasa district of Jharkhand. The order Orthoptera is divided into two suborders namely Caelifera and Ensifera. The suborder Caelifera includes short-horned grasshoppers, locusts and grouse locusts, however Ensifera includes long-horned grasshoppers, katydids, crickets and mole crickets. The suborder Caelifera is represented by 518 species under 214 genera and 11 families from India. Among Acrididae 285 species and 134 genera were recorded from India (Kailash Chandra *et al.*, 2010). A notable taxonomical work on Acrididae was made by Kirby (1914) in the series 'Fauna of British India' and he divided the family Acrididae into eight subfamilies. Uvarov (1921, 1924, 1927, 1942) studied in detail Indian Acrididae. Dirsh (1965, 1975), Tandon (1976), Shishodia (1987, 1997, 1999), Tandon & Shishodia (1969-1989), Usmani & Shafee (1980-1990), Kumar & Virktamath (1991), Julka *et al.* (1982), Shishodia & Hazra (1986) and Hazra *et al.* (1993), Dey & Hazra (2003), Kulkarni & Shishodia (2004, 2005), Usmani (2005), Mandal & Yadav(2007) and Gupta(2008) have contributed works on the taxonomy of this group. More recently Nayeem and Usmani (2012) studied extensively of Grasshopper fauna of state of Jharkhand comprising 41 species belonging to 28 genera of 10 subfamilies, 3 families and 4 tribes. The species namely- *Choroedocus illustris*

(Walker, 1870) (Orthoptera: Acrididae) have been newly recorded from the state of Jharkhand. Identification of specimens is followed after Eades, *et al.*, 2014.

### SYSTEMATIC ACCOUNT

Order ORTHOPTERA

Suborder CAELIFERA

Infraorder ACRIDIDEA

Superfamily ACRIDOIDEA Macleay, 1821

Family ACRIDIDAE Macleay, 1821

Subfamily CATANTOPINAE Brunner von Wattenwyl, 1893

#### 1. *Choroedocus illustris* (Walker, 1870)



**Fig. 1.** *Choroedocus illustris* (Walker, 1870)

1870. *Heteracris illustris* Walker Catalogue of the Specimens of Dermaptera, Saltatoria in the Collection of the British Museum, 4: 663.
1910. *Heteracris illustris* Kirby, A Synonymic Catalogue of Orthoptera (Orthoptera Saltatoria, Locustidae vel Acridiidae), 3(2): 555.
1921. *Choroedocus illustris* Uvarov, Trans. Ent. Soc. London, 69(1&2): 109.
1984. *Choroedocus illustris* Bhowmik & Halder, Rec. Zool. Survey India, 81(1-2): 182.
2007. *Choroedocus illustris* Mandal & Yadav, Fauna of Andhra Pradesh., State Fauna Series, 5(3): 211.

2008. *Choroedocus illustris* Gupta, New records of two short-horned grasshoppers from Central India, Bionotes, 10(3): 89

2012. *Choroedocus illustris* Ahmad, & Nabi, Italian Journal of Zoology, 79(4): 598-606.

**Material examined:** Barkhela, Kolhan Forest Range, Chaibasa distt., Jharkhand, 21.vi.2014, Coll. G. P. Mandal, 3 exs., altitude: 348 meters, co-ordinates, Latitude: 22°33'2.4'' N and Longitude: 85°40'3.5'' E, habitat: under grass field & thick vegetation.

**Diagnosis:** Tegmina with small scattered brownish dots through disc excluding costal anal area; subgenital plate conical and upcurved in male.

**Distribution:** INDIA (Jharkhand, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Uttar Pradesh, Maharashtra, Himachal Pradesh); SRILANKA

**Remarks:** This large brightly coloured species is specialized for life on leaves of thick tropical vegetation. First time recorded from the state of Jharkhand.

### SUMMARY

The present paper is first report of *Choroedocus illustris* (Walker, 1870) (Orthoptera: Acrididae) from Kolhan Forest Range, Chaibasa district of Jharkhand.

### ACKNOWLEDGEMENT

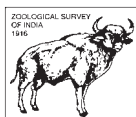
I am grateful to the Director, Dr. K. Venkataraman, Zoological Survey of India, Kolkata for providing laboratory facilities. The author is thankful to Dr. Kailash Chandra, Scientist-F, for encouragement. Author is very much thankful to Dr. S.K. Mandal, ex-Assistant Zoologist, Zoological Survey of India, Kolkata for confirmation of the identification.

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## MARINE SPONGES OF GULF OF MANNAR AND PALK BAY

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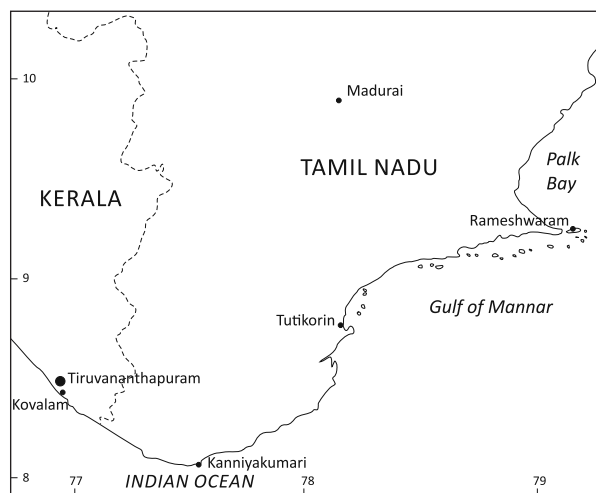
### INTRODUCTION

The Gulf of Mannar and Palk Bay are one of the important Biosphere Reserves of India. It consists of 21 islands spread over an area of 623 hectares (10, 500 km<sup>2</sup>). The area between the Pamban to Tuticorin barrier reef was declared a National park in 1986 and later converted into Biosphere Reserve in 1989. Of the 21 islands, seven islands belong to Mandapam group, seven islands to Keelakarai group, three islands to Vembar group and four remaining islands to Tuticorin group. This Marine National Park, one of the richest coastal regions in Asia, contains over 3,600 species of flora and fauna. (Nammalwar, 2008) The present study is on the Poriferans (Sponges) of this region based on extensive collections made during Dec. 2007. Poriferans have a paleontological significance as they originated about 570 million years ago (Thomas, 1998). The sponge species and its distributions are well studied by several workers in the past. Dendy (1905) reported the Gulf of Mannar as one of the richest centers of sponge distribution. Burton (1930, 1937) added to our knowledge of the sponge fauna of Gulf of Mannar. An extensive survey of the marine sponges of the Gulf of Mannar and Palk bay was conducted during the years 1964-67 by Thomas (1968). Thomas (1986) made a monographic work containing 275

sponge species from Gulf of Mannar and Palk Bay. Subsequently Pattanayak and Manna (2001) recorded 451 species for the whole of India, under 3 classes, 17 orders, 65 families and 169 genera. From the Gulf of Mannar and Palk Bay 321 species belonging to 129 genera were reported of which 257 species belonging to 63 genera are endemic to this region. It is fascinating that 67 % of the India's sponge species were recorded at the Gulf of Mannar and Palk Bay regions. The Class Demospongiae was the dominant group of sponges in the study area.

### MATERIALS AND METHODS

The sponges were collected along the inner reefs of the seven dominant islands and seven coastal areas of the Gulf of Mannar Biosphere reserve. They are Poomarichan Island, Mandapam, Manauli island, Keelakarai, Pullivasal island, Ervadi, Hare island, Pamban Bridge, Manauliputti island, Rameswaram, Krusadai island, Vedalai, Single island and Adiyaman beach. A total of 70 sponge specimens were collected in the intertidal area and studied. Clearing of the hand sections were done in carbol-xytol and mounted in glycerine. Spicules were boiled in nitric acid, mounted in euparal and examined under Labomed microscope and photograph of spicules to be added. Measurements were made with the micrometer and are given in mm.



Map of gulf of mannar of Palk Bay

The following 72 Sponge specimens were identified from the survey tour to Gulf of Mannar and Palk Bay, Tamil Nadu as belonging to 30 species under 11 families.

#### SYSTEMATIC ACCOUNT OF SPONGES OF GULF OF MANNAR AND PALK BAY

Phylum: PORIFERA Grant, 1836

Class DEMOSPONGIAE Sollas, 1885

Subclass TETRACTINOMORPHA Levi, 1953

Order HADROMERIDA

Family CLIONIDAE Gray

1. *Cliothesa quadrata* (Hancock, 1849)
2. *Cliona lobata* Hancock
3. *Speciospongia inconstans* (Dendy, 1887)

Family SUBERITIDAE

4. *Suberites carnosus* (Johnston, 1842)

Family TETHYIDAE

5. *Stellitethya repens* (Schmidt, 1870)

Order POECILOSCLERIDA

Family MICROCIONIDAE

Sub family MICROCIONINAE

6. *Clathria (Clathria) gorgonoides* (Dendy, 1910)

Family RASPAILIIDAE

Sub family ECHINODICTYINAE

7. *Echinodictyum clathratum* Dendy, 1905

Sub order MYXILLINA

Family DESMACIDIDAE

8. *Desmapsamma anchorata* (Carter, 1882)

Order HALICHONDRIDA

Family AXINELLIDAE Carter

9. *Auletta elongata* Dendy, 1905
10. *Axinella durissima* (Dendy, 1905)
11. *Axinella donnani* (Bowerbank, 1873)
12. *Axinella halichondroides* Dendy, 1905
13. *Axinella manus* Dendy, 1905

Family BUBARIDAE

14. *Bubaris vermiculata* (Bowerbank, 1866)

Order HAPLOSCLERIDA

Suborder HAPLOSCLERINA

Family CALLYSPONGIIDAE De Laubenfels

15. *Callyspongia clathrata* (Dendy, 1905)
16. *Callyspongia (cladochalina) diffusa* (Ridley, 1884)
17. *Callyspongia (cladochalina) spinosissima* (Dendy, 1887)

Family CHALINIDAE Gray

18. *Haliclona pigmentifera* (Dendy, 1905)
19. *Haliclona (Gellius) fibulata* (Schmidt, 1862)
20. *Sigmatocia petrosioides* (Dendy, 1905)

Family NIPHATIDAE

21. *Gelliodes pumila* (Lendenfeld, 1887)

Suborder PETROSINA

Family PHLOEODICTYIDAE

22. *Oceanapia sagittaria* (Sollas, 1902)

Order DICTYOCERATIDA

Family THORECTIDAE

Subfamily THORECTINAE

23. *Ircinia fusca* (Carter)

Order DICTYOCERATIDA

Family IRCINIIDAE

24. *Fasciospongia cavernosa* (Schmidt, 1862)

25. *Fasciospongia anomala* (Dendy, 1905)

Family SPONGIIDAE

26. *Hyattella intestinalis* (Lamarck, 1814)27. *Spongia (spongia) hispida* Lamarck, 1814

Subfamily PHYLLOSPONGIINAE

28. *Phyllospongia papyracea* (Esper) ssp. *polyphylla* de Laubenfels

Family DYSIDEIDAE

29. *Dysidea fragilis* (Mantagu, 1818)30. *Lamellodysidea herbacea* (Keller, 1889)1. *Cliothosa quadrata* (Hancock, 1849)  
(Fig. 1)1849. *Cliona quadrata* Hancock, p. 344, pl. 5, fig. 62006. *Cliona quadrata*, Pattanayak, p. 33, pl. III E, fig. 182013. *Cliothosa quadrata* Van Soest et al.

**Material Examined:** 10 exs, station Mandapam, Date, 23.12.07. Reg. No. S-53., Coll. G. Sivaleela & Party.

**Description:** Sponge colour is dark brown. Consistency is Soft and friable. Boring on corals, cavities are formed inside the substratum, Megascleres: tylostyles, head spherical, 0.4 X 0.016-0.018.

**Distribution:** South Atlantic, Mediterranean Sea.

2. *Cliona lobata* Hancock  
(Fig. 2)1849. *Cliona lobata* Hancock, p. 341, pl. 12, figs. 4, 8.1937. *Cliona lobata* Burton, p. 16, pl. 8, fig. 53.

**Material Examined:** 8 exs, sta Pullivasal island. Date, 25.12.07. Reg. No. S-52. Coll. G. Sivaleela & Party.

**Description:** Common on calcareous objects, colour bright red when alive.

**Spicules:** Tylostyles, size, 0.119X 0.004 mm, Spirasters, 0.01-0.065 X 0.002-0.003 mm.

**Distribution:** Atlantic Ocean, and Indo Pacific

3. *Spheciospongia inconstans* (Dendy, 1887)  
(Fig. 3)1887. *Suberites inconstans* Dendy, p. 154.1902. *Spirastrella inconstans*, Sollas, p. 216., pl. 14, fig. 3.2013. *Spheciospongia inconstans*, Van Soest et al.

**Material Examined:** 7 exs, sta: Krusadai island. Date, 25.12.07. Reg. No., S-52. Coll. G. Sivaleela & Party.

**Description:** Sponge, massive, globular, meandrine or finger shaped. Basal portion often buried in sand or coral rock. Colour pale yellow internally and light brown externally in living condition. Oscules scattered in massive forms whereas terminal in digitate forms. Skeleton arrangement as in the above species. Types of the spicules are tylostyles and spirasters.

**Spicules:** Tylostyles size, 0.119-0.121 X 0.002-0.021 mm, Spirasters size, 0.002-0.0125 mm.

**Distribution:** Red Sea to Pacific Ocean.

4. *Suberitus carnosus* (Johnston, 1842)  
(Fig. 4)1842. *Halichondria carnosus*, Johnston.1941. *Suberitus carnosus*, Rao, p. 426.1986. *Suberitus carnosus* Thomas, pl.V, fig. 35.

**Material examined:** 1 ex, sta: Sayalkudi. Date, 24.7.09. Reg. No., Coll. G. Sivaleela & Party.

**Description:** Sponges are encrusting, colour orange, yellow when alive, ramose or even clathrous. Colour, orange, pale yellow or blue when alive. Consistency fleshy; oscules terminal; circular, slit-like and highly contractile. Skeleton composed of tylostyles in ascending tracts; smaller spicules may be present in the dermal parts in brushes. Spicule type is tylostyles. Size, 0.180-0.576 mm.

**Distribution:** Cosmopolitan.

5. *Stellitethya repens* (Schmidt, 1870)  
(Fig. 5)1870. *Tethya repens*, Schmidt, p.1924. *Donatia repens*, p. 1036

**Material Examined:** 1, ex, sta. Pullivasal Island. Date, 25.12.07. Reg. No. S-51., Coll. G. Sivaleela & Party.

**Description:** Sponge encrusting, surface

nodular. Colour, brick red when alive. Surface hispid and is due to the presence of megascleres projecting partly from the surface. Oscules slit-like and contractile. Surface may lodge silt in large quantities. Cortex well developed. Skeleton in radial bundles terminating at the dermal brushes. Smaller brushes may be present in between the main bundles, especially at the dermal region. Spicule types are tylostyles, spherasters and chasters. *Spicules*: Tylostyles- slightly curved, 0.266mm, 0.002 mm. Spherasters small with -6 rays. 0.003 mm in diameter.

*Distribution*: Atlantic ocean, Mediterranean Sea.

6. *Clathria (clathria) gorgonoides*  
(Dendy, 1916)  
(Fig. 6)

1916. *Echinodictyum gorgonoides* Dendy, p.

1937. *Echinodictyum gorgonoides*, Burton, p. 31, pl. 4, fig. 25.

*Material examined*: 5exs, sta, Krusadai island Date 28.12.09. Reg. No. S-50., Coll. G. Sivaleela & Party.

*Description*: Sponge composed of small branches and growing in one plane as in gorgonoides. Colour brick red when alive, consistency is compressible with good resiliency. Surface is hispid and without oscules. The skeleton composed of primaries and secondaries. *Spicules*: Tornotoxeas- 0.121-0.152x 0.002-0.004 mm. Acanthostyles size, 0.088-0.11 x 0.006- 0.012mm

*Distribution*: Widely distributed in Indian Ocean.

7. *Echinodictyum clathratum* Dendy, 1905  
(Fig. 7)

1968. *Echinodictyum clathratum* Thomas, p. 246, pl. 1, fig. A, B.

*Material examined*: 2 exs, sta: Sayalkudi (Tuticorin), 24.7.09. Reg. No. S-49. Coll. G. Sivaleela & Party

*Description*: Sponge stalked, with foliaceous branches arising from the stalk. Colour dark grey with leathery consistency. Oscules and pores absent. Primaries and secondaries are composed

of spicules. *Spicules*: long oxea. Size – 1.7x 0.012mm, small oxea, 0.6 x 0.005 mm, styles size- 3.2 x 0.029 mm, small styles size- 0.89 x 0.004 mm, Acanthostyles, size- 0.1 x 0.006 mm

*Distribution*: known only in Tuticorin coast (Sayalkudi)

8. *Desmapsamma anchorata* (Carter, 1882)  
(Fig. 8)

1927. *Desmacidon carterianum* Arndt, vol. 25: 133-158.

1882. *Fibularia anchorata* Carter, 266-301, 346-368, pls XI-XII.

1886. *Desmapsamma reptans* Ridley & Dendy, (5)18: 325-351, 470-493.

*Material examined*: 2 exs, sta: Sayalkudi (Tuticorin). Date, 24.7.09. Reg. No. 48. Coll. G. Sivaleela & Party

*Description*: Sponge a clathrous mass of slender branches. Oscules on projections or scattered irregularly. Colour of the dermal part pale white and interior, orange when alive. Consistency, compressible when alive but highly friable on drying. Dermal skeleton is formed of oxeas, microscleres and arenaceous objects. Types of spicules are oxeas, sigmas and isochelas.

*Distribution*: Australian region.

9. *Auletta elongata* (Dendy, 1905)  
(Fig. 9)

1905. *Auletta elongate* Dendy, p. 195, pl. 13, fig. 7.

1937. *Acanthella elongate* burton, p. 37, pl. 7, fig. 42.

*Material examined*: 4 exs, sta: Single Island. Date, 29.12.07. Reg. No.,S-17. Coll. G. Sivaleela & Party.

*Description*: Sponges erect stipitate and tubular structure. Surface is minutely hispid and leathery appearance. Oscules present on the surface texture- compressible and resilient. Colour yellowish grey in the spirit. Skeleton composed of stout longitudinal fibres with plumose columns. Spicules styles size, 0.58 x 0.02 mm. Oxeas- 0.38 mm. Strongyles- 0.089. mm.

*Distribution*: Gulf of Mannar, Bay of Bengal.

10. *Axinella durissima* (Dendy, 1905)

(Fig. 10)

1986. *Axinella durissima*, p. 187, pl. 12, fig. 5

**Material examined:** 16 exs, sta: Mandapam, vedalai, Single island. Date, 26.12.07, 28.12.07. Reg. No., Coll. G. Sivaleela & Party.

**Description:** Sponge is massive and vertically elongated. Colour is orange when alive. Surface even, oscules numerous, compound. Main skeleton composed of megascleres. *Spicules:* Oxeas, size, 0.397 x 0.024 mm. Styles size-0.95 x 0.02 mm.

**Distribution:** Widely distributed in Indian Ocean.

11. *Axinella donnani* (Bowerbank, 1873)

(Fig. 11)

1873. *Isodictya donnani*, Bowerbank, p. 28, pl. 6.1886. *Axinella donnani*, Thomas, pl. IV, fig. 23.

**Material examined:** 3 exs, sta.: Manauliputti island, Tuticorin Date 25.12.09. Reg. No. S-29. Coll. G. Sivaleela & Party.

**Description:** Sponge lamellar, lamellae branched and anastomosing or cup shaped. Surface minutely hispid. Colour is yellow or orange when alive and with tough texture. Oscules are arranged in groups, often in a radiating pattern, pores scattered. Fibres are cored and echinated with styles. Spicule types are styles and oxeas. *Spicules:* Styles, 0.137- 0.024 mm. Oxeas, size-0.12-0.002 mm.

**Distribution:** Indian Ocean.

12. *Axinella halichondroides* Dendy, 1905

(Fig. 12)

1905. *Axinella halichondroides*, p. 190, pl. 12, fig. 1.

**Material examined:** 4 exs, sta: Mandapam. Date, 23.12.07. Reg. No., S-46. Coll. G. Sivaleela & Party

**Description:** Sponge is encrusting with monticular elevations. Colour light brown. Consistency firm and compact. Oscules at the tip of elevated structures. Surface conulose. Skeleton is plumose arrangement. *Spicules:* Oxeas, size, 0.118 x 0.01 mm.

**Distribution:** Gulf of Mannar.

13. *Axinella manus* Dendy, 1905

(Fig. 13)

1905. *Axinella manus*, p. 188, pl. 12, fig. 8.

**Material examined:** 2 exs, sta. Sayalkudi (Tuticorin). Coll. Date, 24.7.09. Reg. No. S-35. Coll. G. Sivaleela & Party

**Description:** Sponge is erect and palmately branched. Tips of branches conical and curved inwards. stalk cylindrical and branches flattened. Colour is light gray, tough, compressible and resilient. Surface granular and conulose. Oscules are small. Skeleton consists of spicules and plumosely arranged. *Spicules:* styles, size, 0.295 x 0.016 mm. Oxeas. Size 0.116 x 0.002 mm.

**Distribution:** Gulf of Mannar.

14. *Bubaris vermiculata* (Bowerbank, 1866)

(Fig. 14)

1880. *Hymerhaphia vermiculata* var. *erecta* Carter, p. 46.

**Material examined:** 3 exs, sta.: Pullivasal Island, Date...25.12.09. Reg. No., S-29. Coll. G. Sivaleela & Party.

**Description:** Sponge is encrusting, erect, and composed of a number of vermicular strongyles rising vertically. Surface hispid, colour grayish yellow. Oscules are not visible. Skeleton consists of strongyles, styles. *Spicules:* Strongyles, smooth, 0.245 – 0.001 mm, styles, 0.012 – 0.0013 to 0.014-0.03

**Distribution:** Atlantic Ocean.

15. *Callyspongia clathrata* (Dendy, 1905)

(Fig. 15)

1937. *Callyspongia spinosissima*, p. 21.

**Material examined:** 12 exs, sta, Pullivasal island. Date, 25.12.07. Reg. No. S-45. Coll. G. Sivaleela & Party

**Description:** Sponge is erect, composed of cylindrical branches. Colour yellowish brown. Oscules are scattered. The main skeleton is coarse and irregular. *Spicules:* oxeas, size, 0.0116mm X 0.002-0.001 mm.

**Distribution:** Indian ocean.

**16. *Callyspongia (cladochalina) diffusa***

(Ridley, 1884)

(Fig. 16)

1937. *Callyspongia diffusa*, Burton, p. 20.

**Material examined:** 12 exs, sta, Pullivasal Island. Date, 25.12.07, Reg. No. S-40, Coll. G. Sivaleela & Party

**Description:** Sponges are erect, tubular, flabellate or repent. Consistency compressible with good resiliency. colour is purple. Oscules and pores are minute. Surface is hispid due to hispidity. Connectives are multispicular. *Spicules:* Oxeas Size-0.045-0.109 X 0.002-0.004 mm

**Distribution:** Indo-Pacific.

**17. *Callyspongia (cladochalina) spinosissima***

(Dendy, 1887)

(Fig. 17)

1905. *pachychalina subcylindrica* Dendy, p. 148, pl. 10, fig. 1, 2.1887. *Callyspongia spinosissima* Thomas, pl. II, fig. 15.

**Material examined:** 12 exs, sta, Mandapam. Date, 23.12.07, Reg. No. S-6, Coll. G. Sivaleela & Party.

**Description:** Sponges composed of angular branches of acculeation. Dermal skeleton of a well developed fibres in the tertiary level. The main skeleton is composed of primaries and connectives. *Spicules:* Oxeas, size-0.012 x 0.002 mm.

**Distribution:** Indian Ocean.

**18. *Haliclona pigmentifera* (Dendy, 1905)**

(Fig. 18)

1937. *Adocia pigmentifera*, p. 19, pl. 1, fig. 8.

**Material examined:** 12 exs, sta, Pullivasal island. Date, 25.12.07, Reg. No. S-41 Coll. G. Sivaleela & Party.

**Description:** Sponge is pyriform. Skeleton is isodictyal pattern. Fibres are rarely present. Colour is dark green. *Spicules:* Oxeas, size, 0.112 X 0.003 mm.

**Distribution:** Red Sea.

**19. *Haliclona (Gellius) fibulata***

(Schmidt, 1862).

(Fig. 19)

1880. *Reniera fibulifera*, p. 48.

**Material examined:** 5 exs, sta. Ervadi, Poomarichan island and Mandapam, Date: 23.12.07, 25.12.07, 22.12.07. Reg. No. 1, Coll. G. Sivaleela & Party.

**Description:** Sponge is *Callyspongia* appearance. branches are clathrous structure. colour is dark green due to alga. Consistency hard and slightly compressible. Oscules scattered. Pores minute. The main skeleton consists of spicules. *Spicules:* Oxeas, size. 0.0012-.0.21 x 0.001- 0.003 mm. Sigmas. often notch at the centre. Size is 0.001 mm.

**Distribution:** North Atlantic Ocean, Mediterranean sea, Indo-Australian.

**20. *Sigmatocia petrosioides* (Dendy)**

(Fig. 20)

1905. *Gelliodes petrosioides*, Dendy, p. 138. pl. 9, fig. 3.1886. *Sigmatocia petrosioides*, pl. II, fig. 3.

**Material examined:** 6 exs, sta, Mandapam. Date, 22.12.07. Reg. No., S-2, Coll. G. Sivaleela & Party.

**Description:** Sponge surface is hispid due to more no of spicules. Meshes are triangular. Main skeleton is composed of oxeas and sigmas. Texture is hard. Oscules and pores are scattered.

**Distribution:** Indian Ocean.

**21. *Gelliodes pumila* (Lendenfeld, 1887)**

(Fig. 21)

1934. *Adocia pumila* Burton, p. 537, pl1, figs. 1-9.

**Material examined:** 6 exs, sta, Mandapam, Date, 22.12.07. Reg. No., S-19. Coll. G. Sivaleela & Party.

**Description:** Body finger shaped, with a oscule. Colour is pale grey. consistency is tough; slightly compressible. oscule terminal diameter 6 mm. Dermal skeleton is polygonal. spicules: Oxeas. Slightly curved, size 0.11-0.211 x 0.002-0.013. sigmas chord length; 0.012-0.18 mm.

**Distribution:** Indian Ocean, Australian region.

**22. *Oceanapia sagittaria* (Sollas, 1902)**

(Fig. 22)

1986. *Orina sagittaria*, Thomas, pl. II, fig. 6.

**Material examined:** 5 exs, sta, Tuticorin, Date 24.7.09., Reg. No. S-3. Coll. G. Sivaleela & Party.

**Description:** Sponge is spherical with fistules, basal and fistules are attached to the substratum colour pale gray externally when alive. Consistency, hard but friable on drying. Oscules at the tip of fistules, pores are irregular in outline. **Spicules:** Oxeas, size. 0.167-0.210 X 0.011 mm. **Sigmas-** Notch at the centre- 0.012-0.129 X 0.001 mm.

**Distribution:** Indo-Pacific.

23. *Ircinia fusca* (Carter, 1880)  
(Fig. 23)

1986. *Ircinia fusca* Thomas, pl. I, fig. 6.

1880. *Hircinia fusca* Carter, p. 36.

**Material examined:** 5 exs, sta, Tuticorin, Date 24.7.09., Reg. No., S-3. Coll. G. Sivaleela & Party.

**Description:** Sponge surface is conulose. Colour is dark brown and pale yellow internally. Texture is leathery. Dermal region contain sand particles. This species having long, spherical filaments with oblong heads diameter upto 0.009 mm.

**Distribution:** Indo-Pacific region.

24. *Fasciospongia cavernosa* (Schmidt, 1862)  
(Fig. 24)

1986. *Fasciospongia cavernosa*, Thomas, pl. I, fig. 13.

1948. *Fasciospongia cavernosa*, p. 119.

**Material examined:** 7 exs, sta, Mandapam, Ervadi, Vedalai, Thondi, Single island, Krusadi and Pullivasal island Date. 23.12.07, 25.12.07, 28.12.07, 29.12.07, 28.12.07, 25.12.07., Reg. No., S-15. Coll. G. Sivaleela & Party.

**Description:** Sponge is thickly encrusting, fistular, colour is yellow. Texture is hard and incompressible. Oscules are scattered. Surface is conulose.

**Distribution:** Mediterranean Sea, Red sea, Indo-Australian.

25. *Fasciospongia anomala* (Dendy, 1905)  
(Fig. 25)

1948. *Fasciospongia anomala*, p. 120.

**Material examined:** 7 exs, sta, Tuticorin, Date, 24.7.09, Reg. No., S-42. Coll. G. Sivaleela & Party.

**Description:** Sponge texture is firm and compressible. Surface is composed of sand grains.

Skeleton is irregular which is inseparable into primaries & secondaries

**Distribution:** Gulf of Mannar.

26. *Hyattella intestinalis* (Lamarck, 1814)  
(Fig. 26)

1948. *Hyattella intestinalis*, p. 41, pl. 6, fig. 13.

**Material examined:** 10 exs, sta. Mandapam, Vedalai, Single Island, Adiaman beach and Manuali island Date. 23.12.07, 28.12.07, 29.12.07, 24.12.07. Reg. No. S-39. Coll. G. Sivaleela & Party.

**Description:** Sponge is minutely conulose. Oscules terminal. Texture hard with poor resiliency.

**Distribution:** Atlantic Ocean, Mediterranean Sea, Indian Ocean.

27. *Spongia (Spongia) hispida* Lamarck, 1814  
(Fig. 27)

1905. *Euspongia tenuiramosa*, p. 213.

**Material examined:** 2 exs, sta, Manauli Island. Date, 27.12.07. Reg. No. S-8. Coll. G. Sivaleela & Party.

**Description:** Body is ramose with angular to nodose branches, surface conulose. colour is purplish brown to black. Texture compressible with good resiliency. Skeleton consists of quadrangular network of sponging fibres.

**Distribution:** Indo-Australian

28. *Phyllospongia papyracea* (Esper) ssp.  
polyphylla de Laubenfel  
(Fig. 28)

1948. *Phyllospongia papyracea* (Esper) ssp. *Polyphylla*, p. 47, pl. 9, fig. 8.

**Material examined:** 2 exs, sta. Pullivasal island, Date, 25.12.07. Reg. No. S-13 & S-43. Coll. G. Sivaleela & Party.

**Description:** Sponge is cup shaped. Branches with lobed margins. Wall of the branch is dark brown when alive. Texture is leathery. Skeleton is consists of spongin fibres. Primaries contain sand grain.

**Distribution:** Gulf of Mannar

29. *Dysidea fragilis* (Mantagu, 1818)  
(Fig. 29)

1986. *Dysidea fragilis*, Thomas, p. 1, fig. 15.

**Material examined:** 6 exs, sta, Manauli island, Thondi. Date, 27.12.07., Reg. No. S-34, Coll. G. Sivaleela & Party.

**Description:** Sponge is encrusting and digitate. colour is green to yellow. Consistency is friable. surface is conulose, conules with blunt tips. oscules are terminal on digitate forms. Pores are minute.

**Distribution:** cosmopolitan.

30. ***Lamellodysidea herbacea*** (keller, 1889)  
(Fig. 30)

1941. *Dysidea herbacea*, p. 464, pl. 13, fig. 10.

**Material examined:** 6 exs, sta, Manauli Island. Date, 27.12.07. Reg. No. S-44. Coll. G. Sivaleela & Party.

**Description:** Sponge shape is finger or petaloid branches. Oscules are slit-like and contractile. Skeleton composed of primaries and connectives.

**Description:** Red sea to Pacific Ocean.

### SUMMARY

From the present collections from the Gulf of Mannar a total of 72 exs of sponges were collected and identified as belonging to 30 species under 11 families and 19 genera. In the 7 islands surveyed

species richness were found to be high in Mandapam area. All species reported belong to the Class Demospongiae Of which the dominant species are the two species of boring sponges namely *Cliona lobata* and *Cliona quadrata* followed by the 28 non-boring species *Cliona lobata* and *Hyattella cribricutis* are abundant in Pullivsal island, whereas *Sigmatocia pumila*, *Callyspongia spinosissima* *Dysidea fragilis* and *Dysidea herbacea* were more in Manauli island, Sayalkudi (Tuticorin) and Krusadai islands. *Fasciospongia cavernosa* was abundant in Ervadi, Mandapam and Vedalai areas. The genera *Axinella* is more in Tuticorin group of islands. The genera common in all the islands and coastal areas were *Fasciospongia*, *Callyspongia*, *Sigmatocia*, *Axinella* *Hyattella*, *Dysidea* in their order of abundance.

### ACKNOWLEDGEMENTS

The author is highly grateful to Dr. K. Venkataraman, Scientist-G & Director, Zoological Survey of India, Kolkatta for facilities and permission to carry out the work. The author is thankful to the officer-in-charge, MBRC, Chennai for his assistance and also to Shri. Srinivasu, SRF/ MBRC for his photos alignment.

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PLATE-1



Fig. 1. *Cliothosa quadrata*



Fig. 2. *Cliona lobata*



Fig. 3. *Speciospongia inconstans*



Fig. 4. *Suberitus carnosus*



Fig. 5. *Stellitethya repens*



Fig. 6. *Clathria (clathria) gorgonoides*



Fig. 7. *Echinodictyum clathratum*



Fig. 8. *Desmapsamma anchorata*

## PLATE-2

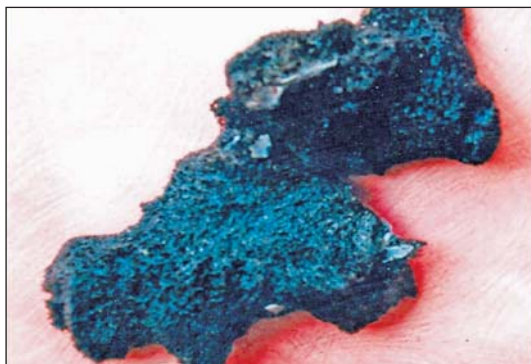
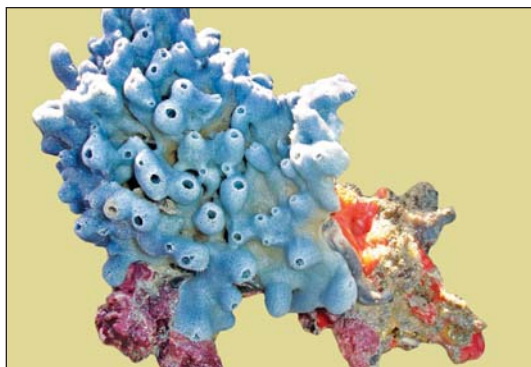
Fig. 9. *Auletta elongata*Fig. 10. *Axinella durissima*Fig. 11. *Axinella donnani*Fig. 12. *Axinella halichondroides*Fig. 13. *Axinella manus*Fig. 14. *Bubaris vermiculata*Fig. 15. *Callyspongia clathrata*Fig. 16. *Callyspongia (cladochalina) diffusa*

PLATE-3



Fig. 17. *Callyspongia (cladochalina) spinosissima*



Fig. 18. *Haliclonma pigmentifera*



Fig. 19. *Haliclona (Gellius) fibulata*



Fig. 20. *Sigmadocia petrosioides*

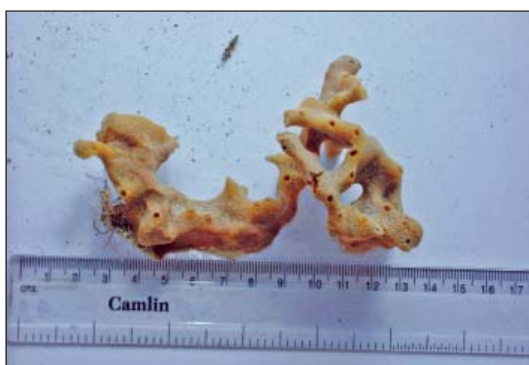


Fig. 21. *Gelliodes pumila*



Fig. 22. *Oceanapia sagittaria*



Fig. 23. *Ircinia fusca*



Fig. 24. *Fasciospongia cavernosa*

## PLATE-4

Fig. 25. *Fasciospongia anomala*Fig. 26. *Hyattella intestinalis*Fig. 27. *Spongia (spongia) hispida*Fig. 28. *Phyllospongia papyracea*Fig. 29. *Dysidea fragilis*Fig. 30. *Lamello dysidea herbacea*

**PLATE-5**



Fig. 31. *Haliclona pigmentifera*

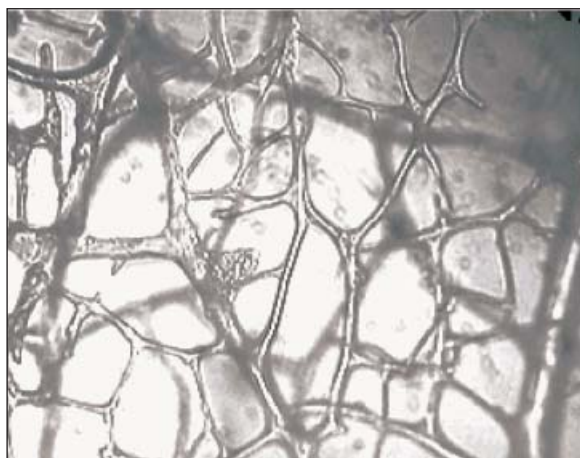


Fig. 32. *Dysidea fragilis*

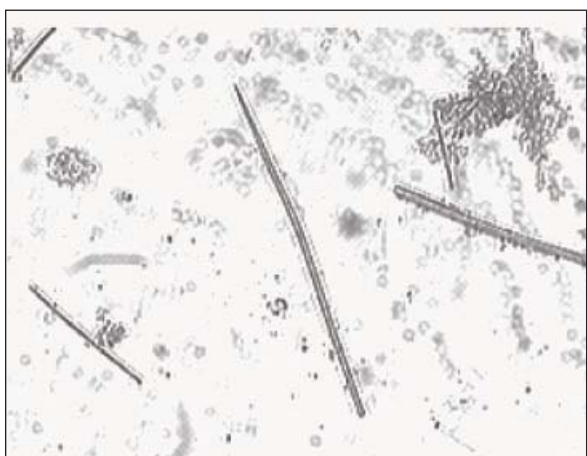


Fig. 33. *C. spinosissima*

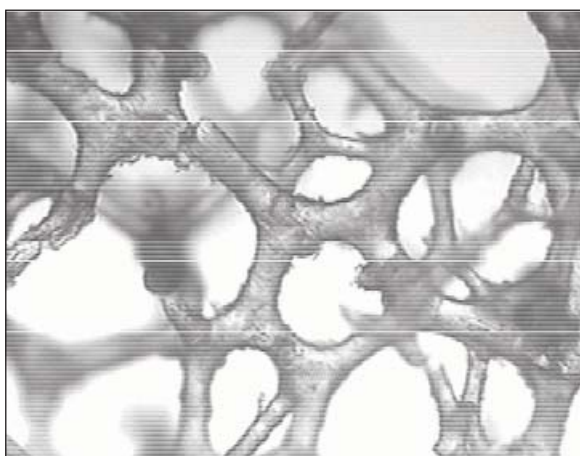


Fig. 34. *Hyattella cribriformis*

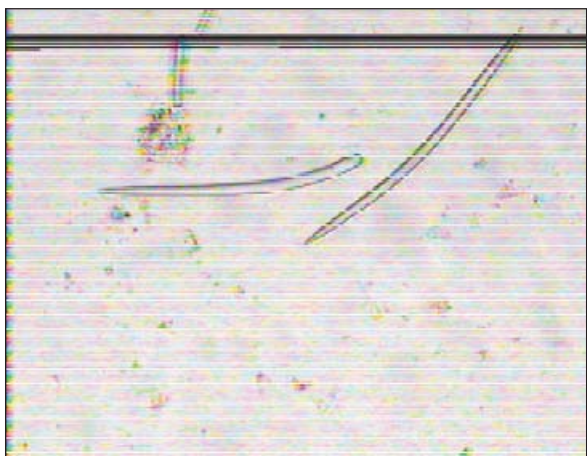


Fig. 35. *Acanthella elongate*



Fig. 36. *Axinella durissima*

## PLATE-6

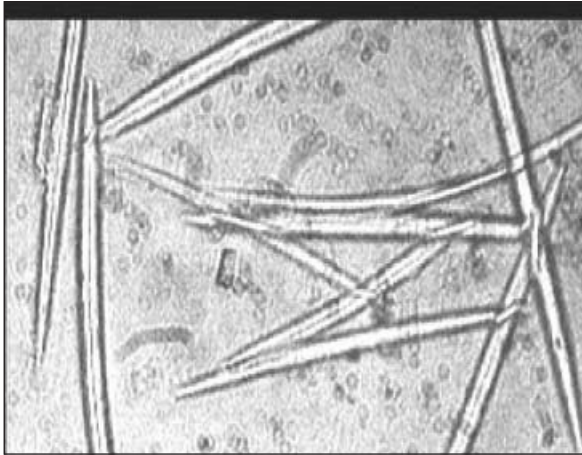
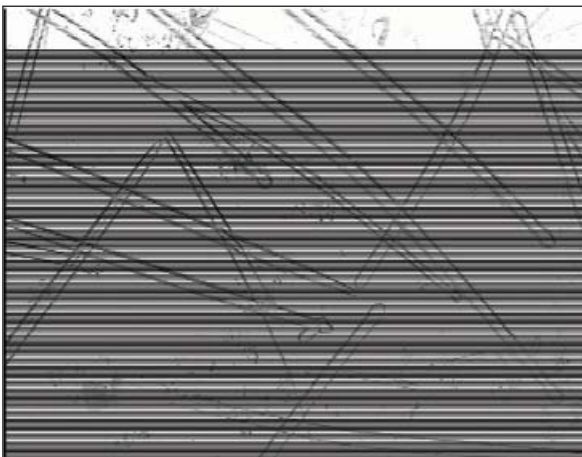
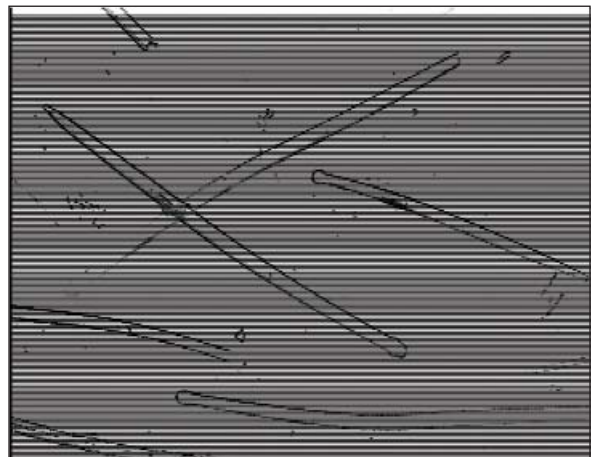
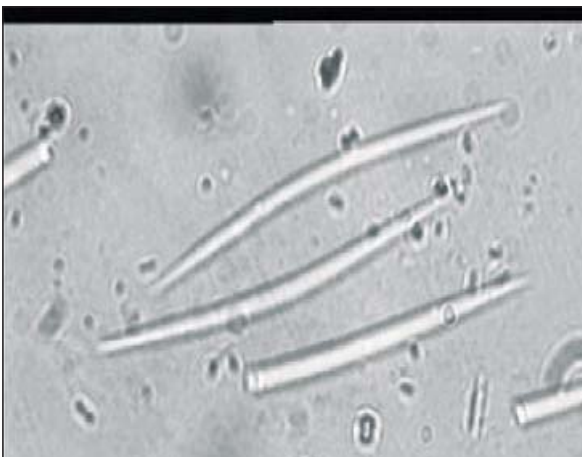
Fig. 37. *Callyspongia clathrata*Fig. 38. *Callyspongia diffusa*Fig. 39. *Cliona lobata*Fig. 40. *Cliona quadrata*Fig. 41. *Oceanapia sagittaria*Fig. 42. *Sigmadocia petrosioides*

PLATE-7

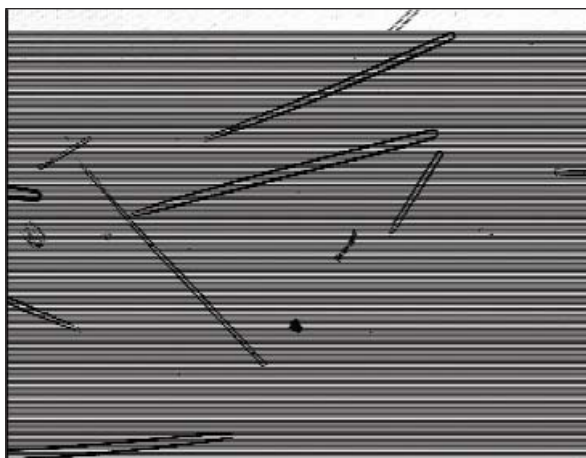


Fig. 43. *Echinodictyum clathrata*

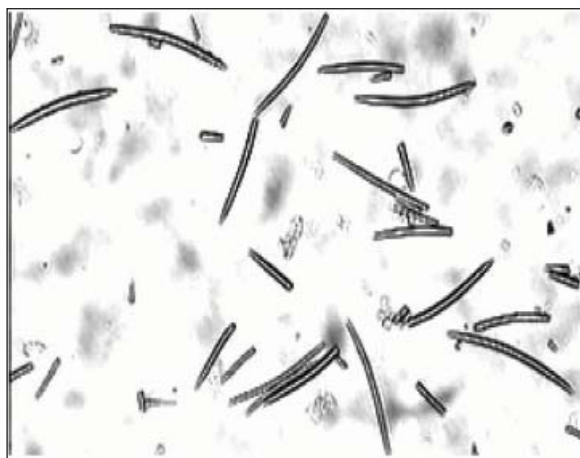


Fig. 44. *Sigmadocia pumila*



Fig. 45. *Spirastrella inconstans*

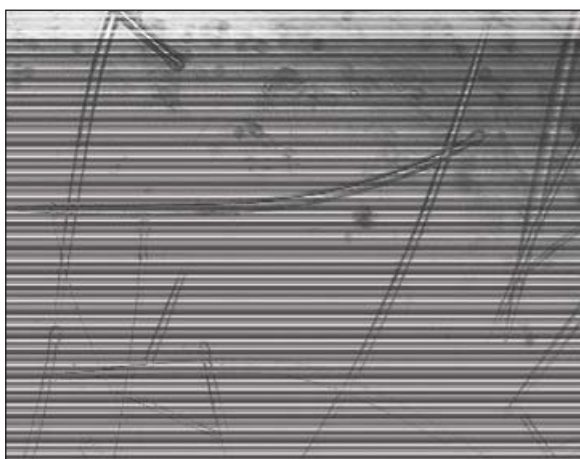


Fig. 46. *Suberitus carnosus*

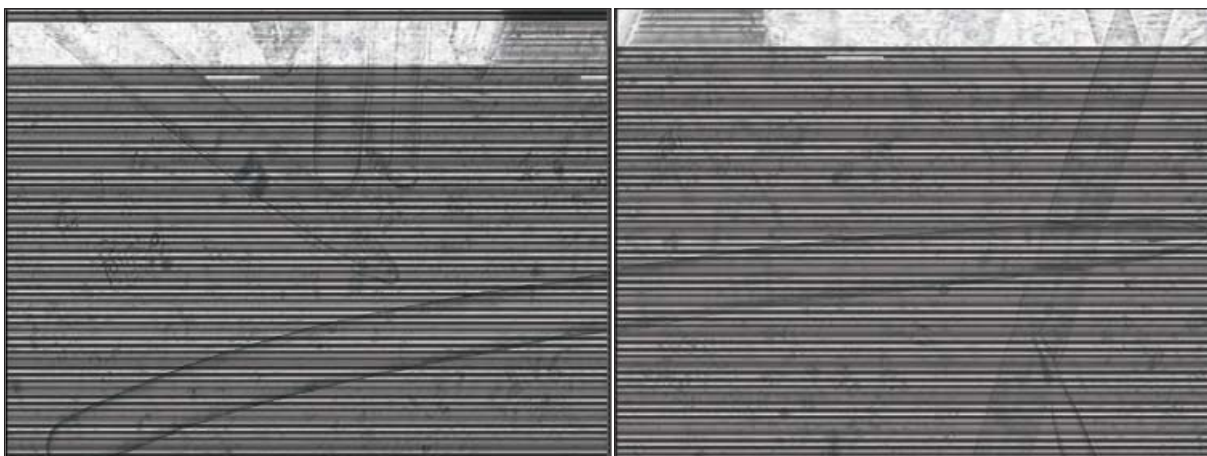
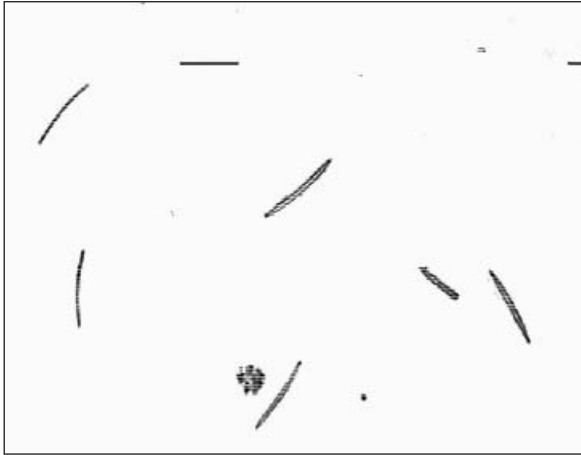
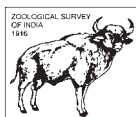


Fig. 47. *Axinella donnani*

## PLATE-8

Fig. 49. *Callyspongia diffusa*Fig. 50. *Desmapsamma anchorata*Fig. 51. *Ircinia fusca*



**“STUDIES ON DIVERSITY AND DISTRIBUTION OF SOIL  
MICRO-ARTHROPODS FAUNA WITH SPECIAL REFERENCE  
TO COLLEMBOLA IN SAJNEKHALI WILD LIFE SANCTUARY,  
SOUTH 24 PGS, WEST BENGAL”**

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### INTRODUCTION

Sajnekhali Wild life Sanctuary which is under Sundarban delta situated a little south of Tropic of Cancer between the latitudes 21°31' and 22°31' North and 88°10' and 89°51' East longitudes in the District of 24 Parganas South, West Bengal. Sunderbans is an estuarine ecosystem with mangroves as the main flora. Mangroves are the plants which can survive, grow and propagate in loose muddy alluvial soil and saline water. These plants have highly specialized adaptations in the form of Stilt Root (for anchoring in loose soil), Pneumatophores or Respiratory roots and Vivipary (germination while attached to mother tree).

Qualitative and quantitative studies of soil fauna, particularly the micro-arthropods from Indian soils began from the mid-sixties, although ecological studies were initiated much earlier (Trehan, 1945). However, major contributions have been from the agricultural fields, grasslands, abandoned fields and tea gardens, and very few from tropical rainforests. While the micro-arthropod studies from various forest floors included those of Banerjee (1972), Choudhuri (1961 & 1962), Hazra (1978), Bisht & Chatteraj (1986 & 1998). And reports from tropical forest soil and litter micro-arthropods are limited to

the works of Singh & Pillai (1975), Prabhoo (1967,'76a,b), Hazra (1976,'78,'82, '84 & 1987), Hazra *et al.* (1981,'83,'90,'96 & 2003), Mitra (1975,'76, '88 & 1993), Mitra *et al.* (1981, '83, '86, '99 & 2002), Guru *et al.* (1988 & 1991) Ghosh and Roy (2005), Hazra & Mandal (2007), Mandal *et al.* (2007a,b,c, '09, '10 & '11). From the above literature it was assumed that the research works on Soil-Biology have tried to assess the impact of different biotic and abiotic factors on the distribution and diversity of soil mesofauna with special reference to Collembola. In India, Soil micro-arthropods fauna from Mangroove forest ecosystem studies are very scanty. Hazra & Sanyal (1996), Hazra, Dey & Mandal (2005) studied ecology of Collembola in periodically inundated newly emerged alluvial island on the river Hooghly, West Bengal.

So far no consolidated research has not been conducted on this part of the Sundarban. Hence, the present investigation is taken up to know the impact of major soil factors on the distribution of soil micro-arthropod and specially the collembolan fauna. The relationship between the collembolan species and the soil parameters has also been analyzed statistically. The present paper deals with collembolan fauna, other micro arthropods fauna will be published somewhere else.

## METHODS OF SAMPLING

Soil samples were collected at random at the rate of 3 samples per plot (in the two sampling sites) every three month (Quarterly) during April, 2011 to March, 2013. Samples were drawn by using of a stainless steel corer (inner cross-section diameter 8.5 sq. /cm) from a depth of 5 cm. Separate soil samples units (500 gram) were taken from each site (2 packet from each site) for collection of collembolan and estimation of soil parameters like- moisture, pH, organic carbon etc. were kept immediately in sterile polythene packet in 4° C in the laboratory for estimations of soil parameters.

A total of 96 sample units of core and 64 samples units of packet soil were collected and examined during the study period. All the samples collected were immediately transferred to polythene packets and labeled, taking as much as possible to prevent loss of moisture. The labeled samples were brought to the laboratory for extraction within 24 hours of their collection.

## EXTRACTION OF COLLEMBOLA

Extraction of soil samples were carried out by "Expedition Funnel Apparatus" modified by Macfadyen (1953) with a 40-watt bulbs for providing heat and light. The extraction period varied from 36 hrs to 72 hours depending upon the moisture content of the soil sample.

## ANALYSIS OF EDAPHIC FACTORS

Soil samples dried in a hot air oven at about 105 °C for further bacterial action (some sample was kept separately for the estimation of soil moisture) were then allowed to cool and stored in a desiccators and dried soil was passed through the 2 mm sieve, mixed and fractionated before analysis.

**Temperature:** Soil-thermometer was put in use to record the temperature of the soil at 5cm depth and the temperature of air, one meter above ground level.

**Moisture:** Moisture of the soil sample measured by the Moisture meter.

**Hydrogen Ion Concentration (pH):** A soil suspension was prepared in a glass bottle with stopper in which one part of soil was mixed with five parts of de-ionized double distilled water and was shaken in a mechanical shaker for one hour and the ratio was determined after CSIR (Piper, 1942) before taking the reading of the pH of the soil solution electronic pH meter, "WTW-pH 320" after standardizing the instrument each time with a standard Beckman buffer solution for avoiding the instrumental error.

**Organic Carbon:** Organic Carbon content of the soil was determined by 'Rapid Titration Method' (Walkely and Black, 1934). % C = 3.951/g (1-TS). Organic matter of the soil (1 gm) was digested with excess 1 (N) K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and conc. H<sub>2</sub>SO<sub>4</sub> and the residual utilized dichromate is then titrated with 1(N) Fe (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> using diphenyle Amine indicator.

**Location Of Study Area:** Sajnekhali Wild life Sanctuary which is under Sundarban delta situated a little south of Tropic of Cancer between the latitudes 21°31' and 22°31' North and 88°10' and 89°51' East longitudes in the District of 24 Parganas South, West Bengal.

Sajnekhali Wild life Sanctuary has been selected two sites, one from core area of Sajnekhali Wild life Sanctuary which was surrounded by fencing. The other site is Sudanyakhali which was also under the Sundarban delta surrounded by fencing.

## STATISTICAL ANALYSIS OF DATA

The statistical analysis of the complex soil faunal communities has been conducted to show the relationship between the soil factors and Collembola. The application of LINEAR CORRELATION and ANOVA (One way analysis) were undertaken in the present study involving the

data of soil factors and collembolan population densities of soil separately for each site. All the analysis has been carried out by using MINITAB statistical software.

**Linear Correlation:** The correlation coefficient ('r' value) of each variable (i.e. total population of Collembola and four edaphic factors (temperature, moisture, pH and organic carbon) on each other in individual site were shown (Table 3-4). The correlation revealed identical relationship between the biotic variables in four sites. The correlation coefficient data mentioned in the above table broadly indicated that the edaphic factors like moisture, organic carbon with the biotic variables showed strong positive correlation in almost four sites. The correlation coefficient ('r' value) in respect of other variables like - temperature and pH with the biotic variables was found to be negatively significant correlated in all four sampling sites with the population densities of Collembola.

## OBSERVATION

### Site Wise Analysis Of Collembolan Fauna

The present investigation involves extraction of soil micro fauna from the sampling plots in two different sites such as:

**Site I:** SAJNEKHALI

**Site II:** SUDANYAKHALI

**Site I:** SAJNEKHALI

### Location and Characteristic of sampling

**site I:** This locality was situated 100 meters from main entry gate of the core area of the sanctuary covered by fencing. The site is located at 22°07' 24.2'' North and 88°49' 45.8'' East longitudes. Soil was humid alluvial in nature and sandy silt in texture. Although the region is situated south of the Tropic of Cancer, the temperature is equable due to its proximity to the sea. Average annual maximum temperature is around 35°C. Average annual rainfall is 1920 mm. Average humidity is about 82% which is more or less uniform

throughout the year. The dominating mangroves are- Sundari (*Heritiera fomes*), Bain (*Avicennia spp.*), Passur (*Xylocarpus mekongensis*), Dhundul (*Xylocarpus granatum*), Golpata (*Nypa fruticans*), Hental (*Phoenix paludosa*), Khalsi (*Aegiceras corniculatum*), Garjan (*Rhizophora apicata*), Garan (*Ceriops decandra*), Gnewa (*Exocaria agallocha*), Keora (*Sonneratia apetala*), Haragoja (*Acanthus ilicifolius*) and Dhanighas (*Porterasia coarctata*). The sampling site was maintained with coverage of litter of the fallen leaves and dried twigs of the above trees.

**Soil factors:** Soils are alluvial, blackish brown in colour and sandy silt in texture. Salinity of surface soil is high during dry season but is reduced to tolerable limits because dilution by the leaching effects of rainwater. Mechanical analysis of soil showed maximum percentage of medium silt 36.4% and more or less equal percentage of fine sand and fine silt. During summer, soil moisture content was 27% in 2011 and 29.5% in 2012. Maximum moisture content in soil (35.5%) was recorded in July, 2011 and 34.5% in the same period of 2012. During summer, other soil factors such as temperature, pH and organic carbon were found 33.5°C, 5.8, 1.3%; 34°C, 5.6, 1.5%; in 2011 and 2012 respectively. Mean values of others revealed more or less identical characteristics (Tab. 1).

**Collembolan Fauna:** The Collembolan fauna obtained from this site belonged to 10 species in 9 genera. Amongst them, the species *Lepidocyrtus curvicolis* was found most dominant and it was (32.5%) of the total fauna recorded from this site. The species *Axelsonia nitida* contributed (18.9%), *Isotoma* sp contributed (16.2%), *Lepidocyrtus caeruleicornis* contributed (12.4%), *Sminthurides appendiculatus* contributed (5.16%), *Sinella curviseta* contributed (5.5%) and *Cyphoderus javanus* contributed (4.14%). Population of other species from this site was numerically low and highly irregular in distribution pattern in the sampling site. Percentage of springtails was found

**Table 1.** Values of edaphic factors from April, 2011- March, 2013 at Sajnekhali

| Month & Year | Temperature (°C) | Moisture (%) | pH  | Organic carbon(%) |
|--------------|------------------|--------------|-----|-------------------|
| April,2011   | 33.5             | 27           | 5.8 | 1.3               |
| July,2011    | 31               | 35.5         | 6.4 | 2.38              |
| October,2011 | 29.5             | 34           | 6.0 | 2.4               |
| January,2012 | 25               | 27.5         | 6.4 | 2.3               |
| April,2012   | 34               | 29.5         | 5.6 | 1.5               |
| July,2012    | 30.5             | 34.5         | 6.1 | 2.7               |
| October,2012 | 29               | 31.5         | 6.2 | 2.4               |
| January,2013 | 24.8             | 28.5         | 6.4 | 2.1               |
| March, 2013  | 34.5             | 28.5         | 5.5 | 1.8               |

maximum in July in two consecutive years, which coincided with the maximum concentration of soil factors like-moisture, organic carbon and other edaphic factors.

**Seasonal changes:** Seasonal changes of each predominant species of Collembola *Lepidocyrtus curvicolis*, *Lepidocyrtus caeruleicornis* and *Axelsonia nitida* obtained from this site revealed that had reached at its peak in July in both the years, while *Isotoma* sp showed maximum in January 2011 but 2012 the peak was shifted to October. It is apparently seen that, predominant forms of collembolan obtained from this site exhibited an irregular trend of fluctuation being minimum in summer months, slightly higher in winter months and higher in monsoon months. In this field, the population peak of other genera / species varied among the years as well as month of observation due to their irregular occurrence.

#### SITE II: SUDANYAKHALI

**Location and Characteristic of sampling site II:** This locality is situated at Sudhynakhali of Sundarban delta. The site is located at 22°06'4.8"North and 88°48' 3.9"East longitudes. The main forest species are Goran,

Passur, Keora, Bain, Garjan, Tora and Hental (local name).

**Soil factors:** Soils of the plots were alluvial in nature, blackish brown in colour and sandy silt in texture. Mechanical analysis of soil showed maximum percentage of medium silt 37.6% and more or less equal percentage of fine sand and fine silt. During summer, soil moisture content was 26.8% in 2011 and 27.5% in 2012. The month of July in sampling year showed maximum moisture content in soil (36.4% in 2011, 37.2% in the same period of 2012. During summer, other soil factors such as temperature, pH and organic carbon, were found 34.5°C, 5.2, 1.3%; 34°C, 5.5, 1.4%; in 2011 and 2012 respectively. Mean values of others revealed more or less identical characteristics (Tab. 2).

**Collembolan Fauna:** The Collembolan fauna obtained from this site belonged to 6 species under 6 genera. The species *Axelsonia nitida* was the most dominant with 24.9% of the total fauna recorded from this site. The species are, *Lepidocyrtus curvicolis*, *Isotoma* sp., *Entomobrya* sp, *Sminthurides appendiculatus* and *Cyphoderus javanus* which represented 20.36 %, 19.84%, 13.76%, 10.90%, and 10.25% respectively. The population of collembola was found maximum in the month of August in both the year, which

**Table 2.** Values of edaphic factors from April, 2011-March, 2013 at Sudanyakhali

| Month & Year | Temperature(°C) | Moisture (%) | pH  | Organic carbon(%) |
|--------------|-----------------|--------------|-----|-------------------|
| April,2011   | 34.5            | 26.8         | 5.2 | 1.3               |
| July,2011    | 32              | 36.4         | 6.1 | 2.4               |
| October,2011 | 29              | 33.7         | 5.9 | 2.1               |
| January,2012 | 26              | 28.5         | 5.8 | 1.9               |
| April,2012   | 34              | 27.5         | 5.5 | 1.4               |
| July,2012    | 30.2            | 37.2         | 6.1 | 2.6               |
| October,2012 | 29.3            | 30.6         | 6.1 | 2.1               |
| January,2013 | 24.9            | 28.7         | 5.9 | 1.8               |
| March, 2013  | 34.5            | 26.2         | 5.4 | 1.2               |

coincided with the maximum concentration of soil factors like moisture, pH and organic carbon. Partial increase in population in December- January as obtained in this site might be due to prevalence of winter maxima resulting from increased population of some species of collembolan as evident.

**Seasonal Changes:** Number of each predominant species of collembolan insects obtained from this site revealed that *Axelsonia nitida* and *Lepidocyrtus curvicolis* indicating single peak in July in both the year (2011 and 2012)

while *Isotoma* sp. showed its peak in January, 2012 but in 2013 the peak shifted to March. *Sminthurides appendiculatus* and *Cyphoderus javanus* exhibited highest peak in October (2011 & 2012) in both the year. It became apparently evident that predominant formed of collembolan obtained in this site exhibited an irregular trend of fluctuation. The population maxima of other genera and species varied during the years as well as months of observation due to their irregular occurrence in this field.

**Table 3.** Correlation(r value) between individual collembolan species with edaphic factors at Site-I

| Name of the species                | Temperature  | Moisture    | pH           | Organic carbon |
|------------------------------------|--------------|-------------|--------------|----------------|
| <i>Hypogastrura</i> sp             | -0.180147846 | 0.828530719 | -0.652997651 | 0.652985415    |
| <i>Lepidocyrtus curvicolis</i>     | 0.109146027  | 0.872077366 | -0.476077623 | 0.565049206    |
| <i>Lepidocyrtus caeruleicornis</i> | 0.11233319   | 0.740633265 | -0.583840341 | 0.498988274    |
| <i>Sinella curviseta</i>           | -0.1471323   | 0.6677209   | -0.568348    | 0.5597715      |
| <i>Entomobrya</i> sp               | -0.4904062   | 0.1977307   | -0.6556189   | 0.4604979      |
| <i>Axelsonia nitida</i>            | -0.0113091   | 0.5849276   | -0.6844386   | 0.479076045    |
| <i>Lobella maxillaris</i>          | 0.073256903  | 0.6271018   | -0.5098721   | 0.469072044    |
| <i>Isotoma</i> sp                  | 0.1328547    | 0.760909    | -0.6889775   | 0.5749779      |
| <i>Cyphoderus javanus</i>          | -0.5243741   | 0.0777475   | -0.371506    | 0.2472246      |
| <i>Sminthurides appendiculatus</i> | -0.4010517   | 0.2774619   | -0.6175193   | 0.427766       |

**Table 4.** Correlation(r value) between individual collembolan species with edaphic factors at Site- II

| Name of the species                | Temperature  | Moisture    | pH           | Organic carbon |
|------------------------------------|--------------|-------------|--------------|----------------|
| <i>Entomobrya</i> sp               | -0.160745935 | 0.786287817 | -0.702520498 | 0.775227292    |
| <i>Lepidocyrtus curvicolis</i>     | 0.010067725  | 0.846771521 | -0.645910627 | 0.749046149    |
| <i>Axelsonia nitida</i>            | -0.713751666 | 0.235595549 | -0.726386647 | 0.640066048    |
| <i>Isotoma</i> sp                  | 0.030307095  | 0.711675122 | -0.590427574 | 0.603337027    |
| <i>Cyphoderus javanus</i>          | -0.641062164 | 0.118584114 | -0.562758953 | 0.435401949    |
| <i>Sminthurides appendiculatus</i> | -0.023930549 | 0.634964027 | -0.540389791 | 0.612977051    |

#### ANALYSIS OF VARIANCE (ANOVA): ONE WAY ANALYSIS

A univariate analysis of variant with the month as a factor has been carried out whether any

significant seasonal fluctuation exists or not in the population of individual species of collembolan in the four sampling sites. The results of analysis are represented in the tables 5-6.

**Table 5.** ANOVA (One way analysis) of the collembolan species in relation to the edaphic factors in site I

| Species                            | Temperature |           | Moisture |          | pH      |          | Organic carbon |          |
|------------------------------------|-------------|-----------|----------|----------|---------|----------|----------------|----------|
|                                    | F value     | P value * | F value  | P value* | F value | P value* | F value        | P value* |
| <i>Hypogastrura</i> sp             | 152.86      | 0.000     | 250.17   | 0.000    | 3.20    | 0.088    | 0.31           | 0.582    |
| <i>Lepidocyrtus curvicolis</i>     | 173.97      | 0.000     | 329.54   | 0.000    | 1.57    | 0.224    | 3.16           | 0.089    |
| <i>Lepidocyrtus caeruleicornis</i> | 152.86      | 0.000     | 250.17   | 0.000    | 3.20    | 0.088    | 0.31           | 0.582    |
| <i>Sinella curviseta</i>           | 358.05      | 0.000     | 1056.63  | 0.000    | 228.95  | 0.000    | 30.13          | 0.000    |
| <i>Entomobrya</i> sp               | 334.22      | 0.000     | 892.93   | 0.000    | 110.23  | 0.000    | 15.25          | 0.001    |
| <i>Axelsonia nitida</i>            | 179.63      | 0.000     | 316.20   | 0.000    | 5.77    | 0.025    | 0.09           | 0.771    |
| <i>Lobella maxillaris</i>          | 348.82      | 0.000     | 997.90   | 0.000    | 170.54  | 0.000    | 22.17          | 0.000    |
| <i>Isotoma</i> sp                  | 152.86      | 0.000     | 250.17   | 0.000    | 3.20    | 0.088    | 0.31           | 0.582    |
| <i>Cyphoderus javanus</i>          | 310.76      | 0.000     | 788.52   | 0.000    | 69.34   | 0.000    | 7.08           | 0.014    |
| <i>Sminthurides appendiculatus</i> | 239.51      | 0.000     | 499.66   | 0.000    | 18.04   | 0.000    | 0.30           | 0.587    |

\* < 0.05 significant

**Table. 6.** ANOVA (One way analysis) of the collembolan species in relation to the edaphic factors in site II

| Species                            | Temperature |          | Moisture |          | pH      |          | Organic carbon |          |
|------------------------------------|-------------|----------|----------|----------|---------|----------|----------------|----------|
|                                    | F value     | P value* | F value  | P value* | F value | P value* | F value        | P value* |
| <i>Entomobrya sp</i>               | 260.30      | 0.000    | 482.12   | 0.000    | 19.35   | 0.000    | 0.02           | 0.891    |
| <i>Lepidocyrtus curvicolis</i>     | 380.08      | 0.000    | 866.15   | 0.000    | 211.63  | 0.000    | 22.15          | 0.000    |
| <i>Axelsonia nitida</i>            | 347.78      | 0.000    | 743.91   | 0.000    | 98.11   | 0.000    | 8.69           | 0.007    |
| <i>Isotoma sp</i>                  | 404.57      | 0.000    | 969.96   | 0.000    | 564.53  | 0.000    | 51.88          | 0.000    |
| <i>Cyphoderus javanus</i>          | 340.48      | 0.000    | 708.68   | 0.000    | 83.05   | 0.000    | 8.11           | 0.009    |
| <i>Sminthurides appendiculatus</i> | 358.59      | 0.000    | 755.07   | 0.000    | 110.49  | 0.000    | 14.98          | 0.001    |

\* &lt; 0.05 significant

## DISCUSSION

The ecological studies of this investigation were based on the sample survey of two sites from Sajnekhali Wild Life Sanctuary, Sundarban Biosphere Reserve, South 24 Parganas, West Bengal over a period of 24 months (April, 2011 to March, 2013). Salinity of surface soil is high during dry season but is reduced to tolerable limits because dilution by the leaching effects of rainwater. The general natures of the soil of two sampling sites were more or less identical.

The Collembolan fauna of the two study sites belonged to 10 species under 9 genera of 6 families: Hypogastruridae, Neanuridae, Isotomidae, Entomobryidae, Cyphoderidae and Sminthuridae (Table 7).

The number of genera occurring in two different sampling sites also varied, maximum extracted from the site-I (10 species under 9 genera) and from the site-II (6 species under 6 genera). Out of the 9 genera, the predominant genera were *Lepidocyrtus* (2 species), *Axelsonia* (1 species), *Isotoma* (1 species), *Cyphoderus* (1 species), *Entomobrya* (1

species), *Sinella* (1 species), *Sminthurides* (1 species) *Lobella* (1 species), *Hypogastrura* (1 species) mentioned in order of dominance.

The genus *Lepidocyrtus* were represented by 2 species like, *Lepidocyrtus curvicolis* and *Lepidocyrtus caeruleicornis*. The genus *Lepidocyrtus* was found to be widely distributed in all sampling plots comprising 22.9% of total population of collembola and being numerically dominant over other forms. The wide distribution range and numerical dominance suggest capability of this genus to dwell in varying ecological conditions. The species, *Lepidocyrtus curvicolis* was seen the most dominant taxon of this genus and occupied first position in order of dominance in respect to the total number of collembola indicating maximum genera and species in the month of July.

The second predominant genus was *Axelsonia* with single species *nitida*, comprising 21.9% of the total population in all the sites. The species was recorded in maximum from the sampling site II reaching its peak in January-February.

**Table 7.** Taxonomic status of the Collembolan species from the Sajnekhali Wild life Sanctuary.

|        |                                                 |
|--------|-------------------------------------------------|
| FAMILY | HYPOGASTRURIDAE                                 |
|        | <i>Hypogastrura</i> sp                          |
| FAMILY | NEANURIDAE,                                     |
|        | <i>Lobella maxillaris</i> Yosii,1966            |
| FAMILY | ISOTOMIDAE                                      |
|        | <i>Axelsonia nitida</i> (Folsom) Borner,1906    |
|        | <i>Isotoma</i> sp                               |
| FAMILY | ENTOMOBRYIDAE                                   |
|        | <i>Sinella curviseta</i> Brook,1882             |
|        | <i>Lepidocyrtus curvicolis</i> Bourlet,1839     |
|        | <i>Lepidocyrtus caeruleicornis</i> Bonet, 1930. |
|        | <i>Entomobrya</i> sp                            |
| FAMILY | CYPHODERIDAE                                    |
|        | <i>Cyphoderus javanus</i> Borner,1906           |
| FAMILY | SMINTHURIDAE                                    |
|        | <i>Sminthurides appendiculatus</i> Imms, 1912   |

The third numerical dominant genus *Isotoma* sp. represented by single species was extracted in maximum number (18%) from all the sampling sites though the insects were maximum in number in October.

Another dominant genus *Sminthurides* and *Cyphoderus* extracted from both the sites and comprised 8.1% and 7.19% of total population occupying fourth position in dominance.

The other important genera collected there were, *Entomobrya*, *Sinella*, *Lobella* and *Hypogastrura* constituting 5.5%, 5.4%, 3.2% and 1.9% respectively.

In the present study, the total population of collembolan of all the sampling sites showed numerical variation with the change of season with minimum in summer months in all sites. Moreover, a general pattern of fluctuation with maximum in monsoon and minimum in pre-monsoon (April), which in agree with Hazra and Choudhuri (1990) and Hazra & Sanyal (1996).

Mitra *et al.*, (1977) and Hazra and Choudhuri (1990) showed that, surface soil vegetations exert an indirect influence on the collembolan population through its effect on the porosity of soil, humus formation and soil moisture in spite of different vegetation in most of the sampling sites.

According to Wallwork (1970), the Collembolan fauna of certain locality was determined by a complex factor of both ecological and historical. Therefore, the author is of the view that the degree of similarity in species composition between two sites could be used as an index of overall ecological similarity and the influence of vegetation type indirectly exert through its effect on soil type, micro floral composition or soil moisture.

Hazra and Sanyal (1996) found increase of the diversity of collembolan members in artificially raised mangrove forest of an island of the river Hooghly (West Bengal) and also said that the number increased with high concentration of moisture and nitrate.

According to Curry (1971) the maximum and minimum population were confined to a particular month or season of the years of observation in particular site which appears similar to the observations of workers in different parts of world. Study of maximum population in all sampling site in August and minimum in May tally with Mukherjee and Singh (1970).

During this investigation, the predominant species *Lepidocyrtus curvicolis*, *Lepidocyrtus caeruleicornis* *Axelsonia nitida* and *Isotoma* sp. attained maximum population in July and two species, *Cyphoderus javanus* and *Sminthurides appendiculatus* in January. *Entomobrya* sp. reached its peak in October followed by in March while *Sinella curviseta* and appeared largest population in the month of August. Individuals of other species like, *Hypogastrura* sp, *Lobella maxillaris* were numerically low in summer months with a very irregular trend of fluctuation and these were altogether absent in many of the sampling months. Thus, most of the predominant forms considered here were found to exhibit a single peak in a year.

According to Straalen (1997) some species had a sharp peak of collembolan community in respective months whereas others tend to fluctuate gradually throughout the year. Existence of single peak suggested the probability of single generation per year (Hale, 1966).

The role of edaphic factors on the distribution and population pattern of different groups of soil inhabiting micro fauna and flora might be assumed that the factors so far analyzed in this study exerted both significant and insignificant effects either singly or in cumulative way depending on the nature of the site. The population was maximum when the factors like moisture, organic carbon were significantly high and other conditions were optimum

Temperature and soil moisture appeared as the main driving variables for seasonal fluctuation of micro-arthropod population especially in temperature climate with dry summer period (Straalen, 1997). In the summer month's soil

temperature was significantly high and yielded minimum population on account of lesser water content and physical stability of the humus layer in this type of climate in West Bengal.

Of the edaphic factors studied, temperature showed wide variation with the change of season, ranging between 25°C and 34.5°C (Table 1-2). Collembolan population indicated negative correlation with temperature in both sites which confirm the study of Pal et al (1992) and Guru et al (1988). Takeda (1978) also found both positive and negative correlation between temperature and different species of springtails. Hazra & Choudhuri (1983) commented that direct influence of temperature on the distribution pattern of Collembola was difficult to evaluate because collembolan are known to withstand a wide range of temperature, as low as -50°C and made a conclusion that temperature alone did not show significant correlation. Thus it might be noted in this connection that the direct influence of temperature on the distribution pattern of soil arthropods was difficult to evaluate. The actual influence of temperature on the soil-organisms could be evaluated in conjunction with the effect of moisture which recorded minimum in summer thereby yielding low population.

Moisture content was recorded maximum (36.4%) and minimum (26.2%) respectively in all sites and thus a range of variation was observed in two different seasons. The value of correlation of collembola with moisture was highly significant in both the sites (Table 3-4). Mukherjee and Singh (1970), Choudhuri and Roy (1967), Hazra and Choudhuri (1983, 90) and Guru *et al.* (1988) found positive but not significant correlation between the soil organisms and moisture. Choudhuri and Roy (1972) and Singh and Pillai (1975) affirmed that soil humidity put its influence on micro-arthropods and collembolan in particular. Highly significant positive correlation with collembola and its monsoon population peak in all sampling sites was similar to Agrell (1941), Poole (1961), Mitra *et al.* (1977), Hazra and Choudhuri (1981, '83). Haarlov (1960) considered either moisture or

organic matters as an important ecological factor in the life of collembola in Danish soil. However, Choudhuri and Roy (1967) and Nijima (1971) reported significant influence of organic matter and soil moisture on the population of Collembola.

According to Singh and Pillai (1975), the ecological parameters like-soil temperature, moisture, organic matter and CaCo<sub>3</sub> content of soil influence composition of soil fauna either individually or in combination with other. Hazra (1978a, b) and Hazra & Choudhuri (1990) suggested that organic matter and water content of soil together exerted direct or indirect influence on the microbial floral and faunal population by (i) maintaining soil reaction, (ii) controlling humification and (iii) stimulating the growth of micro-macro-flora.

The content of organic carbon varied between 1.3% and 2.6% and exhibited strong positive correlations with the population densities of Collembola in all the sampling sites (Table 1-2). The concentration of large population of flora and fauna in the litter and humus layer suggested their affinity to organic matter. The high temperature and low moisture in the soil seemed to influence the amount of organic carbon as was evident here in summer during when soil contain less amount of organic because of low moisture level and ready oxidation of organic matter.

Another important variable affecting the population fluctuation of soil biota was the soil pH which read minimum of 5.2 and maximum of 6.4 (Table.1-2). However, its average value in both the sites did not differ much and was more or less neutral. The statistical analysis showed strong negative correlation with the population densities of Collembola and pH at both the sites which agreed with the findings of Agrell (1941), Bellinger (1954), Choudhuri et al (1978) and Pal et al (1992). According to Hazra and Choudhuri (1983), more or less neutral pH was favorable to soil organisms while Dhillon and Gibson (1962) opined for very little or no direct effect of soil pH on the floral and faunal make up.

It may be concluded from the present investigation that the organic carbon and moisture are key factors which controlling fluctuations of collembolan population. However, the factors considered here and other biotic and abiotic factors not considered at present may also play an important role for the seasonal variation and fluctuation of collembolan fauna.

### SUMMARY

The fauna of the experimental sites belong to 10 species of 9 genera of 6 families: Hypogastruridae, Neanuridae, Isotomidae, Entomobryidae, Cyphderidae and Sminthuridae. Maximum species diversity came in view from the Site-I with 10 species in 9 genera and the Site II with 6 species in 6 genera.

The number of genera occurring in two different sampling sites also varied, maximum extracted from the site-I (10 species under 9 genera) and minimum from the site-II (6 species under 6 genera). Out of the 9 genera, the predominant genera were *Lepidocyrtus* (2 species), *Isotoma* (1 species), *Axelsonia* (1 species), *Entomobrya* (1 species), *Sinella* (1 species), *Sminthurides* (1 species), *Cyphoderus* (1 species), *Lobella* (1 species), and *Hypogastrura* (1 species) mentioned in order of dominance.

Soil factors like-temperature, moisture, hydrogen ion concentration, organic carbon and the roles of these edaphic factors of soil on the distribution of collembola in the mangrove forest ecosystem were taken into consideration in the study.

The peak of population also varied from site to site being minimum in pre monsoon (summer months) and maximum population during monsoon (in the month of July, August & September). Soil factors viz, moisture, organic carbon, also showed

significant positive correlation with the Collembolan population in two sites while negative correlation was observed in respect to temperature and pH.

### ACKNOWLEDGEMENTS

We are grateful to the Director, Dr. K. Venkatraman, Zoological Survey of India, Kolkata for giving permission to carry out the project and laboratory facilities. Authors are grateful to Divisional In-charge, Entomology (B), division, Zoological Survey of India, Kolkata for kind

encouragement & help. Authors are indebted to Dr. A.K.Hazra, Emeritus Scientist, for helping various ways to carry out the project. We are thankful to the sectional staff of the Apterygota namely- Shri Dilip Mondal, Junior Zool Assistant, Shri N. C. Moitra, Laboratory Assisant, Shri K. L. Nath, Collection Tender for helping in collection and sorting out of collembolan specimens as well as soil parameter study. We are also thankful to the Principal Chief Conservator of Forests, Govt. of West Bengal for providing necessary permission to carry out the project.

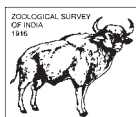
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## ON AN ACCOUNT OF COREOIDEA (HETEROPTERA: HEMIPTERA) FROM CHHATTISGARH, INDIA

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### INTRODUCTION

Reuter (1910) first established the Coreoidea as a superfamily of the Heteroptera and Leston *et al.* (1954) placed the Coreoidea within infraorder Pentatomomorpha. The superfamily includes five families: Alydidae (broad headed bugs), Coreidae (Leaf-footed bugs or Squash bugs), Rhopalidae (Scentless plant bugs), Stenocephalidae (confined to Eastern Hemisphere) and Hyocephalidae (endemic to Australia), comprising of 2376 species from the world (Henry 2009). Of these, about 200 species under 60 genera are so far known from India including 78 endemic species.

Member of the superfamily Coreoidea can easily be recognized by having forewings with numerous veins, ocelli present, head narrower and most often shorter than pronotum, antennae four segmented and hind tibiae in some species with lateral expansions, Scent glands are present on the thorax between mesocoxae and metacoxal and are highly modified and well developed, peritremes are provided with orifices that emit a strong scent that serves both to deter predators and as an alarm pheromone causing aggregation to scatter. They are principally phytophagous but several instances of coprophagy and carrion feeding have been recorded.

Chhattisgarh is tenth largest state (135,000 km<sup>2</sup>) and third largest area under forest cover after Madhya Pradesh and Arunachal Pradesh (43.9%). Information on the Coreoidea fauna of Chhattisgarh is very scanty and only 9 species

under 8 genera are known so far through the work of Chandra and Kushwaha (2012, 2013) from Barnawapara Wildlife Sanctuary and Kanger Valley National Park, Jagdalpur respectively and Biswas and Ghosh (1995) from Indravati Tiger Reserve. The present study revealed an account of 23 species belonging to 16 genera under 4 families of superfamily Coreoidea from the state of Chhattisgarh, out of this 5 species under 5 genera have already been recorded and rest of the 18 species under 11 genera are new record to the state. The material studied was collected during the year 2009-2012 by the different survey parties Zoological Survey of India and deposited in the National Zoological Collection of Z.S.I.

### SYSTEMATIC LIST

Superfamily COREOIDEA

Family COREIDAE

Subfamily COREINAE

Genus 1. *Anoplocnemis* Stal, 1873

\*1. *Anoplocnemis phasiana* (Fabricius, 1781)

Genus 2. *Petillopsis* Hsiao, 1963

2. *Petillopsis calcar* (Dallas, 1852)

Genus 3. *Dalader* Amyot & Serville, 1843

3. *Dalader planiventris* (Westwood, 1842)

Genus 4. *Homoeocerus* Burmeister, 1835

\*4. *Homoeocerus signatus* Walker, 1871

5. *Homoeocerus striicornis* Scott, 1874

- Genus 5. *Aschistocoris* Bergroth, 1909
6. *Aschistocoris brevicornis* (Dallas, 1852)
- Genus 6. *Notobitus* Stal, 1860
- \*7. *Notobitus meleagris* (Fabricius, 1787)
- Genus 7. *Petalocnemis* Stal, 1854
8. *Petalocnemis obscura* (Dallas, 1852)
- Genus 8. *Cletus* Stal, 1860
- \*9. *Cletus bipunctatus* (Westwood, 1840)
10. *Cletus punctulatus* (Westwood, 1842)
11. *Cletus punctiger* (Dallas, 1852)
- Subfamily PSUDOPHLOCINAE
- Genus 9. *Clavigralla* Spinola, 1837
12. *Clavigralla concolor* (Dohrn, 1860)
13. *Clavigralla gibbosa* Spinola, 1837
- Genus 10. *Hoplolomia* Stal, 1873
14. *Hoplolomia scabricula* Stal, 1873
- Family STENOCEPHALIDAE
- Genus 11. *Dicranocephalus* Hahn, 1826
15. *Dicranocephalus lateralis* (Signoret, 1879)
- Family ALYDIDAE
- Subfamily MICRELYTERINAE
- Genus 12. *Leptocorisa* Latreille, 1829
16. *Leptocorisa oratorius* (Fabricius, 1873)
17. *Leptocorisa acuta* (Thunb.)
- Subfamily ALYDINAE
- Genus 13. *Nariscus* Stal, 1866
18. *Nariscus fisheri* (Distant, 1908)
- Genus 14. *Riptortus* Stal, 1860
19. *Riptortus pedestris* (Fabricius, 1775)
- \*20. *Riptortus linearis* (Fabricius, 1775)
- Family RHOPHALIDAE
- Subfamily RHOPHALINAE
- Genus 15. *Liorhyssus* Stal, 1870
21. *Liorhyssus rubicundus* (Signoret, 1859)
22. *Liorhyssus hyalinus* (Fabricius, 1794)
- Subfamily SERINATHINAE
- Genus 16. *Leptocoris* Hahn, 1833
23. *Leptocoris augur* (Fabricius, 1781)

## SYSTEMATIC ACCOUNT

### Superfamily COREOIDEA

#### Key to the families of the superfamily Coreoidea

1. Abdominal spiracle dorsal..... 2
- Abdominal spiracle ventral..... 3
2. Metathoracic scent gland auricles absent or greatly reduced..... Rhopalidae
- Metathoracic scent gland auricles large and conspicuous, never bristly, ovipositor usually flattened and plate like, if lacinate then tibiae not sulcate and abdominal pore bearing organs lacking..... Coreidae
3. Interocular distance greater than width of anterior margin of scutellum, ovipositor plate like ..... Alydidae
- Interocular distance less than width of anterior margin of scutellum, ovipositor lacinate... . Stenocephalidae

#### Family COREIDAE

#### Key to the subfamilies of family Coreidae

- 1 Length variable; tibiae sulcate (sometimes shallowly sulcate); head longitudinally impressed near central lobe; posterior angles of dorsal surface of sixth abdominal segment in male rounded, obtuse, or straight, or somewhat prominently recurved; tibiae above generally sulcate or dilated..... Coreinae.
- Member of the subfamily not more than 12 mm long; tibiae not sulcate; head not impressed near central lobe metathoracic scent gland orifices with a single large or two nearly fused disc, posterior angles of dorsal surface of sixth abdominal segment in both sexes prominently recurved, slightly dentate, or spinose; meso and meta sterna sulcate, male with a bi-lobed genital capsule opening, filled by the clearly visible parameres; tibiae rounded, not sulcate ..... Pseudophlocinae.

## Subfamily Coreinae

**Key to the genera of the subfamily Coreinae**

1. Posterior femora incrassated, profoundly thickened..... 2
  - Posterior femora not incrassated..... 5
2. Anterior femora incrassated..... 3
  - Anterior femora not incrassated..... 4
3. Posterior tibiae moderately dilated.....*Petillopsis* Hsiao
  - Posterior tibiae not dilated.....*Anoplocnemis* Stal
4. Apex of head slightly produced.....*Notobitus* Stal
  - Apex of head not produced; lateral margin of corium perceptibly rounded; meso-sternum sulcate .....*Petalocnemis* Stal
5. Third joint of antenna foliaceously dilated on each side; pronotum with lateral angles always strongly dilated.....*Dalader* Amyot and Serville
  - Third joint of antenna not foliaceously dilated on each side; pronotum with lateral angles not dilated ..... 6
6. Abdomen not ampliased; pronotal angles not acutely produced ..... 7
  - Abdomen profoundly ampliased; pronotal angles acutely produced; abdominal segmental angles not exteriorly acutely produced.....*Cletus* Stal
7. Central lobe of head distinctly deflected between lateral lobes.....*Homoeocerus* Burmeister
  - Central lobe of head not distinctly deflected between lateral lobes.....*Aschistocoris* Bergroth

Genus 1. *Anoplocnemis* Stal, 18731873. *Anoplocoemis* Stal, *En. Hem.*, 3: 47.1. *Anoplocnemis phasiana* (Fabricius, 1781)1781. *Lygaeus phasiana* Fabricius, *Spec. Ins.*, 2: 361.1902. *Anoplocnemis phasiana*: Distant *Fauna Brit. India, Rhynchota*, 1: 346.

*Material examined*: 4 exs., Nakti pond, Dist. Raipur, 13.vii.2011, coll. Sunil Kumar and party; 1ex. Jilianala, Dist. Raipur, 25.vii.2011, coll. Sunil Kumar and party.

*Diagnostic characters*: Body brown; head wider than long, about 0.73 times as long as wide; corium reddish brown with the margins and apex black; antennae black, with the apical joint light brown to brown; scutellum brown apically; hind femora in male curved at base, strongly incrassated, inwardly broadly dentate near apex, outer margin linearly serrate. A1:A2:A3:A4::1: 0.81: 0.72: 1.1. *Length*: 22-28 mm.

*Distribution*: India: Chhattisgarh (Raipur), Assam, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Nagaland, Sikkim, Uttarakhand. *Elsewhere*: Sri Lanka, Myanmar, Malayan Archipelago, Malayan Peninsula.

Genus 2. *Petillopsis* Hsiao, 19631963. *Petillopsis* Hsiao, *Act. Zool. Sinica*, 15: 622.2. *Petillopsis calcar* (Dallas, 1852)1852. *Mictis calcar* Dallas *List. Hem.*, 2: 397.1902. *Petillia calcar*: Distant, *Fauna Brit. India, Rhynchota*, 1: 351.2006. *Petillopsis calcar*: Dolling, *Cat. Het. Palae. Reg.*, 5: 97.

*Material examined*: 1 ex., Seja, Dist. Durg, 23.viii.2011, coll. Sunil Kumar and party; 1ex., Pavirid, Dist. Raipur, 3.viii.2011, coll. Sunil Kumar and party; 1ex., Sakri river, Dist. Kabirdham, 25.viii.2011, coll. Sunil Kumar and party.

*Diagnostic characters*: Body brown and pilose, paler ventrally provided with small scattered black spots; pronotum with some scattered black tuberculous points, the lateral margins darkly serrate, the lateral angles produced, their apices pointed and slightly directed backward; connexivum alternately brown and black; veins of the corium black; posterior femora incrassated, posterior tibiae inwardly dilated and strongly dentate. *Length*: 22 to 27 mm.

*Distribution*: India: Chhattisgarh (Durg, Kabirdham, Raipur), Sikkim, Meghalaya, Nagaland, Maharashtra. *Elsewhere*: Myanmar, Philippine Islands, Sri Lanka.

Genus 3. **Dalader** Amyot & Serville, 18431843. *Dalader* Amyot & Serville, *Hem*: 187.3. **Dalader planiventris** (Westwood, 1842)1842. *Acauonicus planiventris* Westwood, in *Hope Cat.*, 2: 8.1902. *Dalader planiventris*: Distant, *Fauna Brit. India, Rhynchota*, 1: 352.

**Material examined:** 1 ex., Pagwahi, Dist. Kabirdham, 1.ix.2011, coll. Sunil Kumar and party.

**Diagnostic characters:** Body brown in colour, finely punctate; antennae finely pilose, third joint amplified on each side, fourth joint slender and a little paler; pronotum with distinct central longitudinal carination, the lateral angles lunately produced, their apices obliquely truncate, the anterior lateral margins finely denticulate; membrane provided with scattered darker spots; abdominal dilatations with paler reflections on each segment; abdomen coarsely granulate. Head wider than long, about 0.79 times as long as wide; maximum width of head 0.24X as long as maximum width of pronotum and pronotum much wider than long, about 0.35X as long as wide. *Length:* 23 to 28 mm.

**Distributions:** India: Chhattisgarh (Kabirdham), Assam, Maharashtra, Tamil Nadu, Sikkim. **Elsewhere:** Sri Lanka, Mayanmar, Malayan Peninsula and Sumatra.

Genus 4: **Homoeocerus** Burmeister, 18351835. *Homoeocerus* Burmeister, *Handb.*, 2: 316**Key to the species of the genus Homoeocerus**

1. Third rostral segment longer than fourth ; third antennal segment distinctly dilated apically; macular spot touching costal margin.....  
..... *signatus*
- Third rostral segment shorter than the fourth; dominant body color green; antennae thicker and shorter; pronotum with red lateral lines, posterior margin sinuate; body with punctures of yellow color; pronotal angles less acute and narrow ..... *striicornis*

4. **Homoeocerus signatus** (Walker, 1871)1871. *Prismatocerus signatus* Walker, *Cat. Hemip. Hetin the Collection of the British Museum*, 4(92): 97.1871. *Homoeocerus signatus* Walker, *Cat. Het.*, 4: 97.1902. *Homoeocerus signatus*: Distant, *Fauna Brit. India, Rhynchota*, 1: 356.

**Material examined:** 1 exs., Makki Range, Bastar, Dist. Bastar, 27.ix.2011, coll. R.P. Gupta and party.

**Diagnostic characters:** Body brown; a broad basal fascia to the pronotum between the lateral angles; corium with a large transverse macular spot at inner angle and the lateral margins and yellowish brown in colour; head wider than long, about 0.64 times as long as wide, with a narrow fascia on each side before eyes, and the sub-granulous lateral margins of the pronotum, black; antennae with the first and second joints pale reddish brown, third joint light brown, apices of second and third joints black, second joint longer than the first, A1:A2:A3:A4:: 1:1.42: 1.85: 1.87; meso and meta-sterna with a black spot on each lateral area; lateral angles of the pronotum moderately and sub-acutely produced, pronotum little wider than long, about 0.72 X as long as wide, maximum width of head about 0.33X as long as maximum width of pronotum. *Length:* 19 to 21 mm.

**Distribution:** India: Chhattisgarh (Bastar), Himachal Pradesh, Maharashtra, Sikkim, **Elsewhere:** Pakistan, Sri Lanka.

5. **Homoeocerus striicornis** (Scott, 1874)1874. *Homoeocerus striicornis* Scott, *A.M.N.H.* (4)14: 362.2006. *Homoeocerus striicornis*: Dolling. *Cat.Het.Palae. Reg.*, 5: 83.

**Material examined:** 1 ex., Ramgarh, Dist. Koriya, 2.viii.2011, coll. Angshuman Raha and party.

**Diagnostic characters:** Body greenish to pale brown; antennae light brown with reddish tinge, the first and second joints exteriorly with a longitudinal black line, fourth joint with its apical half infuscated, first and third joints sub-equal in length, third shortest, considerably shorter than fourth; pronotum longer than wide, the lateral margins with a fine black line, the lateral angles distinctly angulately prominent; corium with a

distinct sub-costal black line; body beneath and legs pale; rostrum with the third joint considerably shorter than fourth. Head wider than long, about 0.76X as long as wide, maximum width of pronotum about 2X as long as maximum width of the head, pronotum wider than long, about 0.71X as long as wide. *Length*: 17 to 20 mm.

*Distribution*: India: Chhattisgarh (Koriya), Assam, Himachal Pradesh, Maharashtra, Sikkim. *Elsewhere*: Thailand, Sri Lanka, Japan.

#### Genus 5. *Aschistocoris* Bergroth, 1909

1909. *Aschistocoris* Bergroth, *Ann. Soc. Entomol. Belg.* 53: 34.

#### 6. *Aschistocoris brevicornis* (Dallas 1852)

1852. *Aschistus brevicornis* Dallas, *List of the specimens of hemipterous insects in the collection of the British Museum*, 2: 448.

1998. *Aschistocoris brevicornis*: Ahmad & Praveen, *Proc. Pak. Cong. Zool.* 18: 231-238.

*Material examined*: 1 ex., Donduala, Dist. Raipur, 10.vii.2011, coll. Sunil Kumar and party.

*Diagnostic characters*: Body elongate and brown in colour, thickly punctate; head wider than long, about 0.98 times as long as wide; maximum width of head 0.45X as long as maximum width of pronotum; antennae with first, third, and fourth joints sub-equal in length, second joint longest, fourth slender and infuscated towards apex, A1: A2: A3: A4: : 1:1.8:1:1. Pronotum wider than long, about 0.86X as long as wide. Scutellum slightly longer than wide; membrane brassy, hyaline, not reach reaching the apex of abdomen, beneath and legs pale brown; sternum coarsely punctate, furrowed and ridged on each lateral area, a minute fuscous spot on each side of the meso- and meta sterna; abdomen finely punctate, with a series of foveate spots on each lateral area. Length of hind femur about 0.93X as long as hind tibia. *Length*: 15 mm.

*Distribution*: India: Chhattisgarh (Raipur), West Bengal.

#### Genus 6. *Notobitus* Stal, 1860

1860. *Notobitus*: Stal 1859, *Ofv. Vet.-Ak. Forh.*, p. 451.

#### 7. *Notobitus meleagris* (Fabricius, 1787)

1787. *Cimex meleagris* Fabricius, *Mant.*, 2: 207.

1902. *Notobitus meleagris* Distant, *Fauna Brit. India, Rhynchota*, 1: 371.

*Material examined*: 7 exs., Ravan Forest, Dist. Raipur, 20.ix.2011, coll. Sunil Kumar and party.

*Diagnostic characters*: Body grayish brown; head brown, wider than long, 0.85 X as long as wide, maximum width of head 0.45X as long as maximum width of pronotum; pronotum wider than long, about 0.63X as long as wide; antennae blackish, basal area of fourth joint light brown, with 2<sup>nd</sup> and 3<sup>rd</sup> segments sub-equal in length, length of the 2<sup>nd</sup> segment about 1.16X as long as 1<sup>st</sup> segment; corium brown on its apical area; posterior femora in the male extending considerably beyond the apex of the abdomen, with a long spine beyond middle of inner surface, followed by some smaller spines, posterior tibiae in the male with their inner margins strongly serrate; abdomen above black. Length of hind femur about 1.07X as long as hind tibia. *Length*: 22 to 25 mm.

*Distribution*: India: Chhattisgarh (Raipur), Tamil Nadu. *Elsewhere*: China, several islands in the Malayan Archipelago.

#### Genus 7. *Petalocnemis* Stal, 1854

1854. *Petalocnemis* Stal 1853, *Ofv. Vet. Ak. Forh.*, p. 259.

#### 8. *Petalocnemis obscura* (Dallas, 1852)

1852. *Acanthocoris obscura* Dallas *List. Hem.*, 2: 518.

1902. *Petalocnemis obscura*: Distant, *Fauna Brit. India, Rhynchota*, 1: 386.

*Material examined*: 6 exs., Davgaon forest, Dist. Raipur, 12.xii.2011, coll. Sunil Kumar and party.

*Diagnostic characters*: Body brown, provided with short hairs throughout the body; head and pronotum with a central pale carinate line, pronotal angles broadly truncate; corium with spinous hairs on the anterior-lateral margins; conuexivum with obscure transverse brown spots at the incisures; body beneath and legs light brown; anterior tibiae compressed, somewhat dilated, with a double series

of spinous tubercles on outer margin. Antennae with first, second, and third joints concolorous with the body, apices of second and third joints black, apical joint brownish black. Head wider than long, about 0.67 times as long as wide, maximum width of head about 0.36X as long as maximum width of pronotum, pronotum wider than long, about 2X as long as wide, hind tibia slightly shorter than hind femur. *Length*: 13 to 14.5 mm.

*Distribution*: India: Chhattisgarh (Raipur), Meghalaya, Maharashtra, Punjab, West Bengal. *Elsewhere*: Sri Lanka.

#### Genus 8. *Cletus* Stal, 1860

1860. *Cletus* Stal, *Freg. Eug. Resa, Ins. Hem*: 236.

#### Key to the species of the genus *Cletus*

- 1 Body length of adult may reach up to 12 mm. the apices of lateral margin of pronotum produced into long black spines ..... *punctiger*
- Body length of adults reach up to 10 mm.; apices of the pronotum not much produce... ..... 2
2. Pronotal angles shortly and rosately produced ending into fuscous spines; femora without yellow brown spots; breadth between pronotal angles 3.5-4 m.m. .... *bipunctatus*  
Pronotal angles widely and acutely produced ending into short thick yellow brown spines; breadth between pronotal angles 4.5-5 mm. .... *punctulatus*

#### 9. *Cletus bipunctatus* (Westwood, 1840)

1842. *Coreus bipunctatus* Westwood, in *Hope Cat.*, 2: 23.

1902. *Cletus bipunctatus*: Distant, *Fauna Brit. India, Rhynchota*, 1: 393.

*Material examined*: 7 exs., Hardinala, Dist. Raipur, 8.xi.2011, col. Anil and party; 4exs., Junagad forest, Dist. Gariabandh, 17.xi. 2011, col. Sunil Kumar and party; 3 exs., Pipartala forest, Dist. Kabirdham, 17.x.2011, col. Sunil Kumar and party.

*Diagnostic characters*: Body pale brown and somewhat punctate; Head wider than long, about

0.68 times as long as wide, maximum width of head 0.40X as long as maximum width of pronotum, pronotum wider than long, about 0.54X as long as wide; scutellum slightly wider than long, about 0.97X as long as wide; lateral margins of the corium and a small spot on its inner apical margin light brown; abdomen above brown, with transverse black markings, connexivum brown, body beneath and legs light brown, a small spot on the lateral area of each sternal segment; antennae reddish brown, the apical joint fuscous; pronotal lateral angles shortly and acutely produced, the apices of the spines fuscous. Length of hind femur about 1.12X as long as hind tibia. *Length*: 9 to 10 mm.

*Distribution*: India: Chhattisgarh (Gariabandh, Kabirdham, Raipur), Himachal Pradesh, Maharashtra, West Bengal, Karnataka. *Elsewhere*: Myanmar, Sri Lanka.

#### 10. *Cletus punctulatus* (Westwood, 1842)

1842. *Coreus punctulatus* Westwood, in *Hope Cat.*, 2: 23.

1902. *Cletus punctulatus*: Distant, *Fauna Brit. India, Rhynchota*, 1: 392.

*Material examined*: 1 ex., Kodmali, Goriyaband, 18.x.2011, Coll. Sunil Kumar and party; 4 exs., Hardinala, Dis. Raipur, 8.xi.2011, Coll. Anil and party; 1ex., Junagad forest, Dist. Goriya band, 17.x.2011, Coll. Sunil Kumar and party.

*Diagnostic characters*: Body brown in colour, thickly covered with dark reddish brown punctures; lateral margins of head and corium, connexivum, a small spot near inner apical margin of corium, body beneath, and legs, brown; a spot on lateral area of each segment of the sternum and a number of discal spots to abdomen are black in colour; head wider than long, about 0.82X as long as wide, and maximum width of head 0.33X as long as maximum width of pronotum, pronotal angles widely and acutely produced, pronotum wider than long, pronotum wider than long, about 0.47X as long as wide; antennae with the basal joint reddish brown, 1<sup>st</sup> joint longest, 3rd and 4<sup>th</sup> joints sub-equal in length; rostrum about reaching posterior coxae; abdomen above black except at margins. *Length*: 9-10 mm,

**Distribution:** India: Chhattisgarh (Gariaband, Raipur), Himachal Pradesh, Meghalaya, Nagaland, Sikkim, and West Bengal.

#### 11. *Cletus punctiger* (Dallas, 1852)

1852. *Gonocerus punctiger* Dallas, *List. Hem.*, 2: 494.

1902. *Cletus punctiger*: Distant, *Fauna Brit. India, Rhynchota*, 1: 393.

**Material examined:** 2 exs., Hardinala, Dist. Raipur, 8.xi.2011, Anil and party.

**Diagnostic characters:** Body above, beneath and legs brown, thickly covered with dark brown punctures; head wider than long, about 0.82 times as long as wide, maximum width of head 0.34X as long as maximum width of pronotum; pronotum with the lateral angles acutely spinous and more produced, wider than long, about 0.57X as long as wide; scutellum about 0.93X as long as wide; corium with the lateral margin and a small spot in the inner apical angle whitish; membrane pale brownish, black at base; abdomen above red, with the lateral margins very yellow brown; sternum coarsely punctate provided with a small black spot on the lateral area of each segment; length of hind femur about 1.09 X as long as hind tibia; antennae dark brown, with 1<sup>st</sup> and 3<sup>rd</sup> joints sub-equal, 2<sup>nd</sup> about 1.3X as long as 1<sup>st</sup> joint. **Length:** 10-12 mm.

**Distribution:** India: Chhattisgarh (Raipur), Himachal Pradesh, Punjab, West Bengal; **Elsewhere:** China, Pakistan, Myanmar.

#### Subfamily PSUDOPHLOCINAE

#### Key to the genera of the subfamily Psudophlocinae

1. Scutellum convex and elevated.....  
..... *Clavigralla* Spinola
- Scutellum plain, not elevated; antennae with the first joint shorter than head.....  
..... *Hoplolomia* Stal

#### Genus 9. *Clavigralla* Spinola, 1837

1837. *Clavigralla* Spinola, *Spin. Ess.*, 202.

#### Key to the species of genus *Clavigralla*

1. Lateral pronotal angles produced into acute black spines directed a little forward and upward; femora with the castaneous annulations to apices and base..... *gibbosa*
- Lateral pronotal angles acute, spines a little directed forward; lateral pronotal margins bi-dentate; femora without any annulations  
..... *concolor*

#### 12. *Clavigralla concolor* Dohrn, 1860

1860. *Clavigralla concolor* Dohrn, *Stett. ent. Zeit.*, 21: 403.

1902. *Myla concolor*: Distant, *Fauna Brit. India, Rhynchota*, 1: 403.

1986. *Clavigralla concolor* Dolling, *Bull. Br. Mus. (Nat. Hist.) Entomol.*, 53: 182.

**Material examined:** 2 exs., Pipartala forest, Dist. Kabirdham, 17.xi.2011, coll. Sunil Kumar and party; 1ex., Barnala, Dist. Raipur, 14.xi.2011, coll. Anil and party.

**Diagnostic characters:** Body reddish brown; punctured with fuscous; head longer than wide, about 1.07 times as long as wide, maximum width of head about 0.50X as long as maximum width of pronotum; pronotum wider than long, 0.60X as long as wide, pronotal angles acute, spines a little directed forward; lateral pronotal margins bi-dentate; membrane pale; abdominal margin with three spines; hind tibia is sub-equal to hind femur. 1<sup>st</sup> joint of antennae smallest, 2<sup>nd</sup> and 4<sup>th</sup> sub-equal in length, 3<sup>rd</sup> joints longest, A1:A2:A3:A4:: 3.0:3.5:4.0:3.6. Hind femur slightly longer than hind tibia. **Length:** 7 mm.

**Distribution:** India: Chhattisgarh (Kabirdham and Raipur); **Elsewhere:** Sri Lanka.

#### 13. *Clavigralla gibbosa* Spinola, 1837

1837. *Clavigralla gibbosa* Spinola, *Ess.*, 202.

1902. *Clavigralla gibbosa*: Distant, *Fauna Brit. India, Rhynchota*, 1: 401.

**Material examined:** 1 ex., Komali, Dist., Gariaband, 18.x.2011, coll. Sunil Kumar and party.

**Diagnostic characters:** Body reddish brown,

moderately pilose; head slightly longer than wide, about 1.01 times as long as wide, about 0.35X as long as maximum width of pronotum, pronotum much wider than long about 0.44X as long as wide, posterior area of pronotum, and apical area of corium, brown; antennae brown, apical joint pale brown, second and third joints sub-sub-equal in length, A1:A2:A3::1:0.85:0.82; lateral angles of pronotum produced into acute black spines, the anterior area thickly and strongly pilose; scutellum thickly and strongly pilose; legs yellow brown, apical halves of femora, bases, apices, central annulation to tibiae reddish brown in colour; posterior femora spined beneath towards apices, hind femur about 1.17X longer than the hind tibia. *Length*: 8-10 mm.

*Distribution*: India: Chhattisgarh (Gariaband), Karnataka, Maharashtra. Elsewhere: Myanmar

Genus 10. **Hoplolomia** Stal, 1873

1873. *Hoplolomia* Stal, *En. Hem.*, 3: 84.

14. **Hoplolomia scabricula** Stal, 1873

1873. *Hoplolomia scabricula* Stal, *En. Hem.*, 3: 84.

1902. *Hoplolomia scabricula*: Distant, *Fauna Brit. India, Rhynchota*, 1: 404.

*Material examined*: 2 exs., Kodamali, Dist. Gariaband, 18.x.2011, coll. Sunil Kumar and party; 1ex., Makdi Range, Dist. Bastar, 9.XI.2011, Coll. R.P. Gupta and party.

*Diagnostic characters*: Head, antenna, pronotum, and scutellum dark brown; corium brown, its apical area light brown; legs brown, posterior femora, excluding bases, reddish brown; apices of the tibiae brown; body beneath obscure pale brown, head wider than long, about 0.78 times as long as wide, maximum width of head 0.44X as long as maximum width of pronotum, pronotum wider than long, about 0.47X as long as wide; pronotum with two prominent central discal tubercles, lateral angles produced and spinous, lateral margins strongly dentate, length of hind femur about 1.46X as long as hind tibia. 1<sup>st</sup> joint about 0.80X as long as 2<sup>nd</sup> joint and 0.67X as long as 3<sup>rd</sup> joints. *Length*: 6.5 mm.

*Distribution*: India: Chhattisgarh (Gariaband, Bastar), All over India, Elsewhere: Myanmar.

Family STENOCEPHALIDAE

Genus 11. **Dicranocephalus** Hahn, 1826

1826. *Dicranocephalus* Hahn., *Icon. Mon. Cimi.*, 24.

15. **Dicranocephalus lateralis** (Signoret, 1879)

1879. *Stenocephalus lateralis* Signoret, *Bull. Soc. Zool. Fr.*, 72

2006. *Dicranocephalus lateralis*: Dolling, *Cat.Het.Palae. Reg.* 5: 5.

*Material examined*: 2 exs., Durg Camp, Dist. Durg, 24.viii. 2011; 1ex., Nawapara, Dist. Raipur, 28.vii. 2011, coll. Sunil Kumar and party; 1ex., Bar village, Dist. Raipur, 14.vii.2011, coll. Sunil Kumar and party.

*Diagnostic characters*: Body brown, coarsely punctate; head cylindrical longer than wide, about 1.49X as long as wide, with anterior portion of pronotum somewhat darker, maximum width of head about 0.45X as long as maximum width of pronotum, lateral margins of the pronotum, pronotum wider than long about 0.48X as wide as long; corium, and membrane impunctate and yellow brown; antennae strongly pilose, first joint robust and slightly curved, slightly shorter than the head, second joint about as long as the fourth, third and first sub-equal; the second joint is yellow brown, fourth pale fuscous and yellow brown at base, A1: A2: A3:A4:: 1:0.80:0.67:0.75; legs yellow brown; fore and intermediate femora lightly fuscous at apex, hind femora broadly and more distinctly fuscous; apices and bases of tibiae and tarsi fuscous, hind femur slightly less than one and a half times as long as hind tibia. *Length*: 10-12 mm.

*Distribution*: India: Chhattisgarh (Durg, Raipur, Seoni), Maharashtra, Tamil Nadu, Elsewhere: Sri Lanka.

Family ALYDIDAE

Key to the subfamilies of the family Alydidae

1. 1<sup>st</sup> joint of rostrum extend beyond the eyes; pronotum posteriorly about one and a half times as long as width of the head Micrelyterinae.
- 1<sup>st</sup> joint of rostrum not extending behind the eyes; head large, not or slightly shorter than the pronotum .....Alydinae

## Subfamily MICRELYTERINAE

Genus 12. *Leptocorisa* Latreille, 18291892. *Leptocorisa* Latreille, *Fam. Nat.*; 421.**Key to the species of the genus *Leptocorisa***

1. Venter with a series of lateral dark spots on ventrites 3-6.....*oratorius*
- Venter entirely pale; callosities near pronotal posterior angles small and pale.....*acuta*

16. *Leptocorisa oratorius* (Fabricius, 1794)1794. *Gerris oratorius* Fabricius, *Ent. Syst. Em. Auc. Sec.*, 4: 191.2006. *Leptocorisa oratorius*: Dolling, *Cat. Het. Palae. Reg.*, 5: 30.

**Material examined:** 2 exs., Nakti forest, Dist. Raipur, 13.vii.2011; 1ex., Lalbandh pond, Raipur, 13.vii.2011, coll. Sunil Kumar and party; 2 exs., Barnawapara, Dist. Raipur, 16.viii.2011, coll. Sunil Kumar and party. 1ex., Chipli forest, Dist. Kabirdham, 14.vii.2011, 1ex., Anjani Beat, Surguja, 10.xi.2011, coll. Angshuman Raha and party; 2 exs. Makdirng, Dist. Bastar, 11.xi.2011, coll. R.P. Gupta and party.

**Diagnostic characters:** Body above grayish yellow, beneath pale greenish brown; head longer than wide, about 1.26X as long as wide; antennae fuscous, bases of second, third, and fourth joints yellow brown, A1: A2: A3: A4:: 1: 0.80: 0.92: 1.41; pronotum wider than long, about 0.35X as long as wide, 0.65X as long as maximum width of head provided with a small distinct tubercle near each lateral pronotal angle and a distinct central carinate line; scutellum longer than wide, about 1.32X as long as wide; abdomen above reddish-brown, with the margins pale greenish yellow. Hind femur about 0.88X as long as hind tibia. **Length:** 13 to 15 mm.

**Distribution:** India: Chhattisgarh (Bastar, Kabirdham, Raipur), Assam, Jharkhand, Meghalaya, Maharashtra, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, Karnataka, Kerala, West Bengal. *Elsewhere:* Australia, Bangladesh, Bhutan, China, Indonesia, Malaysia, Solomon island, Sri Lanka and Tibet.

17. *Leptocorisa acuta* (Thunberg, 1783)1902. *Leptocorisa acuta* Distant, *Fauna Brit. India, Rhynchota*, 1: 410.2006. *Leptocorisa acuta* : Dolling, *Cat. Het. Palae. Reg.*, 5: 29-30.

**Material examined:** 1 ex, Kudaidhura forest, Dist. Kabirdham, 15.11.2011, Sunil Kumar and party; 1ex. Dullibahal forest, Dist. Raipur, 10.xi.2011, Anil and party; 1ex. Nakti pond, Dist. Raipur, 13.vii.2011, Sunil Kumar and party.

**Diagnostic characters:** Body pale greenish brown to brownish-orange; head longer than wide, Rostrum relatively shorter and just reaches apices of mesocoxae; antennae and legs are usually pale, antennal joints of variable colour, brown to brownish orange; pronotum with well-developed dark brown humeral calli; scutellum longer than wide; colour of abdomen variable, but dorsum usually darker. Hind femur about 0.88X as long as hind tibia. Male genitalia with pygophore small and almost rounded; claspers bifurcated at their apices. **Length:** 15-16 mm.

**Distribution:** India: Chhattisgarh (Kabirdham, Raipur), West Bengal. *Elsewhere:* Bhutan, China, Fiji, Indonesia, Malaysia, New Caledonia and Samoa.

## Subfamily ALYDINAE

**Key to the genera of the subfamily Alydinae**

1. Antennae with first joint a little longer than the second and about equal in length to third, fourth longest.....*Riptortus* Stål
- Fourth joint of the antennae longer than the two preceding joints taken together; Posterior tibiae straight, shorter than the femora, with a single row of spines beneath commencing at about one third from base and clothed with long spinulose hairs, scutellum short, sub-triangular, somewhat raised, its apex moderately spatulate.....*Nariscus* Stål

Genus 13. *Nariscus* Stål, 18661866. *Nariscus* Stål. *Hemip. Afr.*, 2: 8.18. *Nariscus fisheri* (Distant, 1908)1908. *Akbaratus fisheri* Distant, *Fauna Brit. India, Rhynchota*, 4: 486.

2006. *Nariscus fisheri*: Dolling, *Cat. Het. Palae. Reg.*, 5: 39.

**Material examined:** 1 ex., Barnawapara, Dist. Raipur, 24.vii.2011, coll. Sunil Kumar and party

**Diagnostic characters:** Body greenish brown, head slightly longer than wide and sub-equal to length of the pronotum, maximum width of head slightly shorter than maximum width of pronotum; pronotum pale brownish yellow with a central longitudinal line, anterior marginal area with brown impression and a small nodules at each posterior angle, as long as wide; antennae with first three joints greyish spotted with black; corium pale brownish yellow, thickly punctuate; posterior femora with two brownish annulations. **Length:** 13 mm.

**Distribution:** India: Chhattisgarh (Raipur), Maharashtra, Uttarakhand.

#### Genus 14. *Riptortus* Stal, 1860

1860. *Riptortus* Stal, *Ofv. Vet. -Ak. Forh.*,: 460.

#### Key to the species of genus *Riptortus*

1. A dark castaneous lateral fascia on each side of head, not extending beyond base of antennae ..... *pedestris*
- A sublateral levigate pale ochraceous fascia margined with black on each side of head and sternum ..... *linearis*

#### 19. *Riptortus pedestris* (Fabricius, 1775)

1775. *Gerris pedestris* Fabr., *Syst. Ent.*,: 727.

1902. *Riptortus pedestris* Distant, *Fauna Brit. India, Rhynchota*, 1: 415.

**Material examined:** 1 ex., Kundpani Forest, Dist. Kabirdham, 21 .ix.2011, coll. Anil and party; 1 ex., Barnala, Dist. Raipur, 4.xi.2011, coll. Anil and party; 1 ex., Junagadh Forest, Dist. Gariaband, 17.x.2011, coll. Sunil Kumar and party.

**Diagnostic characters:** Body dark brownish, finely and brown pilose; head wider than long, about 0.77X as long as wide, maximum width of head 0.73X as long as maximum width of pronotum, pronotum wider than long, about

0.74X as long as wide, posterior margin of the pronotum and a lateral fascia on each side of head dark reddish brown, lateral pronotal spines black; sternum somewhat brown with reddish tinge, with prominent pale yellow brown spots placed near the coxae; scutellum about 1.23X as long as wide; coanexivum yellowish brown, posterior femora thickly mottled with reddish-brown; about 1.22X as long as hind tibia; posterior tibiae with the bases and apices reddish-brown. **Length:** 15 to 18 mm.

**Distribution:** India: Chhattisgarh (Gariaband, Kabirdham, Raipur), Karnataka, Maharashtra, Meghalaya. **Elsewhere:** Malayan peninsula, Myanmar, Sri Lanka.

#### 20. *Riptortus linearis* (Fabricius, 1775)

1775. *Lygaeus linearis* Fabr., *Syst. Ent.*,: 710.

1902. *Riptortus linearis*: Distant, *Fauna Brit. India, Rhynchota*, 1: 415.

**Material examined:** 1 ex., Bakaband, Dist-Bastar, 21.xi.2011, Coll. R.P. Gupta and party; 1 ex., Kherpani, Dist. Kabirdham, 16.xi.2011, Sunil Kumar and party; 1 ex., Banjari hills, Dist. Kabirdham, 25.xi.2011, Anil and party; 1 ex., Jamunpani forest, Dist. Kabirdham, 22.xi.2011, Anil and party; 1 ex., Amajheria, Dist-Balrampur, 9.xi.2011, Coll. Raha and party.

**Diagnostic characters:** Body dark reddish brown dorsally, disk of sternum and abdomen black with some yellow brown spots. Head wider than long, about 0.83X as long as wide, maximum width of head 0.75X as long as maximum width of pronotum, pronotum wider than long, about 0.81X as long as wide, a small spot at the middle of posterior pronotal margin and the apex of the scutellum pale brown; scutellum about 1.06X as long as wide, length of hind femur 1.27X as long as hind tibia. A1:A2:A3:4A:: 1.00:0.69: 0.75: 1.87. **Length:** 14 to 16 mm.

**Distribution:** India: Chhattisgarh (Balrampur, Bastar, Kabirdham), Karnataka, Maharashtra, Sikkim, West Bengal. **Elsewhere:** Myanmar, several islands of the Malayan Archipelago.

## Family RHOPHALIDAE

## Key to the subfamilies of the family

## Rhopalidae

1. Anterior lateral margins of the pronotum not or obtusely sinuate; areole at anterior apical area of corium quadrangular ..... Rhopalinae
- Anterior lateral margins of the pronotum distinctly angulately emarginate; areolus at interior apical area of corium triangular..... Serinathinae

## Subfamily RHOPHALINAE

Genus 15. *Liorhyssus* Stal, 1870

1870. *Liorhyssus* Stal, *En. Hem.*, 1: 222.

Key to species of the genus *Liorhyssus*

- 1 Scutellum black, its apex reddish or ochraceous; corium ochraceous, its apical area more or less reddish- piceous or reddish ; body beneath red ; body beneath red ; abdomen with a series of luteous spots on each lateral area, the extreme lateral margins alternately black and brown..... *rubicundus*
- Scutellum somewhat acute at the apex, punctured with black and clothed with long whitish hairs, body beneath ochraceous; abdomen impunctate, clothed with short pale hairs.....*hyalinus*

21. *Liorhyssus rubicundus* (Signoret, 1859)

1859. *Corizus rubicundus* Signoret, *Ann. Soc. Ent. Fr.*, 3(7): 86.

1902. *Liorhyssus rubicundus*: Distant, *Fauna Brit. India, Rhynchota*, 1: 415.

*Material examined*: 1 ex., Kehrpani, Dist. Kabirdham, 16.xi.2011, coll. Sunil and party; 1ex., Kodmali, Dist. Gariaband, 18.x.2011, coll. Sunil and party; 1ex., Hardinala, Dist. Raipur, 8.xi.2011, coll. Anil and party.

*Diagnostic characters*: Head, pronotum and scutellum dark reddish brownish in colour, rest of the body pale brown, body beneath red; abdomen with a series of yellow brown spots on each lateral area; head wider than long, about 0.89X as long as wide, maximum width of head 0.72X as long

as maximum width of pronotum; pronotum with an anterior and posterior transverse black fascia, pronotum wider than long, about 0.62X as long as wide; corium pale brown, scutellum about 1.13X as long as wide; legs pale reddish brown; length of hind femur about 0.67X as long as hind tibia. A1:A2:A3:4A:: 1.0:2.0:2.3:3.6. *Length*: 6 to 9 mm.

*Distribution*: India: Chhattisgarh (Gariaband, Kabirdham, Raipur). *Elsewhere*: Sri Lanka.

22. *Liorhyssus hyalinus* (Fabricius, 1794)

1794. *Lygaeus hyalinus* Fabricius, *Ent. Syst.* 4: 168

2009. *Liorhyssus hyalinus* Werner, *Heteropteron*, 31: 35-36

*Material examined*: 1 ex., Hardinala, Dist. Raipur, 8.xi.2011, coll. Anil and party.

*Diagnostic characters*: Body brownish yellow above; head with several black streaks and dots, rostrum pale yellow, with the apex black; antennae pale yellow, with a brown line along the upper surface of the first three joints. Head wider than long, about 0.81 times as wide as long, maximum width of head 0.66X as long as maximum width of pronotum ; pronotum thickly and finely punctured with black, dark brown near anterior and posterior margins, pronotum wider than long, about 0.57X as long as wide; scutellum somewhat acute at the apex, punctured with black; tarsi with the tips of the first and third joints and the claws black. *Length*: 5 to 6 mm.

*Distribution*: India: Chhattisgarh (Raipur), Maharashtra, West Bengal.

## Subfamily SERINATHINAE

Genus 16. *Leptocoris* Hahn, 1831

1831. *Leptocoris* Hahn, *Wanz. Ins.*, 1: 200.

23. *Leptocoris augur* (Fabricius, 1781)

1781. *Cimex augur* Fabr., *Spec. Ins.*, 2: 366.

1902. *Serinetha augur*: Distant, *Fauna Brit. India, Rhynchota*, 1: 420.

2006. *Leptocoris augur*: Dolling, *Cat. Het. Palae. Reg.*, 5: 9.

*Material examined*: 2 exs., Latadar, Dist. Raipur, 8.vii.2011, coll. Sunil Kumar and party;

5 exs., Barnawapara, Dist. Raipur, 8.vii.2011, coll. Sunil Kumar and party; 3 exs., Kodmali, Dist. Gariabandh, 18.x.2011, coll. Sunil Kumar and party.

**Diagnostic characters:** Body pale reddish brown; head wider than long, about 0.60 times as long as wide, maximum width of head 0.71X as long as maximum width of pronotum, antennae, rostrum, legs, and membrane black; pronotum very distinctly centrally carinate and finely punctate, pronotum wider than long, about 0.59X as long as wide, scutellum about 1.20X as long as wide, length of hind femur about 0.81X as long as hind tibia. *Length:* 14 to 16 mm.

**Distribution:** India: Chhattisgarh (Gariaband, Raipur) Assam, Maharashtra, Tamil Nadu, West Bengal. *Elsewhere:* Sri Lanka, West Yunnan, Malayan Peninsula, and Hainan.

## SUMMARY

This paper reports 23 species of Coreoid bugs under 16 genera belonging to 4 families from the state of Chhattisgarh, of these so far 5 species under 5 genera (marked with \*) were known from the state. The diagnosis of each species along with measurements and their ratios, keys to various taxa, distributions of each species in different districts of Chhattisgarh, other states as well as from elsewhere along with relevant references have also been incorporated.

## ACKNOWLEDGEMENT

Authors are grateful to Dr. K. Venkataraman, Director, ZSI, for providing all necessary facilities. We would like to thank Dr. K. A. Subramanian, Scientist- C, Divisional-in-Charge, Entomology Division– B. for his numerous courtesies.

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PLATE I



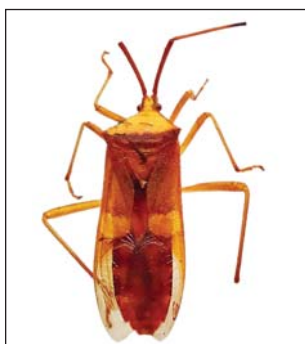
**Figs. 1.** *Anoplocnemis phasiana* (Fabr.)



**Figs. 2.** *Petillopsis calcar* (Dall.)



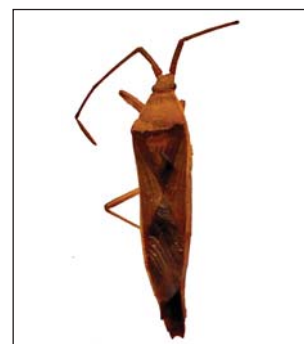
**Figs. 3.** *Dalader planiventris* (Westw.)



**Figs. 4.** *Homoeocerus signatus* Walker



**Figs. 5.** *Homoeocerus striicornis* Scott



**Figs. 6.** *Aschistocoris brevicornis* (Dallas)



**Figs. 7.** *Notobitus meleagris* (Fabr.)



**Figs. 8.** *Petalocnemis obscura* (Dall.)



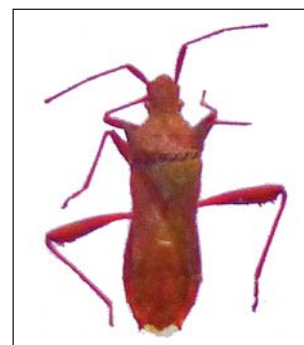
**Figs. 9.** *Cletus bipunctatus* (Westw.)



**Figs. 10.** *Cletus punctulatus* (Westw.)



**Figs. 11.** *Cletus punctiger* (Dall.)



**Figs. 12.** *Chavigralla concolor* (Dohrn)

## PLATE II



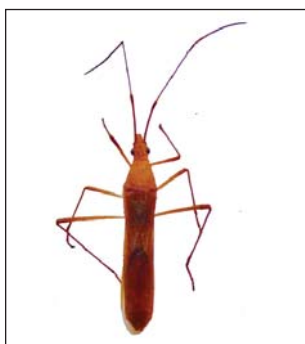
**Figs. 13.** *Chavigralla gibbosa*  
Spinola



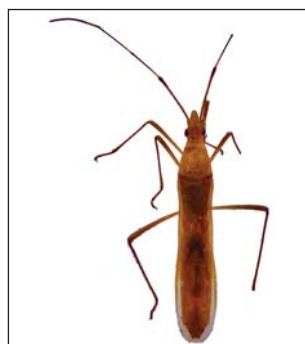
**Figs. 14.** *Hoplolomia*  
*scabricula* Stal



**Figs. 15.** *Dicranocephalus*  
*lateralis* (Signoret)



**Figs. 16.** *Leptocoris*  
*oratorius* (Fabr.)



**Figs. 17.** *Leptocoris*  
*acuta* (Thunb.)



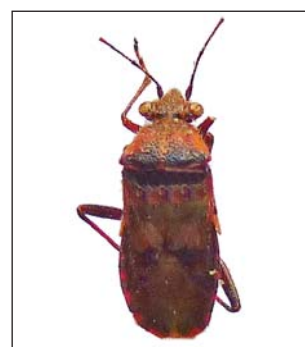
**Figs. 18.** *Nariscus fisheri*  
(Distant)



**Figs. 19.** *Riptortus pedestris*  
(Fabr.)



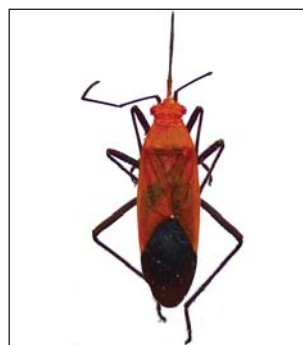
**Figs. 20.** *Riptortus linearis*  
(Fabr.)



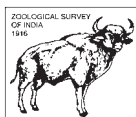
**Figs. 21.** *Liorhyssus*  
*rubicundus* (Signoret)



**Figs. 22.** *Liorhyssus hylinus*  
(Fabr.)



**Figs. 23.** *Leptocoris augur*  
(Fabr.)



## FRESHWATER CRABS (CRUSTACEA: DECAPODA: BRACHYURA: GECARCINUCIDAE) IN THE COLLECTION OF WESTERN GHAT REGIONAL CENTRE, ZOOLOGICAL SURVEY OF INDIA, KOZHIKODE

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### INTRODUCTION

Freshwater crabs of India have been poorly studied (Cumberlidge *et al.*, 2009) among the crustaceans even though 94 species have already been reported from the country (S.K. Pati, unpublished data). Systematic contributions on the group in India were mainly that of Alcock (1910), Bott (1970a) and Bahir & Yeo (2005 and 2007). Many reports (Alcock, 1910; Chhapgar, 1956; Bott, 1970a; Srivastava, 2005; Bahir & Yeo, 2007; Ghatak & Ghosh, 2008; Pati & Sharma,

2011, 2013, 2014a and Klaus *et al.*, 2014) on the freshwater crabs of Western Ghats are also available. Recently, some new taxa have been described from the Western Ghats (Pati & Sharma, 2013, 2014a; Klaus *et al.*, 2014) besides a recent report on the specimens in the National Zoological Collections of Western Regional Centre, Zoological Survey of India, Pune (Pati & Sharma, 2014b). Nevertheless, knowledge on diversity and distribution of freshwater crabs in the Western Ghats is limited due to poor sampling efforts and inaccessibility to remote localities in general

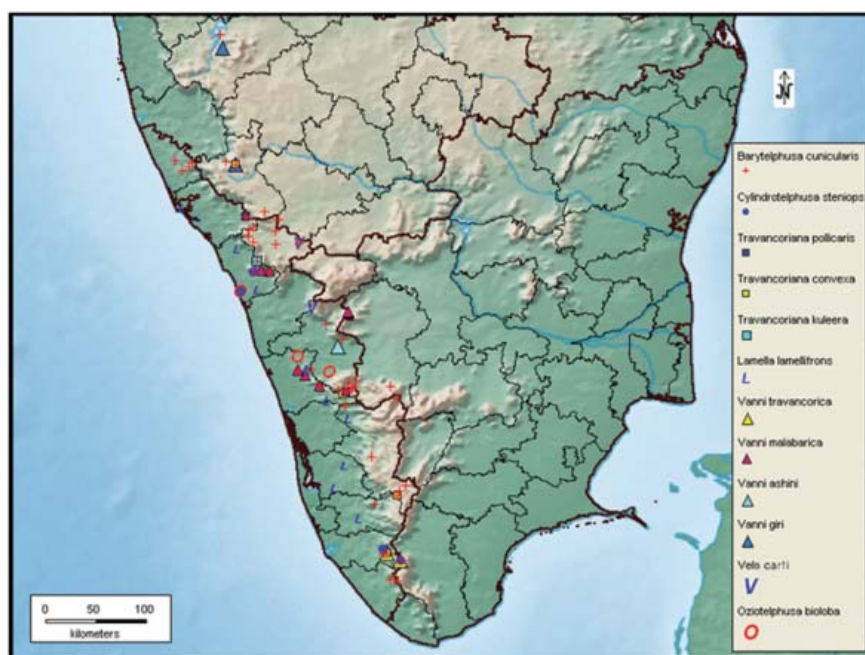


Fig. 1. Map showing distribution of freshwater crabs studied in the collection of WGRC, ZSI, Kozhikode.

and unstudied museum specimens in particular. Hence, priority was given to study systematically the unidentified freshwater crabs of the National Zoological Collections (NZC) of Western Ghat Regional Centre (WGRC), Zoological Survey of India (ZSI), Kozhikode.

### MATERIAL AND METHODS

The holdings of NZC, WGRC, Kozhikode contained about 194 freshwater crab specimens collected mainly from Western Ghats (in the southern states of Karnataka, Kerala and Tamil Nadu) over a period of 33 years from 1981 to 2013. Freshwater crab specimens were identified using both morphological and male gonopod structures following Alcock (1910), Bott (1970a) and Bahir & Yeo (2005 & 2007). Methods of measurement and terminology were adopted from Ng & Tay (2001) and Bahir & Yeo (2007).

The following abbreviations are used: Coll.: Collector; dist.: district; IUCN: International Union for Conservation of Nature; NZC: National Zoological Collections; R.F.: Reserve Forest; T.R.: Tiger Reserve; W.L.S.: Wildlife Sanctuary; WGRC: Western Ghat Regional Centre; ZSI: Zoological Survey of India; G1: male first pleopod; G2: male second pleopod.

### RESULTS

From collections of WGRC, ZSI, Kozhikode, 12 species of freshwater crabs under 7 genera of the family Gecarcinucidae were identified. All the species except *Vanni giri* Bahir & Yeo, 2007 from Kerala, 3 species from Karnataka and 1 species from Tamil Nadu were collected (Table-1). Distribution of all the identified species is presented (Fig.-1).

**Table-1.** District-wise distribution of freshwater crabs studied from the collection of WGRC, ZSI, Kozhikode

| State                    | District           | Species    |          |          |           |          |           |          |           |          |          |          |          | Specimens studied |
|--------------------------|--------------------|------------|----------|----------|-----------|----------|-----------|----------|-----------|----------|----------|----------|----------|-------------------|
|                          |                    | 1          | 2        | 3        | 4         | 5        | 6         | 7        | 8         | 9        | 10       | 11       | 12       |                   |
| Karnataka                | Chikkamagaluru     | +          | –        | –        | –         | –        | –         | –        | –         | –        | +        | –        | –        | 3                 |
|                          | Kodagu             | +          | –        | –        | +         | –        | –         | –        | –         | –        | +        | –        | –        | 13                |
| Kerala                   | Ernakulam          | +          | –        | –        | –         | –        | +         | –        | –         | –        | –        | –        | –        | 4                 |
|                          | Idukki             | +          | –        | –        | +         | –        | –         | –        | –         | –        | –        | –        | –        | 12                |
|                          | Kannur             | +          | –        | +        | –         | –        | +         | –        | –         | –        | –        | –        | –        | 18                |
|                          | Kasaragod          | +          | –        | –        | –         | –        | –         | –        | –         | –        | –        | –        | –        | 10                |
|                          | Kollam             | +          | +        | –        | +         | –        | –         | +        | –         | –        | –        | –        | –        | 11                |
|                          | Kottayam           | –          | –        | –        | –         | –        | +         | –        | –         | –        | –        | –        | –        | 2                 |
|                          | Kozhikode          | +          | +        | –        | –         | +        | +         | –        | +         | –        | –        | +        | +        | 20                |
|                          | Palakkad           | +          | –        | +        | –         | –        | –         | –        | +         | +        | –        | +        | –        | 46                |
|                          | Pathanamthitta     | +          | –        | –        | –         | –        | +         | –        | –         | –        | –        | –        | –        | 7                 |
|                          | Thiruvananthapuram | +          | –        | –        | –         | –        | –         | –        | –         | –        | –        | –        | –        | 4                 |
|                          | Thrissur           | +          | –        | –        | +         | –        | +         | –        | +         | –        | –        | –        | +        | 24                |
|                          | Wayanad            | +          | –        | –        | –         | –        | –         | –        | –         | –        | –        | +        | –        | 19                |
| Tamil Nadu               | Coimbatore         | +          | –        | –        | –         | –        | –         | –        | –         | –        | –        | –        | –        | 1                 |
| <b>Specimens studied</b> |                    | <b>118</b> | <b>4</b> | <b>4</b> | <b>11</b> | <b>2</b> | <b>16</b> | <b>2</b> | <b>18</b> | <b>6</b> | <b>3</b> | <b>3</b> | <b>7</b> | <b>194</b>        |

Species-1: *Barytelphusa cunicularis* (Westwood, 1836); 2: *Cylindrotelphusa steniops* (Alcock, 1909); 3: *Travancoriana pollicaris* (Alcock, 1909); 4: *Travancoriana convexa* (Roux, 1931); 5: *Travancoriana kuleera* Bahir & Yeo, 2007; 6: *Lamella lamellifrons* (Alcock, 1909); 7: *Vanni travancorica* (Henderson, 1913); 8: *Vanni malabarica* (Henderson, 1912); 9: *Vanni ashini* Bahir & Yeo, 2007; 10: *Vanni giri* Bahir & Yeo, 2007; 11: *Vela carli* (Roux, 1931); 12: *Oziotelphusa biloba* Bahir & Yeo, 2005

**SYSTEMATIC LIST**

- Phylum ARTHROPODA Latreille, 1829  
 Subphylum CRUSTACEA Brönnich, 1772  
 Class MALACOSTRACA Latreille, 1802  
 Subclass EUMALACOSTRACA Grobben, 1892  
 Superorder EUCARIDA Calman, 1904  
 Order DECAPODA Latreille, 1803  
 Suborder PLEOCYEMATA Burkenroad, 1963  
 Infraorder BRACHYURA Linnaeus, 1758  
 Section EUBRACHYURA de Saint Laurent, 1980  
 Subsection HETEROTREMATA Guinot, 1977  
 Superfamily GECARCINUCOIDEA Rathbun, 1904  
 Family GECARCINUCIDAE Rathbun, 1904  
 1. *Barytelphusa cunicularis* (Westwood, 1836)  
 2. *Cylindrotelphusa steniops* (Alcock, 1909)  
 3. *Travancoriana pollicaris* (Alcock, 1909)  
 4. *Travancoriana convexa* (Roux, 1931)  
 5. *Travancoriana kuleera* Bahir & Yeo, 2007  
 6. *Lamella lamellifrons* (Alcock, 1909)  
 7. *Vanni travancorica* (Henderson, 1913)  
 8. *Vanni malabarica* (Henderson, 1912)  
 9. *Vanni ashini* Bahir & Yeo, 2007  
 10. *Vanni giri* Bahir & Yeo, 2007  
 11. *Vela carli* (Roux, 1931)  
 12. *Oziotelphusa biloba* Bahir & Yeo, 2005

**SYSTEMATIC ACCOUNT**

1. *Barytelphusa cunicularis* (Westwood, 1836)  
 (Plate-I, Figs. 1–3; Plate-III, Figs. 1–3)  
 1836. *Thelphusa cunicularis* Westwood in Sykes & Westwood, *Trans. Ent. Soc. London*, **1**: 183.  
 1905. *Potamon* (*Potamonautes*) *jacquemonti* Rathbun, *Nouv. Arch. Mus. Hist. nat. Paris*, (4)7: 185.  
 1910. *Paratelphusa* (*Barytelphusa*) *jacquemontii* Alcock, *Cat. Ind. decap. Crust. Coll. Ind. Mus.*, **I**(2): 79.  
 1970a. *Barytelphusa* (*Barytelphusa*) *cunicularis* Bott, *Abh. senckenb. naturforsch. Ges.*, **526** : 31.

2007. *Barytelphusa cunicularis* Bahir and Yeo, *Raffles B. Zool., Supp. No.* **16** : 312.

*Type locality* : Western Ghats from latitude 17° to 19° 23' N and longitude from 73° to 75° E (previously in Bombay Presidency), Maharashtra, India.

*Material examined*: 1 ♀, Annamalai, Yerabtiyar, Coimbatore dist., Tamil Nadu, 20. 12. 1983, Coll. G.U. Kurup & Party, ZSI/WGRC/IR/INV/2749; 1 ♂, Nanjarajapuzha, Coorg, Kodagu dist., Karnataka, 05.01.1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2732; 2 ♀, Nagarhole River, Kodagu dist., Karnataka, 16. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2758; 1 ♀, Kakktha holi, Kodagu dist., Karnataka, 28. 01. 1985, Coll. K.N. Nair & Party, ZSI/WGRC/IR/INV/2748; 1 ♂ & 1 ♀, Vaniyampara, Vellani, Thrissur dist., Kerala, 14.03.1992, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2695; 2 ♀, Meenmutty, Kattilappara, Kulathupuzha, Kollam dist., Kerala, 22.03.1992, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2705; 1 ♂, Bonacaud, Thiruvananthapuram dist., Kerala, 26.03.1992, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2677; 1 ♀, Bonacaud, Thiruvananthapuram dist., Kerala, 26.03.1992, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2679; 1 ♀, Parappa-Santhimala, Kasaragod dist., Kerala, 24.09. 1993, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2739; 2 ♀, Maruthom, Kasaragod dist., Kerala, 26.10.1993, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2752; 1 ♂, Coorg & Wayanad, Kodagu dist., Karnataka, 04. 03. 1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2758; 1 ♂, Kalligola, Kodagu dist., Karnataka, 04. 03. 1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2744; 2 ♂ & 1 ♀, Devarakolley, Kodagu dist., Karnataka, 05.03.1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2738; 3 ♂ & 2 ♀, Kavadikanam, Samakochi & Bandarkozhi-Payradukka, Kasaragod dist., Kerala, 20. 03. 1994, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2681; 1 ♂, Periya Choppa, Wayanad dist., Kerala, 14.08.1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2727; 1 ♂, Periya Peats,

- Wayanad dist., Kerala, 15.08.1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2697; 5♂ & 2♀, Mokeyamkundu, Wayanad dist., Kerala, 12.11.1994, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2700; 4♂ & 1♀, Kurichiyat R.F., Wayanad dist., Kerala, 23.12.1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2716; 2♀, Kurichiyat R.F., Wayanad dist., Kerala, 24.12.1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2720; 2♂, Kuruva, Wayanad dist., Kerala, 25.12.1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2736; 1♂ & 1♀, Ambayathode, Kannur dist., Kerala, 02.02.1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2698; 1♂ & 1♀, Narikadavu, Aralam W.L.S., Kannur dist., Kerala, 06.04.1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2751; 5♂ & 6♀, Uruppukunnu, Aralam W.L.S., Kannur dist., Kerala, 15.04.1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2701; 2♂ & 1♀, Vellanimala, Thrissur dist., Kerala, 09.10.1995, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2713; 3♂ & 2♀, Vengoli, Parambikulam W.L.S., Palakkad dist., Kerala, 27.10.1995, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2730; 2♂ & 2♀, Sarkapathi, Parambikulam W.L.S., Palakkad dist., Kerala, 29.10.1995, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2728; 1♂ & 1♀, Vattachira, near Thusaragiri, Kozhikode dist., Kerala, 15.02.1996, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2715; 3♂, Chimmoni, Thrissur dist., Kerala, 26.02.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2710; 1♂, Orukomban, Parambikulam, Palakkad dist., Kerala, 15.03.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2699; 1♀, Karimala, Parambikulam W.L.S., Palakkad dist., Kerala, 18.03.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2735; 1♂ & 3♀, Tunnel Entry Road, Parambikulam W.L.S., Palakkad dist., Kerala, 21.03.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2678; 1♀, Meenmutty, Kozhikode dist., Kerala, 05.06.1996, Coll. Ashok Kumar & N.P. Pillai, ZSI/WGRC/IR/INV/2690; 1♂ & 1♀, Mlappara, Periyar T.R., Idukki dist., Kerala, 04.11.1996, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2674; 1♂, Karadikkavala, Periyar T.R., Idukki dist., Kerala, 06.11.1996, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2722; 1♀, Mlappara, Periyar T.R., Idukki dist., Kerala, 08.11.1996, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2712; 1♂ & 4♀, Mullakudi, Periyar T.R., Idukki dist., Kerala, 12.11.1996, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2742; 1♂, Vellagi Kamalli, Idukki W.L.S., Idukki dist., Kerala, 14.11.1996, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2688; 1♂, Chambakkad, Chinnar W.L.S., Idukki dist., Kerala, 18.11.1996, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2719; 2♂ & 2♀, Kariyanchola, Parambikulam W.L.S., Palakkad dist., Kerala, 22.01.1997, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2726; 1♂ & 4♀, Thellickal, Parambikulam W.L.S., Palakkad dist., Kerala, 24.01.1997, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2731; 1♂, Angamoozhy, Pathanamthitta dist., Kerala, 20.02.1997, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2692; 1♂, Tunnel Entry, Parambikulam W.L.S., Palakkad dist., Kerala, 23.03.1997, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2687; 1♂, Kottayali, Parambikulam, Palakkad dist., Kerala, 28.03.1997, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2680; 1♂, Choodal, Shendurney W.L.S., Kollam dist., Kerala, 07.08.1997, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2682; 1♀, Kattilappara, Shendurney W.L.S., Kollam dist., Kerala, 12.08.1997, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2709; 1♂ & 1♀, Peruthady, Ranipuram, Kasaragod dist., Kerala, 18.05.1998, Coll. M. Madhavan, ZSI/WGRC/IR/INV/2676; 1♂, Myladipuzha (Malampuzha), Palakkad dist., Kerala, 17.03.1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2684; 1♂, Kanjirapuzha, Palakkad dist., Kerala, 22.03.1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2686; 1♂ & 1♀, Idamalayi/Kapayem, Ernakulam dist., Kerala, 19.11.1999, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2673; 1♂, Vithura-Chathancode, Thiruvananthapuram dist., Kerala, 18.03.2001, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2729; 1♂ & 1♀, Thechi, Kinaloor Estate, Kozhikode dist., Kerala, 30.05.2002, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2717; 1♂, Bhadra

Dam Site, Lakka Valley Range, Bhadra W.L.S., Chikkamagaluru dist., Karnataka, 07.11.2006, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2724; 1 ♀, Pandipath, Thiruvananthapuram dist., Kerala, 14. 10. 2012, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2937 and 1 ♀, Kakkayem, Ambalapara, Malabar W.L.S., Kozhikode dist., Kerala, 29.05.2013, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2934.

**Diagnosis:** Carapace broader than long, slightly convex anteriorly and gradually sloped posteriorly; epigastric cristae well developed, slightly anterior to and confluent with postorbital cristae; *postorbital cristae well developed, forms a gentle concave ridge in dorsal view, separated from epibranchial tooth by cervical groove; external orbital angle triangular, with outer margin 2.5 times length of inner margin; epibranchial tooth distinct, blunt, in level with postorbital cristae; epistomal median lobe without median tooth.* Exopod of third maxilliped with long flagellum. Suture between thoracic sternites 2, 3 distinct; between 3, 4 visible as shallow grooves on sides only. Male abdomen narrowly triangular; sixth male abdominal somite broader than long, nearly equal in length to telson, with concave lateral margins; telson tongue shaped. *G1 long, narrow, curving slightly outwards; terminal article long (0.6 to 0.65 times length of subterminal segment), tip pointed. G2 short; distal article short (0.2 times length of basal segment).*

**Distribution:** Distributed throughout India from Himachal Pradesh in north to Kerala in south except north-east India.

**IUCN status:** Least Concern (Cumberlidge, 2008a).

## 2. *Cylindrotelphusa steniops* (Alcock, 1909)

(Plate-I, Figs. 4–6; Plate-III, Figs. 4–6)

1909a. *Gecarcinus* (*Cylindrotelphusa*) *steniops* Alcock, *Rec. Indian Mus.*, **3**(4): 380.

1910. *Gecarcinus* (*Cylindrotelphusa*) *steniops* Alcock, *Cat. Ind. decap. Crust. Coll. Ind. Mus.*, **I**(2) : 125.

1970a. *Cylindrotelphusa steniops* Bott, *Abh. senckenb. naturforsch. Ges.*, **526**: 28.

2007. *Cylindrotelphusa steniops* Bahir and Yeo, *Raffles B. Zool.*, *Supp. No.* **16**: 315.

**Type locality:** Shathancotta (presently Sasthamkotta) near Quilon (presently Kollam), Kollam district, Kerala, India.

**Material examined:** 1 ♂, Eranhipalam, Kozhikode dist., Kerala, 11. 01. 1982, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2704; 1 ♂, Choodal, Shendurney W.L.S., Kollam dist., Kerala, 07. 08. 1997, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2683; 1 ♀, Thechi, Kinaloor Estate, Kozhikode dist., Kerala, 30. 05. 2002, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2718 and 1 ♀, Thenmala I.B. area, Kollam dist., Kerala, 18. 10. 2012, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2932.

**Diagnosis:** Carapace deep, dorsal surface highly convex; postorbital cristae well developed; *anterolateral margin of carapace with distinct serrations; external orbital angle small, acutely triangular, with outer margin nearly same length as inner margin; epibranchial tooth blunt and less distinct; epistomal median lobe with acute median tooth.* Exopod of third maxilliped with long flagellum and not reaching proximal one-third of merus. Suture between thoracic sternites 2, 3 visible as shallow depression; between 3, 4 visible as shallow grooves on sides only. Male abdomen narrowly triangular; sixth male abdominal somite broad, squarish; telson narrowly triangular, longer than sixth abdominal somite, with concave outer margin. *G1 long, narrow; terminal article long (0.55 times length of subterminal segment), sickle-shaped, tip pointed. G2 short; distal article short (0.2 times length of basal segment).*

**Distribution:** Kerala (Kollam, Kozhikode, Idukki, Thiruvananthapuram and Thrissur) and Tamil Nadu (Nilgiris).

**IUCN status:** Least Concern (Cumberlidge, 2008b).

## 3. *Travancoriana pollicaris* (Alcock, 1909)

(Plate-I, Figs. 7–9)

1909a. *Paratelphusa* (*Barytelphusa*) *pollicaris* Alcock, *Rec. Indian Mus.*, **3**(4): 377.

1910. *Paratelphusa (Barytelphusa) pollicaris* Alcock, Cat. Ind. decap. Crust. Coll. Ind. Mus., **1**(2): 89.
1931. *Paratelphusa (Barytelphusa) pollicaris* Roux, Rev. Suisse Zool., **38**(4): 48.
- 1970a. *Travancoriana pollicaris* Bott, Abh. senckenb. naturforsch. Ges., **526**: 41.
- 1970b. *Travancoriana pollicaris* Bott, Rev. Suisse Zool., **77**(2): 336.
2007. *Travancoriana pollicaris* Bahir and Yeo, Raffles B. Zool., Supp. No. **16**: 318.
- 1970a. *Travancoriana pollicaris* Bott, Abh. senckenb. naturforsch. Ges., **526**: 41 (part) (not *Paratelphusa (Barytelphusa) pollicaris* Alcock, 1909).
2007. *Travancoriana convexa* Bahir and Yeo, Raffles B. Zool., Supp. No. **16**: 321.

*Type locality*: Tandikudi, Palnis, Dindigul district, Tamil Nadu, India.

*Material examined*: 1♂ & 2♀, Otekally/S. Coorg, Kodagu dist., Karnataka, 08.03.1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2746; 3♀, Sholayar R.F., Thrissur dist., Kerala, 21.02.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2689; 1♀, Sholayar, Thrissur dist., Kerala, 22.02.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2706; 1♀, Mlappara, Periyar T.R., Idukki dist., Kerala, 04.11.1996, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2675 and 1♂ & 2♀, Kattilappara, Shendurney W.L.S., Kollam dist., Kerala, 12.08.1997, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2708.

*Diagnosis*: Carapace broader than long, slightly convex in frontal view; epigastric cristae well developed, slightly anterior to and confluent with postorbital cristae; postorbital cristae well developed, reaching rugose epigastric cristae; external orbital angle broadly triangular, with outer margin 5 times length of inner margin; epigastric groove long and bifurcated posteriorly; cervical grooves deep, broad; epibranchial tooth indistinct, in level with postorbital cristae. Exopod of third maxilliped with long flagellum. Suture between thoracic sternites 2, 3 visible as broad groove not reaching lateral margins; between 3, 4 visible on sides only. *Male abdomen acutely triangular*; sixth male abdominal somite broader than long, nearly equal in length to telson. G1 terminal article short (0.3 times length of subterminal segment), *tip distinctly curving outwards*. G2 distal article long (0.5 times length of basal segment).

*Type locality*: South India, presented by Travancore Museum, India.

*Material examined*: 2♀, Uruppukunnu, Aralam W.L.S., Kannur dist., Kerala, 15.04.1995, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2702 and 2♂, Karimala, Parambikulam W.L.S., Palakkad dist., Kerala, 18.03.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2734.

*Diagnosis*: Carapace broader than long, slightly convex in frontal view; epigastric cristae well developed, slightly anterior to and confluent with postorbital cristae; postorbital cristae well developed, reaching rugose epigastric cristae; external orbital angle broadly triangular, with outer margin 5 times length of inner margin; epigastric groove long and bifurcated posteriorly; cervical grooves deep, broad; epibranchial tooth indistinct, in level with postorbital cristae. Exopod of third maxilliped with long flagellum. Suture between thoracic sternites 2, 3 visible as broad groove not reaching lateral margins; between 3, 4 visible on sides only. *Male abdomen acutely triangular*; sixth male abdominal somite broader than long, nearly equal in length to telson. G1 terminal article short (0.3 times length of subterminal segment), *tip distinctly curving outwards*. G2 distal article long (0.5 times length of basal segment).

*Distribution*: Known only from the type specimens collected from south India.

*IUCN status*: Data Deficient (Cumberlidge, 2008c).

#### 4. *Travancoriana convexa* (Roux, 1931)

(Plate-I, Figs. 10–12; Plate-III, Figs. 7–9)

1931. *Paratelphusa (Barytelphusa) pollicaris convexa* Roux, Rev. Suisse Zool., **38**(4): 49.

**Distribution:** Kerala (Idukki) and Tamil Nadu (Dindigul).

**IUCN status:** Least Concern (Esser & Cumberlidge, 2008a).

5. ***Travancoriana kuleera*** Bahir & Yeo, 2007  
(Plate-I, Figs. 13–15; Plate-III, Figs. 10–12)

2007. *Travancoriana kuleera* Bahir and Yeo, *Raffles B. Zool., Supp. No.* 16: 323.

**Type locality:** Between Gudalur and Manjeri, Malappuram district, Kerala, India [type locality in the original description was mentioned as ‘between Gudalur and Manjeri, Tamil Nadu, India’ (Bahir & Yeo, 2007). However, from the data of geographical coordinates, it was confirmed that the holotype and male paratypes was actually described from Malappuram district of Kerala and the female paratypes from Nilgiris district of Tamil Nadu].

**Material examined:** 1 ♀, Kakkayem, Ambalapara, Malabar W.L.S., Kozhikode dist., Kerala, 22.05.2013, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2936 and 1 ♀, Kakkayem, Ambalapara, Malabar W.L.S., Kozhikode dist., Kerala, 29.05.2013, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2935.

**Diagnosis:** Carapace broader than long, slightly convex in frontal view; epigastric cristae well developed, slightly anterior to and confluent with postorbital cristae; postorbital cristae and epigastric cristae well developed, confluent; epigastric cristae rugose; external orbital angle broadly triangular, with outer margin 3 times length of inner margin; epigastric groove long and bifurcated posteriorly; cervical grooves shallow, narrow, much interrupted; epibranchial tooth small, blunt, cleft clearly visible. Exopod of third maxilliped with long flagellum. Suture between thoracic sternites 2, 3 distinct as broad groove not reaching lateral margins; between 3, 4 visible reaching lateral margins. *Male abdomen broadly T-shaped*; sixth male abdominal somite longer than broad, longer than telson. G1 long, almost straight; terminal article long (0.35 times length of subterminal segment), narrow, cone-

*shaped with characteristically bent tip, inner margin characteristically curved or angled slightly below juncture between terminal and subterminal segments*; subterminal segment stout. G2 distal article long (0.4 times length of basal segment).

**Distribution:** Kerala (Malappuram) and Tamil Nadu (Nilgiris).

**IUCN status:** Data Deficient (Esser & Cumberlidge, 2008b).

6. ***Lamella lamellifrons*** (Alcock, 1909)

(Plate-I, Figs. 16–18; Plate-III, Figs. 13–15)

1909a. *Paratelphusa* (*Barytelphusa*) *lamellifrons* Alcock, *Rec. Indian Mus.*, 3(4): 376.

1909b. *Paratelphusa* (*Barytelphusa*) *lamellifrons* Alcock, *Rec. Indian Mus.*, 3(3): 251.

1910. *Paratelphusa* (*Barytelphusa*) *lamellifrons* Alcock, *Cat. Ind. decap. Crust. Coll. Ind. Mus.*, 1(2): 82.

1970a. *Barytelphusa* (*Barytelphusa*) *cunicularis* Bott, *Abh. senckenb. naturforsch. Ges.*, 526: 31, 32 (part) (not *Thelphusa cunicularis* Westwood, 1836).

2007. *Lamella lamellifrons* Bahir and Yeo, *Raffles B. Zool., Supp. No.* 16: 330.

**Type locality:** Madathara (=Madathoray) (Travancore Museum), Kollam district, Kerala, India.

**Material examined:** 2 ♂ & 4 ♀, Kamanem Peroor, Konni, Pathanamthitta dist., Kerala, 24.01.1992, Coll. M.B. Raghunathan & Party, ZSI/WGRC/IR/INV/2760; 1 ♀, Kuthiran, Thrissur dist., Kerala, 14.03.1992, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2755; 1 ♂, Peringalkuth, Irumbupalam, Thrissur dist., Kerala, 20.02.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2737; 1 ♀, Athirapally, Thrissur dist., Kerala, 23.02.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2703; 1 ♀, Janakikkotu, Kuttiyadi R.F., Kozhikode dist., Kerala, 26.03.1996, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2759; 1 ♂, Karukachal, Kottayam dist., Kerala, 25.10.2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2725; 1 ♀, Bharananganam, Kottayam dist., Kerala, 28.10.2000, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2694; 1 ♀, Poolade, Rangapuzha?, Kozhikode dist., Kerala, 24.04.2002, Coll. K.G.

Emiliyamma, ZSI/WGRC/IR/INV/2753; 1♂, Madayipara, Kannur dist., Kerala, 23.09.2003, Coll. Md. Jafer Palot, ZSI/WGRC/IR/INV/2750; 1♂, Urulanthanni, Thattekkad, Ernakulam dist., Kerala, 03.12.2006, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2743 and 1♂, Urulanthanni, Ernakulam dist., Kerala, 13.12.2006, Coll. K. Rajmohana, ZSI/WGRC/IR/INV/2756.

**Diagnosis:** Carapace broader than long, slightly convex anteriorly and flat posteriorly; epigastric cristae well developed, slightly anterior to and confluent with postorbital cristae; epistomal median lobe without median tooth; *postorbital cristae and epigastric cristae well developed, confluent, forming sharp and straight crest; external orbital angle broadly triangular, with outer margin 5 times length of inner margin;* cervical grooves shallow, broad; *epibranchial tooth sharp, acutely triangular, separated from external orbital angle by distinct cleft, even visible from ventral view, well below level of postorbital cristae.* Exopod of third maxilliped with long flagellum. Suture between thoracic sternites 2, 3 distinct as narrow groove reaching lateral margins; between 3, 4 slightly visible as shallow groove from sides only. Male abdomen T-shaped; sixth male abdominal somite longer than broad, longer than telson. *G1 long, narrow, straight, inner margin characteristically curved or angled slightly below juncture between terminal article and subterminal segment; terminal article long (0.4 times length of subterminal segment), tip circular; subterminal segment stout. G2 distal article short (0.2 times length of basal segment).*

**Distribution:** Kerala (Kollam, Kottayam, Pathanamthitta, Thiruvananthapuram and Thrissur).

**IUCN status:** Least Concern (Cumberlidge, 2008d).

#### 7. *Vanni travancorica* (Henderson, 1913)

(Plate-II, Figs. 1–3; Plate-III, Figs. 16–18)

1913. *Paratelpusa* (*Liotelpusa*) *malabarica* var. *travancorica* Henderson, *Rec. Indian Mus.*, **9**(2): 47.

1931. *Paratelpusa* (*Barytelpusa*) *travancorica* Roux, *Rev. Suisse Zool.*, **38**(4) : 53.

1970a. *Travancoriana malabarica* Bott, *Abh. senckenb. naturforsch. Ges.*, **526**: 42 (part) (not *Paratelpusa* (*Liotelpusa*) *malabarica* Henderson, 1912).

1970b. *Travancoriana travancorica* Bott, *Rev. Suisse Zool.*, **77**(2): 336.

2007. *Vanni travancorica* Bahir and Yeo, *Raffles B. Zool., Supp. No.* **16**: 338.

2011. *Vanni travancorica* Pati & Sharma, *Bionotes*, **13**(4): 152.

**Type locality :** Ponmudi, Thiruvananthapuram district, Kerala (Earlier in Travancore), India.

**Material examined:** 1♂, Choodal, Shendurney W.L.S., Kollam dist., Kerala, 07.08.1997, Coll. P.M. Sureshan, ZSI/WGRC/IR/INV/2685 and 1♀, Kattilappara, Kollam dist., Kerala, 16.10.2012, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2938.

**Diagnosis:** Carapace slightly broader than long, slightly convex in frontal view; postorbital cristae distinct, reaching rugose epigastric cristae; external orbital angle outer margin 3 times length of inner margin; cervical grooves shallow, broad, much interrupted; epibranchial tooth slightly visible, cleft visible. Third maxilliped exopod with long flagellum. Suture between thoracic sternites 2, 3 very shallow, not reaching lateral margins; between 3, 4 indistinct. Male abdomen T-shaped; sixth male abdominal somite squarish, longer than broad, longer than telson. G1 almost straight, inner margin characteristically curved or angled just below juncture between terminal article and subterminal segment; *terminal article comparatively very narrow, short (0.25 times length of subterminal segment), cone-shaped; subterminal segment basal part distinctly broader than distal part.* G2 distal article relatively short (0.45 times length of basal segment).

**Distribution:** Karnataka (Uttar Kannada) and Kerala (Thiruvananthapuram).

**IUCN status:** Data Deficient (Esser & Cumberlidge, 2008c).

**8. *Vanni malabarica*** (Henderson, 1912)

(Plate-II, Figs. 4–6; Plate-IV, Figs. 1, 2)

1912. *Paratelphusa* (*Liotelphusa*) *malabarica* Henderson, *Rec. Indian Mus.*, 7(2): 111.1913. *Paratelphusa* (*Liotelphusa*) *malabarica* Henderson, *Rec. Indian Mus.*, 9(2): 48.1970a. *Travancoriana malabarica* Bott, *Abh. senckenb. naturforsch. Ges.*, 526: 42.2007. *Vanni malabarica* Bahir and Yeo, *Raffles B. Zool., Supp. No. 16*: 340.*Type locality*: River at Kavalai in the Cochin State Forest, Kochi district, Kerala, India.

*Material examined*: 8♂ & 1♀, Dohney, Nilgiri Biosphere, Palghat, Palakkad dist., Kerala, 16.01.1990, Coll. M.B. Raghunathan & Party, ZSI/WGRC/IR/INV/2747; 4♀, Karadipara, Peechi, Thrissur dist., Kerala, 15.03.1992, Coll. K.C. Gopi & Party, ZSI/WGRC/IR/INV/2754; 1♂, Vellanimala, Thrissur dist., Kerala, 09.10.1995, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2714; 1♀, Vattachira, near Thusaragiri, Kozhikode dist., Kerala, 15.02.1996, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2715; 1♀, Chimmuni, Thrissur dist., Kerala, 26.02.1996, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2711 and 2♂, Kakkavayal, Eangapuzha, Kozhikode dist., Kerala, 20.10.2009, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2740.

*Diagnosis*: Carapace broader than long, slightly convex in frontal view; *postorbital cristae* distinct, just reaching distinct and rugose epigastric cristae; external orbital angle outer margin 2.5 times length of inner margin; cervical grooves shallow, broad, interrupted; epibranchial tooth blunt, cleft visible. Third maxilliped exopod with long flagellum. Suture between thoracic sternites 2, 3 and 3, 4 indistinct. Male abdomen T-shaped; sixth male abdominal somite squarish, longer than broad, longer than telson. G1 almost straight, inner margin characteristically curved or angled just below juncture between terminal article and subterminal segment; *terminal article* stout, short (0.2 times length of subterminal segment), cone-shaped; subterminal segment basal part broader

than distal part. G2 distal article relatively short (0.25 times length of basal segment).

*Distribution*: Kerala (Kochi).*IUCN status*: Data Deficient (Cumberlidge, 2008e).**9. *Vanni ashini*** Bahir & Yeo, 2007

(Plate-II, Figs. 7–9; Plate-IV, Figs. 3–5)

2007. *Vanni ashini* Bahir and Yeo, *Raffles B. Zool., Supp. No. 16*: 343.*Type locality*: Ponmudi, Thiruvananthapuram district, Kerala, India.

*Material examined*: 6♀, Dhoni-Choppel, Nilgiri Biosphere, Palghat, Palakkad dist., Kerala, 17.11.1990, Coll. M.B. Raghunathan & Party, ZSI/WGRC/IR/INV/2707.

*Diagnosis*: Carapace slightly broader than long, slightly convex in frontal view; postorbital cristae distinct, sharp, reaching rugose epigastric cristae; external orbital angle outer margin 3 times length of inner margin; cervical grooves shallow, slightly broad, interrupted; epibranchial tooth blunt, cleft visible. Third maxilliped exopod with long flagellum. *Ambulatory legs* long; *second and third pairs of legs* longest, more than 2 times carapace length. Suture between thoracic sternites 2, 3 narrow, not reaching lateral margins and between 3, 4 indistinct. Male abdomen T-shaped; sixth male abdominal somite squarish, longer than broad, longer than telson. G1 almost straight, inner margin slightly curved or angled just below juncture between terminal article and subterminal segment; *terminal article* stout, short (0.2 times length of subterminal segment), cone-shaped; subterminal segment basal part broader than distal part. G2 distal article relatively short (0.4 times length of basal segment).

*Distribution*: Kerala (Thiruvananthapuram).*IUCN status*: Data Deficient (Esser & Cumberlidge, 2008d).**10. *Vanni giri*** Bahir & Yeo, 2007

(Plate-II, Figs. 10–12; Plate-IV, Figs. 6–8)

2007. *Vanni giri* Bahir and Yeo, *Raffles B. Zool., Supp. No. 16*: 346.

*Type locality:* Between Munnar-Maraiyoor, on Munnar-Pollachchi, Idukki district, Kerala, India.

*Material examined:* 1♂, Otekally/S. Coorg, Kodagu dist., Karnataka, 08.03.1994, Coll. P.M. Sureshan & Party, ZSI/WGRC/IR/INV/2745 and 2♂, Virapakshi Khan, Bhadra W.L.S., Chikkamagaluru dist., Karnataka, 22.11.2007, Coll. Md. Jafer Palot, ZSI/WGRC/IR/INV/2757.

*Diagnosis:* Carapace broader than long, slightly convex in frontal view; *postorbital cristae* distinct, *granular*, *reaching rugose epigastric cristae*; external orbital angle outer margin 3 times length of inner margin; cervical grooves shallow, broad, interrupted; epibranchial tooth distinct, blunt, cleft visible. Third maxilliped exopod with long flagellum. Suture between thoracic sternites 2, 3 narrow, reaching lateral margins and between 3, 4 very shallow. Male abdomen broadly T-shaped; sixth male abdominal somite squarish, longer than broad, longer than telson. G1 almost straight, inner margin characteristically curved or angled just below juncture between terminal article and subterminal segment; *terminal article stout, short (0.25 times length of subterminal segment), cone-shaped, tip curved outwards*. G2 distal article slightly long (0.4 times length of basal segment).

*Distribution:* Kerala (Idukki).

*IUCN status:* Data Deficient (Esser & Cumberlidge, 2008e).

*Remarks:* In original description of the species, it was wrongly mentioned that distal article of G2 is 0.25 times the length of basal segment (Bahir & Yeo, 2007: p.346). From the figure of left G2 of the holotype male (Bahir & Yeo, 2007: figure 43E), it was confirmed that G2 distal article is 0.4 times the length of basal segment. The present specimens are also having a long distal article (Plate-IV, Fig. 8).

#### 11. *Vela carli* (Roux, 1931)

(Plate-II, Figs. 13–15; Plate-IV, Figs. 9–11)

1931. *Paratelpusa (Barytelpusa) carli* Roux, Rev. Suisse Zool., **38**(4): 50.

1970a. *Travancoriana carli* Bott, Abh. senckenb. naturforsch. Ges., **526**: 43.

1970b. *Travancoriana carli* Bott, Rev. Suisse Zool., **77**(2): 336.

2007. *Vela carli* Bahir and Yeo, Raffles B. Zool., Supp. No. **16**: 349.

*Type locality:* Mudumalai, Nilgiris district, Tamil Nadu, India.

*Material examined:* 1♂, Silent Valley, Pathrakadavu, Palghat, Palakkad dist., Kerala, 08.02.1988, Coll. G.U. Kurup & Party, ZSI/WGRC/IR/INV/2741; 1♀, Kurichiyat R.F., Wayanad dist., Kerala, 24.12.1994, Coll. C. Radhakrishnan, ZSI/WGRC/IR/INV/2721 and 1♂, Kakkayem, Ambalapara, Malabar W.L.S., Kozhikode dist., Kerala, 29.05.2013, Coll. K.G. Emiliyamma, ZSI/WGRC/IR/INV/2933.

*Diagnosis:* Carapace broader than long, highly convex in frontal view; *postorbital cristae* distinct, confluent with *epigastric cristae*; external orbital angle outer margin 3 times length of inner margin; *cervical grooves shallow, broad*; *epigastric groove long*; epibranchial tooth small, blunt, cleft visible; *frontal margin almost straight*; *epistome with lateral and outer parts of posterior margin almost straight*. Third maxilliped exopod with long flagellum. Suture between thoracic sternites 2, 3 prominent, deep, not reaching lateral margins and between 3, 4 prominent, deep, reaching lateral margins. Male abdomen T-shaped; sixth male abdominal somite very long, longer than broad, longer than telson, *lateral margins gently converging distally*; telson slightly narrow. G1 almost straight, inner margin characteristically curved or angled just below juncture between terminal article and subterminal segment; terminal article long (0.4 times length of subterminal segment), cone-shaped, *basal two-thirds part distinctly stouter than cylindrical distal one-third part*, tip straight. G2 distal article long (0.45 times length of basal segment).

*Distribution:* Tamil Nadu (Nilgiris).

*IUCN status:* Data Deficient (Cumberlidge, 2008f).

12. ***Oziotelphusa biloba*** Bahir & Yeo, 2005

(Plate-II, Figs. 16–18; Plate-IV, Figs. 12–14)

2005. *Oziotelphusa biloba* Bahir and Yeo, *Raffles B. Zool., Supp. No. 12*: 101.

*Type locality*: Kodagara Village on Trissur-Chalakudy Road, Thrissur district, Kerala.

*Material examined*: 1♂ & 2♀, Eranhipalam, Kozhikode dist., Kerala, 03.10.1981, Coll. K.N. Nair, ZSI/WGRC/IR/INV/2691; 1♀, Eranhipalam, Kozhikode dist., Kerala, 05.05.1982, Coll. Jian Koshy, ZSI/WGRC/IR/INV/2733; 1♀, Vazhani, Thrissur dist., Kerala, 07.10.1995, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2693 and 1♂ & 1♀, Asurankundu, Thrissur dist., Kerala, 08.10.1995, Coll. K.C. Gopi, ZSI/WGRC/IR/INV/2723.

*Diagnosis*: Carapace broader than long, highly convex in frontal view; epigastric cristae distinct, anterior to postorbital cristae; postorbital cristae distinct, sharp, gently curved; postorbital region concave; branchial regions inflated; external orbital angle outer margin 2 times length of inner margin; cervical grooves very shallow, narrow, interrupted, not reaching level of postorbital cristae; epigastric groove bifurcated; epibranchial tooth moderate in size, not very much sharp, situated slightly above postorbital cristae level and below supraorbital margin level; frontal margin straight in dorsal view; *epistomal median lobe notched or bilobed*, without a distinct, sharp tooth. Third maxilliped exopod with long flagellum. Suture between thoracic sternites 2, 3 deep, short, not reaching lateral margins and between 3, 4 deep, broad, not reaching lateral margins. Male abdomen narrowly triangular, lateral margins concave; sixth male abdominal somite trapezoidal, slightly broader than long, slightly shorter than telson, lateral margins concave; telson broad, elongate, lateral margins nearly straight. G1 stout; terminal article short (0.4 times length of subterminal segment), basal two-thirds part stout and turned outwards; subterminal segment much stouter than terminal article, basal two-thirds part comparatively stout than distal one-third part. G2 distal article short (0.35 times length of basal segment).

*Distribution*: Kerala (Thrissur).

*IUCN status*: Vulnerable (Esser & Cumberlidge, 2008f).

## DISCUSSION

*Barytelphusa cunicularis* (Westwood, 1836) was commonly found in the areas under study except Kottayam district of Kerala. *Lamella lamellifrons* (Alcock, 1909) is a widely distributed species in Kerala and can be found up to 190 m altitude. *Vela carli* (Roux, 1931) was recorded for the first time from Kerala whereas *Travancoriana convexa* (Roux, 1931) and *Vanni giri* Bahir & Yeo, 2007 stood as new records to Karnataka. *Travancoriana kuleera* Bahir & Yeo, 2007 was originally described from Malappuram district of Kerala but wrongly mentioned as from Tamil Nadu (Bahir & Yeo, 2007). Hence, the present records from Kozhikode district of Kerala is only a range extension of *T. kuleera*.

## SUMMARY

Freshwater crabs (194 specimens) in the collections of Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, have been identified. In total, 12 species under 7 genera of the family Gecarcinucidae are reported. Data on distribution of all the identified species are provided. *Barytelphusa cunicularis* (Westwood, 1836) was the most commonly collected species in the studied area (Karnataka, Kerala and Tamil Nadu). *Vela carli* (Roux, 1931) is recorded for the first time from Kerala whereas *Travancoriana convexa* (Roux, 1931) and *Vanni giri* Bahir & Yeo, 2007 were found to be new records to Karnataka.

## ACKNOWLEDGEMENTS

We are grateful Dr. K. Venkataraman, Director, Zoological Survey of India, Kolkata for facilities, constant encouragement and support. We are thankful to the scientists and staff of Western Ghat Regional Centre, Zoological Survey of India, Kozhikode for support and help during the study. Sincere thanks to all the collectors of freshwater crab specimens deposited at WGRC, ZSI, Kozhikode.

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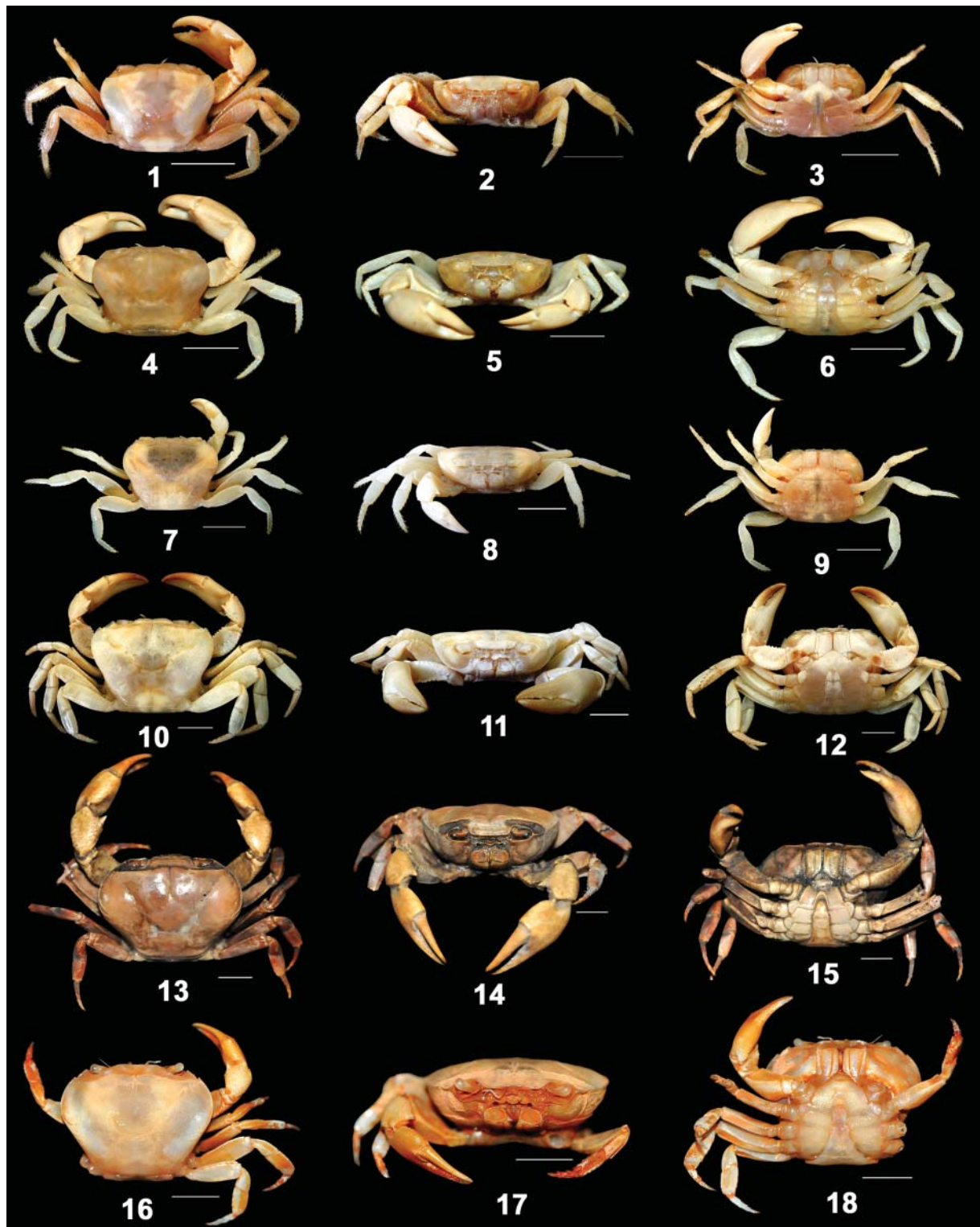
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## PLATE-I



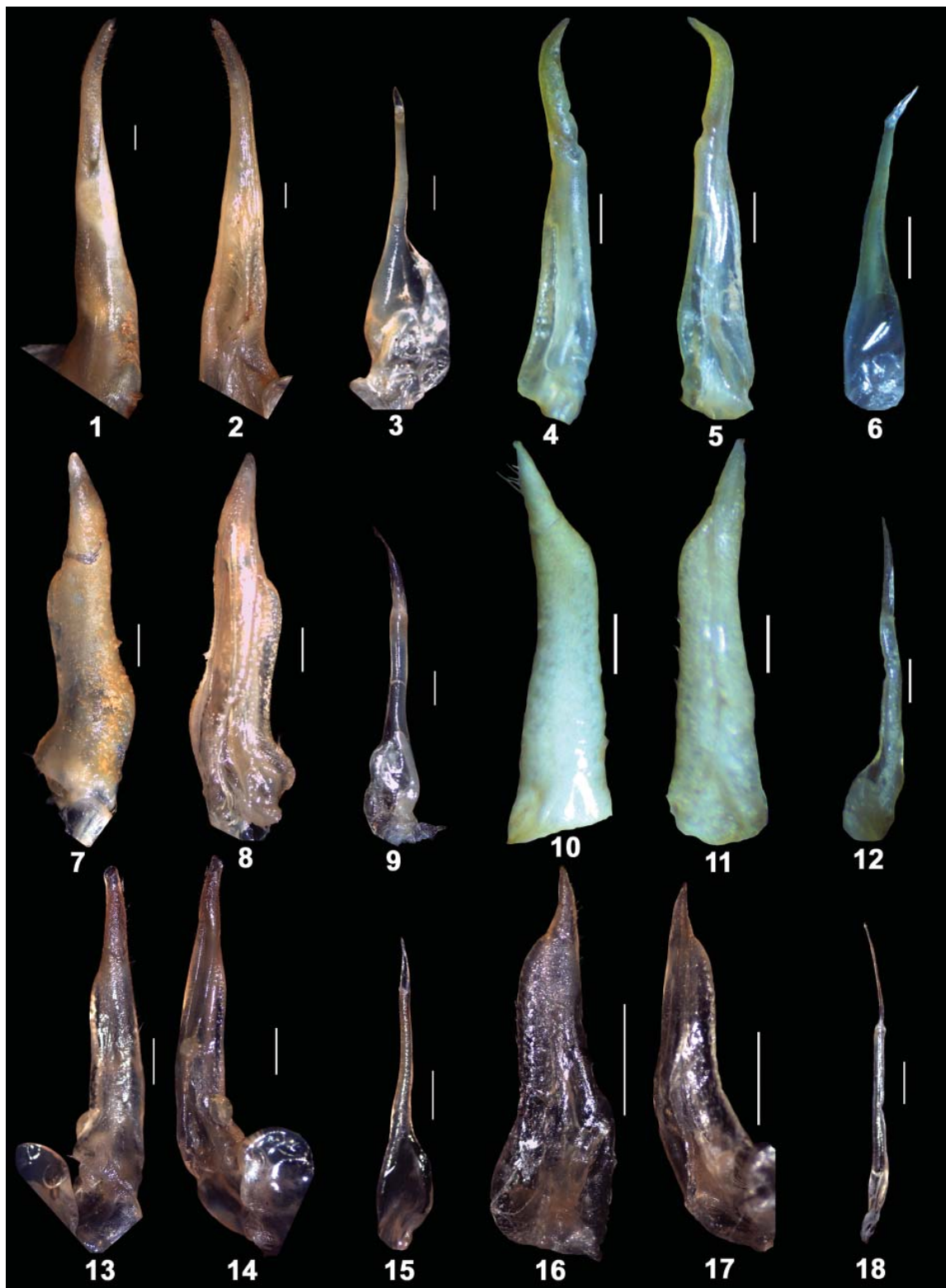
1–3. *Barytelphusa cunicularis*; 4–6. *Cylindrotelphusa steniops*; 7–9. *Travancoriana pollicaris*; 10–12. *Travancoriana convexa*; 13–15. *Travancoriana kuleera*; 16–18. *Lamella lamellifrons*. 1, 4, 7, 10, 13, 16, dorsal views; 2, 5, 8, 11, 14, 17, frontal views; 3, 6, 9, 12, 15, 18, ventral views. Scale bar = 10 mm.

## PLATE-II



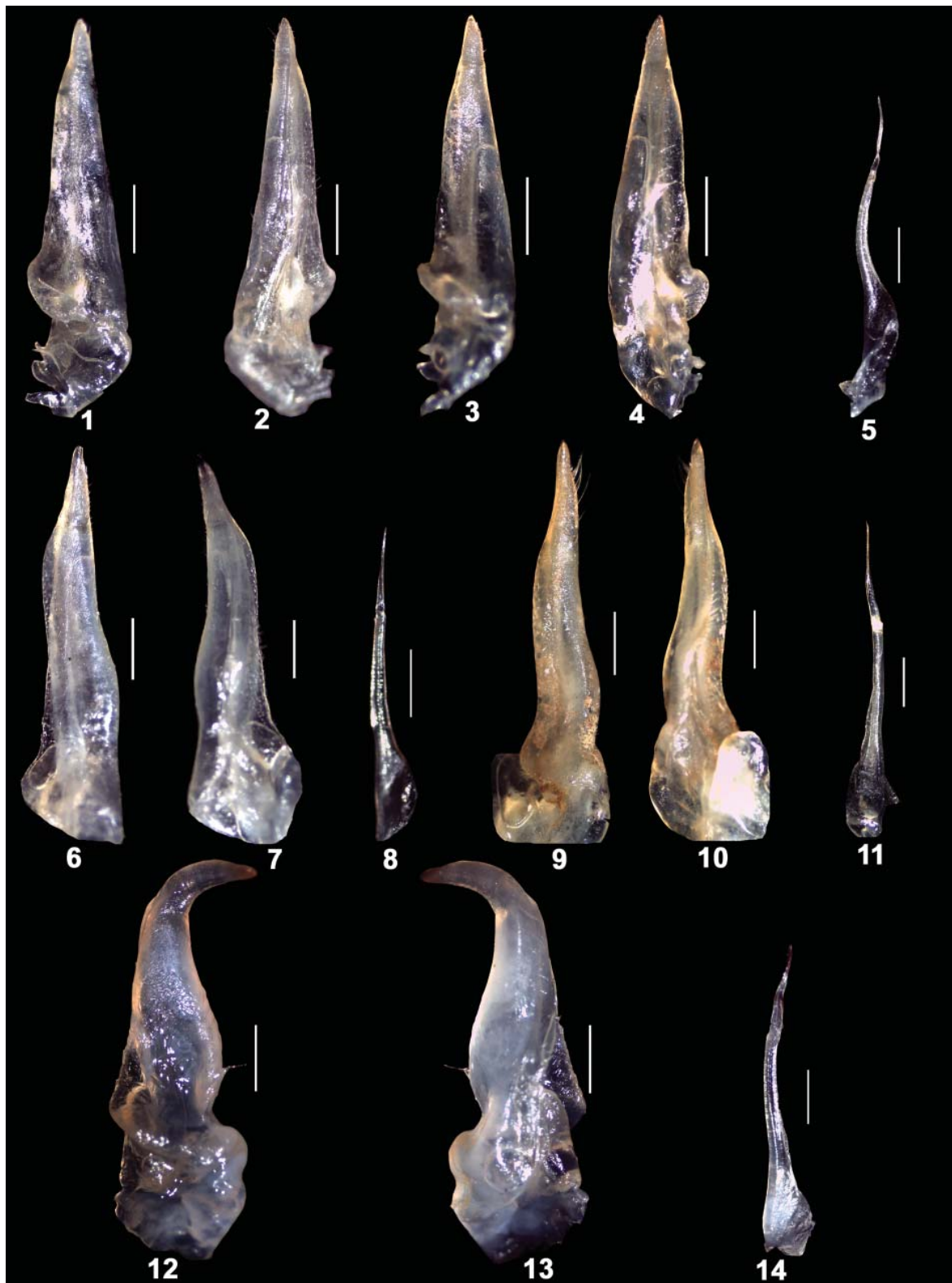
1–3. *Vanni travancorica*; 4–6. *Vanni malabarica*; 7–9. *Vanni ashini*; 10–12. *Vanni giri*; 13–15. *Vela carli*; 16–18. *Oziotelphusa biloba*. 1, 4, 7, 10, 13, 16, dorsal views; 2, 5, 8, 11, 14, 17, frontal views; 3, 6, 9, 12, 15, 18, ventral views. Scale bar = 10 mm.

## PLATE-III

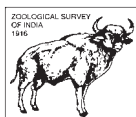


1–18. Gonopod structures. 1–3. *Barytelphusa cunicularis*; 4–6. *Cylindrotelphusa steniops*; 7–9. *Travancoriana convexa*; 10–12. *Travancoriana kuleera*; 13–15. *Lamella lamellifrons*; 16–18. *Vanni travancorica*. 1, 4, 7, 13, 16, right G1 dorsal views; 2, 5, 8, 14, 17, right G1 ventral views; 3, 6, 9, 15, 18, right G2; 10, left G1 dorsal view; 11, left G1 ventral view; 12, left G2. Scale bar = 1 mm.

## PLATE-IV



1–14. Gonopod structures. 1, 2. *Vanni malabarica*; 3–5. *Vanni ashini*; 6–8. *Vanni giri*; 9–11. *Vela carli*; 12–14. *Oziotelpusa biloba*. 1, 3, 6, 9, 12, right G1 dorsal views; 2, 4, 7, 10, 13, right G1 ventral views; 5, 8, 14, right G2; 11, left G2. Scale bar = 1 mm.



**A NEW SPECIES OF AGRIOCNEMIS SELYS, 1869 (ZYGOPTERA:  
COENAGRIONIDAE) FROM EASTERN INDIA WITH REDESCRIPTION  
OF AGRIOCNEMIS KERALENSIS PETER, 1981**

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### INTRODUCTION

The genus *Agriocnemis* Selys, 1869 consists of some of the smallest odonates in the world distributed throughout the tropical zones of Africa to Australia and Oceania. The genus is essentially an Oriental one, with bulk of the species coming from southern Asia. Currently, there are 42 species recognized under this genus (Schorr & Paulson, 2014). Fraser (1933) included 10 species of *Agriocnemis* in his work on *Odonata of British India*, viz. *A. pygmaea* (Rambur, 1842), *A. femina* (Brauer, 1868), *A. lacteola* Selys, 1877, *A. pieris* Laidlaw, 1919, *A. splendidissima* Laidlaw, 1919, *A. aborensis* (Laidlaw, 1914), *A. dabreui* Fraser, 1919, *A. clauseni* Fraser, 1922, *A. nana* Laidlaw, 1914 and *A. naia* Fraser, 1923; the latter two being from Upper and Lower Myanmar respectively. *Agriocnemis nainitalensis* was described by Sahní in 1965, but was later synonymised with *Ischnura senegalensis* by Mitra (1992). Subsequently, *A. corbeti* was described by Kumar and Prasad in 1978 and *Agriocnemis keralensis* was described by Peters in 1981. Subramanian (2009) in his Checklist of Odonata of India included 9 species, omitting *A. nana* and *A. naia* but adding *A. corbeti* and *A. keralensis*. Mitra and Babu (2010) in their revision of Indian Platynemididae and Coenagrionidae, suppressed both *A. corbeti* and *A. keralensis*, and considered the former as a junior synonym of *A. pygmaea* and latter as that of *A.*

*splendidissima*. However, no type specimens were studied. Mitra and Babu (2010) also included *A. nana* Laidlaw, 1914 and cited the report of this species from Kolkata (Mitra and Lahiri, 1980). However, recent field studies based on fresh specimens confirmed the taxonomic validity of *A. keralensis* which is restricted to the south western India (Emiliyamma *et al.*, 2010; Rangnaker *et al.*, 2010; Kiran and Raju, 2013; Varghese *et al.*, 2014). On the other hand, the description of *A. corbeti* is very detailed including the final instar larvae. Hence both *A. keralensis* and *A. corbeti* were retained in the revised checklist of Indian odonates by Subramanian (2014). Thus, currently, ten valid species of *Agriocnemis* are known within Indian limits, the details of which are given in table-1 with their known distributions. Here we describe a new species of *Agriocnemis* sp.nov from Odisha and revalidate the species status of *A. keralensis*.

### MATERIAL AND METHODS

Morphological terminology follows Chao (1953) and Watson & O'Farrell (1991). Colouration is given as from the freshly preserved material and photographs taken in life. Measurements are given in millimetres (mm). Adult specimens were collected from Nandankanan (Lat. N 20.398; Long. E 85.821; Alt. 27m) and photographed at Attabira (Lat. N 21.373; Long.

E 83.775; Alt.165m), Odisha and preserved in alcohol. Photographs of body parts were taken with Leica EZ4HD and M205A microscopes. The holotype and paratypes of the new species are deposited in the Central Entomology Laboratory, National Zoological Collections, Zoological Survey of India, Kolkata.

***Agriocnemis kalinga* sp. nov.**

(Figures 1-14, Plate I-II)

**Description:** All measurements are in mm. Measurements of holotype, paratypes and specimens from Howrah, West Bengal is provided in table-2.

**Adult Male:** *Head:* Labium, labrum, mandible, clypeus, anterior frons and genae light green in life which turns into to light sky blue or pale white upon preservation in alcohol. Base of labrum is black; clypeus with three black markings. Median and lateral ocellus are dark brown. Antennae, vertex, occiput and post ocular area are black. Centre of the occiput with thick horizontal light green mark which is followed on either side after a narrow black interruption by “hockey stick” or “L” shaped light green mark of same width. Eyes are light green below with a black cap above. *Thorax:* Prothorax black dorsally, light green anteriorly, laterally and posteriorly. Synthorax is light green with broad black antehumeral and posthumeral stripes. *Legs:* Fore, mid and hind coxae, trochanter and femur light green with black spines. The flexor surface of femur is black. Tibia and tarsus pale green. *Wings:* Transparent, pterostigma diamond shaped and yellow. Pterostigma of hind wing is brighter than fore wing. Two antenodal and six post nodal crossveins present in fore and hind wings.

*Abdomen:* Terga largely black; tergum 1, narrow at base and broad at apex, sides and apical border light green; terga 2 with the dorsum broadly black, except at the sub-apical and apical end where the black is constricted, enclosing a greenish yellow patch; at the base there are a pair of oval yellow spots broadly separated medially, resembling a ‘hood mark’; tergum 3 to 6 with broadly black and the sides greenish yellow, with the sub-apical end and the apical end constricted so as to enclose a greenish yellow patch on sides, terga 7 the same, except that the enclosed

subapical patch is bright yellow, terga 8 and 9 bright yellow, marked on the proximal end with a small black triangle with its apex pointing to the distal end and continuing as an indistinct black line, with two thin black lines perpendicular to it, just after the centre (the entire pattern reminiscent of an ‘anchor’), terga 10 yellow with a broad ‘X’ mark on the dorsum. These patterns on tergum 8-10, are much more distinct and clearly marked on sub-adult individuals as compared to mature individuals where the yellow is more brighter and extensive, largely obliterating the black markings. Sterna light green in segments 1-3 which gradually changes into bright yellow in segments 4-10. Secondary genitalia typical of the genus.

*Anal appendages:* Superiors yellowish with black tips, slightly longer than segment 10, curved a little downwards as seen from the sides. The inferiors pale yellow with black tip, considerably shorter, broad at base as seen from side and below; the apex curved inwards as seen from above.

*Adult Female:* The head, thorax and abdomen of adult female are light green. The black markings of labrum and clypeus are similar to male. The occiput is black as in male with light orange “hockey stick” markings. The pro, synthorax and abdomen are without black markings. Legs are light green with black spines. Wings and pterostigma are similar to male.

**Diagnosis:** A tiny damselfly, possibly the smallest described thus far from India, with the abdomen about 13-14 mm and hindwing 8-11 mm, labrum non-metallic, superior anal appendages longer than inferior, tergum 2 of abdomen of male marked with a characteristic ‘cobra hood’ like marking, ground colour bright yellow with black on dorsum, yellow pterostigma and bright yellow tip to abdomen. The differences from all other valid species of *Agriocnemis* from India are given in Table-1. In many aspects, the *A. kalinga* sp.nov is very close to *Agriocnemis keralensis* Peter, 1981. However, it can be distinguished by (1) overall ground colour bright yellowish than greenish yellow, including the tip of abdomen being yellow rather than ochreous; (2) distinct “hockey stick” shaped markings in the occiput; (3) bright yellow pterostigma without black; (4) hood mark of segment 2 broadly confluent with black apical tip distally in *sp nov*; narrowly

connected in *A. keralensis*; (5) difference of patterns in abdominal segments 8-10; (6) shape of anal appendages.

**Material examined** (in alcohol): Holotype ♂, INDIA: Odisha, Nandankanan, Kanjia Lake, 11.viii.2009, Manoj V. Nair leg, NZC Reg. No. 4982/H13. Paratype, 1♂, same data of holotype, 7.viii.2009, NZC Reg. No. 4983/H13. Other materials: same data of holotype 1♀, 31.vii.2009, Manoj V. Nair leg; NZC Reg. No. 4984/H13. West Bengal, Howrah district, Panchala, 1♂ 2♀, 30.xi.2011, P. Dawn leg. NZC Reg. No. 4985/H13.

**Etymology:** Gender neutral; named after the historical kingdom. Kalinga (Odiya: କଳିଙ୍ଗ, Devnagari: कलिंग, an early republic (c. 265 BCE), in eastern India which comprised most of the modern state of Odisha, the current stronghold of this species.

**Habitat and Distribution:** Adults were found on the edge of lakes and pond with aquatic vegetation, flying close to the ground. In eastern India, they are found in the state of Odisha (Photographic records: Khurda, Mayurbhanj, Sambalpur & Bargarh districts) and West Bengal (Photographic records: Panchala, Howrah; Narendrapur, South 24 Parganas districts).

#### **The status of *Agriocnemis keralensis* Peter, 1981**

*Agriocnemis keralensis* was described by Peters in 1981 from 3 specimens (2 males and 1 female, all teneral) collected from Karamana, south Trivandrum, Kerala. It was thought to be similar to *A. peiris* by the author in many respects, but still had distinct characters to enable it be given a species status. The author surmised that the green and the ochreous colour of the specimens collected might later change to blue on maturity. However, Mitra and Babu (2010), invalidated it considering it a junior synonym of *A. splendidissima* as the shape and size of anal appendages, wing characteristics etc. agree with immature forms of *A. splendidissima*. The decision was also furthered by the fact that the original description was based on teneral individuals and that no specimens were available in India for further examination, the holotypes and paratypes being deposited in Berlin Zoological Museum.

However, recent field studies, photographs and specimens confirms the taxonomic validity of *A. keralensis* Peter, 1981 (Emiliyamma *et al.*, 2010; Rangnaker *et al.*, 2010; Kiran and Raju, 2013; Varghese *et al.*, 2014) which is distributed along the west coast in southern India. Based on recent studies, *A. keralensis* Peter, 1981 is redescribed.

#### **Redescription of *Agriocnemis keralensis* Peter, 1981**

**Material:** 3 males and 1 female collected on 18.viii.2009 from a water-logged meadow adjacent to the backwaters of Vembanad lake at Coconut Lagoon Resort, Kumarakom, Kottayam district, Kerala (9.633N, 76.418E; Alt:1m), all collected by the first author.

**Adult male:** Length of abdomen: 14 mm; Hindwing: 9-9.5 mm

**Head:** Labium pale yellow with a black strip; labrum pale yellow; anteclypeus, base of mandibles, genae and post clypeus greenish yellow, the latter narrowly black at base; frons greenish yellow; vertex and occiput black with the latter having greenish yellow median horizontal stripe boarded by two post-ocular spots of same colour on either side, thus having five disjoint parts; eyes black above, green at sides and fading below. **Prothorax:** black on dorsum, except the anterior lobe which is bright yellow; posterior lobe with its central portion produced into a rounded lobe, the entire posterior margin thinly bordered with yellow. **Thorax:** Black on dorsum to as far as the antero-lateral suture, marked with greenish-yellow antehumeral stripes on either side; laterally greenish yellow marked with a broad black stripe on the postero-lateral suture; beneath greenish yellow fading to ventral sides. **Legs:** pale creamy white with extensor surface of femora black, 4-5 black spines on hind tibiae.

**Wings:** Hyaline, 6 post-nodal nervures in forewings, 5 in hind-wings; arc situated beyond the distal antenodal nervure. Pterostigma of both forewing and hindwing twice as long as broad with oblique posterior frame; dirty yellow, with a suffused black spot in the proximal corner.

**Abdomen:** Segment 1 with tergum black with sides and apical border yellow; segment 2 with the tergum broadly black with paired yellow spots resembling the hood mark of a cobra, except at

the apical end where there is a broad yellow band, with a fine black line conjoint with the 'hood'; segments 3 to 5 with the tergum narrowly brownish black and the sides greenish yellow, with the basal, sub-apical and the apical end constricted so as to enclose a greenish yellow patch, segment 6 with broadly brownish black with no apical constriction, segment 7 brownish on tergum and ochreous on sides, with a hint of basal constriction and fading gradually into broad ochreous base, 8, 9 and 10 bright ochreous.

**Anal appendages:** Ochreous-brown with black inner surfaces and tips, the inferior pale yellow; the superiors slightly longer than segment 10, very slightly curved down as seen from the sides, the apex straight and blunt as seen from above; inferiors considerably shorter, broad at base as seen from side.

**Adult female:** Similar to adult male size and colouration except that the ochreous part of abdomen is replaced with yellowish green and tergum of abdominal segments 8-10 is broadly black.

**Habitat and distribution:** Found in the paddy fields, ponds, backwaters and coastal marshes of west coast of India (Kerala and Goa).

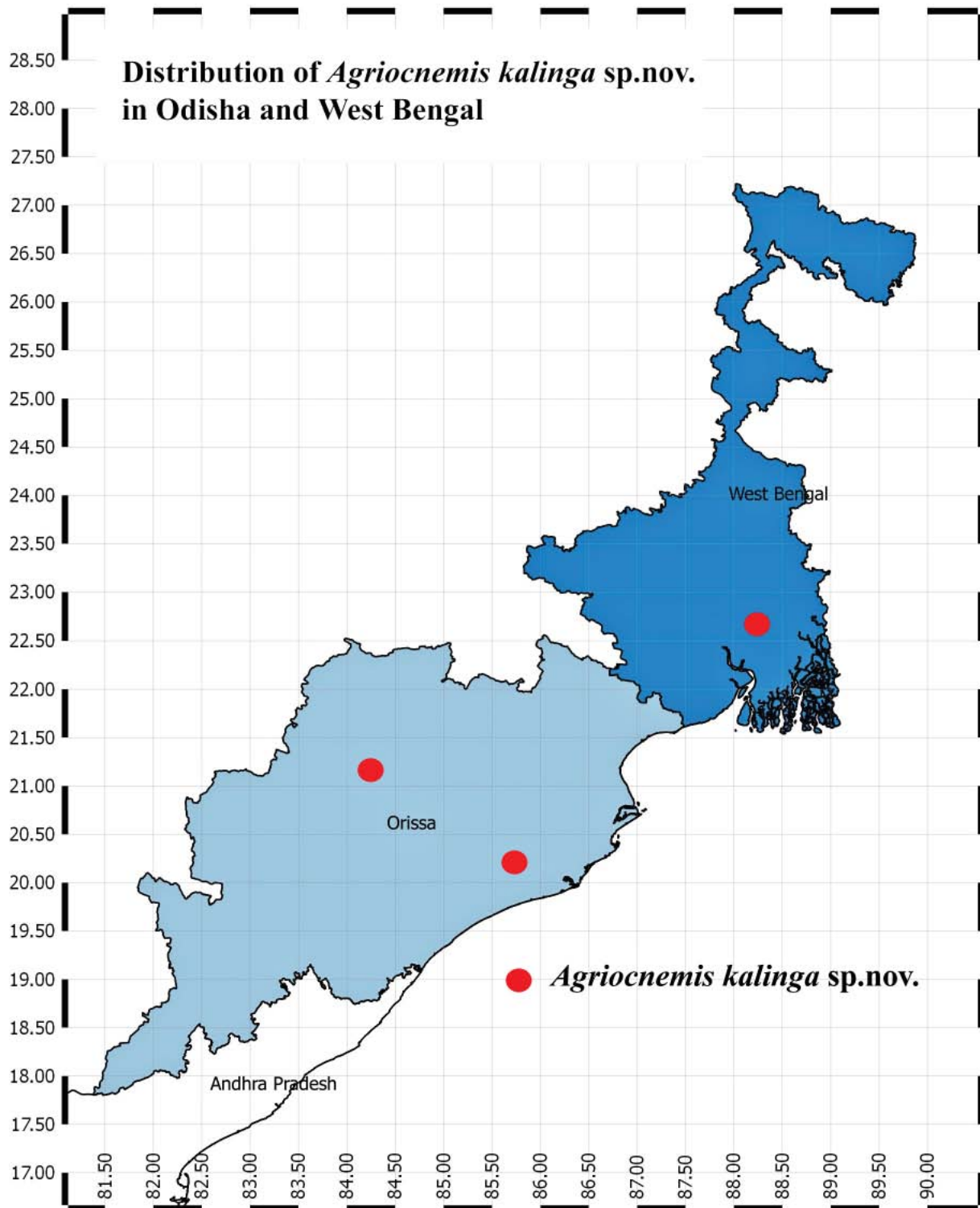
## DISCUSSION

Fraser (1933) classified the members of the genus into two natural groups based on the colour of labrum and length of anal appendages. In the first group, comprising of *A. pygmaea* and *A. femina* labrum is metallic blue and anal appendages are of variable length. In the second group, labrum is non-metallic and anal appendages are more or less homogenous, superiors being considerably longer than inferiors. In this group, second abdominal segment of *A. lacteola*, *A. peiris* and *A. splendidissima* is devoid of "cobra hood" marking. Remaining species including *A. corbeti* has a "cobra hood" marking which was not mentioned in the original paper but illustrated (Kumar and Prasad, 1978). The presently described species can be distinguished from other members of the genus found in India by its diminutive size, overall yellowish ground colour with bright yellow tip of abdomen and distinct "hockey stick" shaped markings in the occiput.

Discovery of this new species of *Agriocnemis* from relatively under-explored regions of the country highlight the importance of intensive field surveys in revealing hitherto unknown species. Moreover, distribution and biology of many species of *Agriocnemis* in India is poorly known. Hence it is important to carry out detailed field studies to document biology and ecology of such species.

## Key to male *Agriocnemis* Selys, 1869 of India

1. Labrum metallic blue, anal appendages of variable length ..... 2
- Labrum non metallic, anal appendages more or less similar ..... 3
2. Superior anal appendage longer than inferiors ..... *A. pygmaea*  
Superior anal appendages shorter than inferiors ..... *A. femina*
3. With "cobra hood" mark in the tergum of second abdominal segment ..... 4  
Without "cobra hood" mark in the tergum of second abdominal segment ..... 5
4. a. Abdominal segment 8 entirely black, FW with 6-7 post nodal nervures ..... *A. clauseni*  
b. Abdominal segment 8 ochreous with a black anchor mark on dorsum and tergum of second abdominal segment with a pair of blue eyespots ..... *A. dabruei*  
c. Abdominal segment 8 blue with black markings which enclose two blue spots .....  
..... *A. nana*  
d. Abdominal segments brick red with black markings ..... *A. corbeti*  
e. Abdominal segment 8-10 bright ochreous; 5 postocular spots ..... *A. keralensis*  
f. Abdominal segment 8-10 bright yellow and 10 marked with black "X" mark on dorsum; 3 postocular spots ..... *A. kalinga* sp.nov.
5. a. Abdominal segments 4-10 white, unmarked ..... *A. lacteola*  
b. Abdominal segments 4-6 white with black apical rings confluent with a subapical arrow-head ..... *A. pieris*  
c. Abdomen dark blue with black tergal markings largely obscuring blue ground colour ..... *A. splendidissima*



**Map-1:** Distribution of *Agriocnemis kalinga* in Odisha and West Bengal.

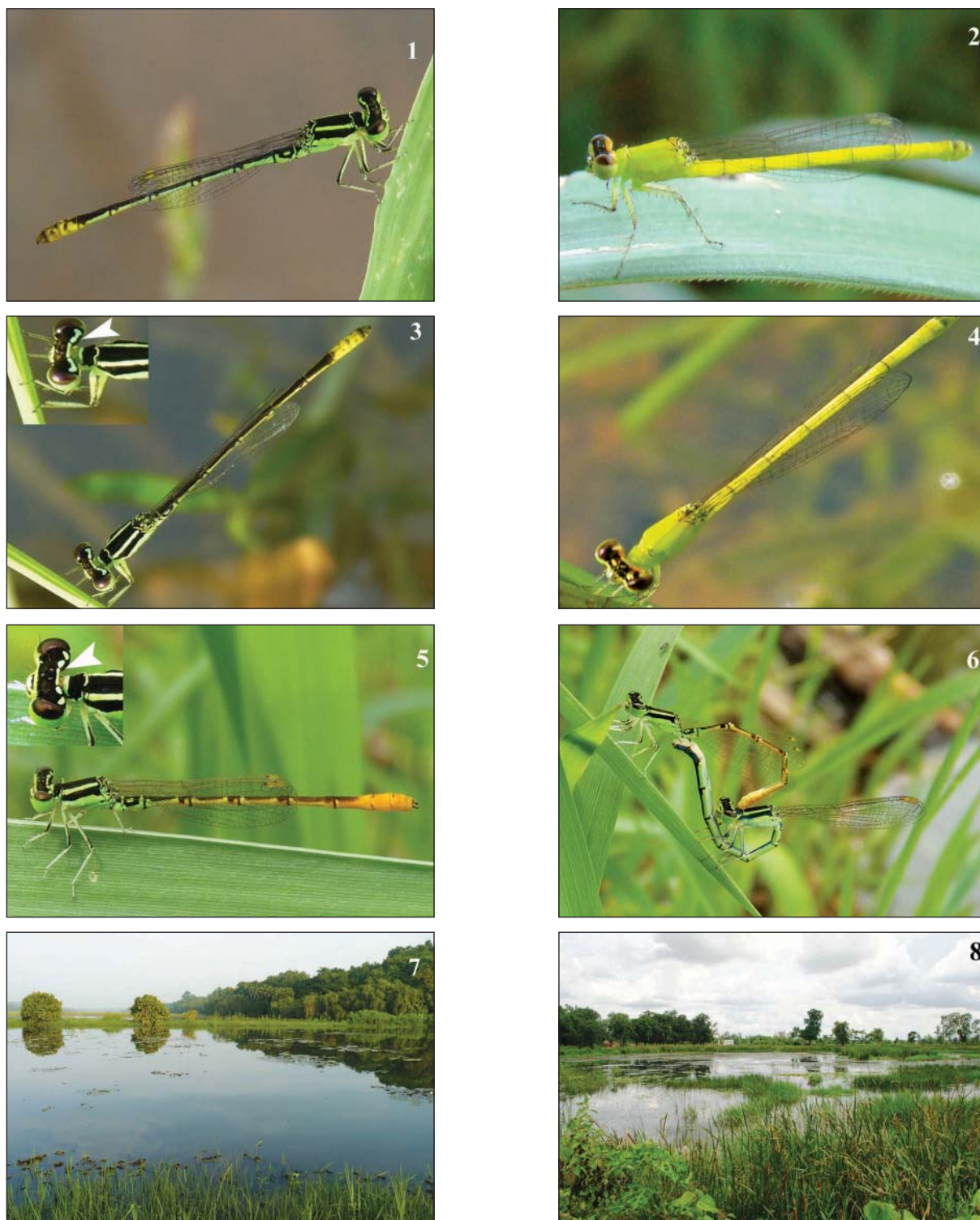
**Table-1.** A comparative account of *Agriocnemis* Selys, 1869 of India

| <i>Agriocnemis</i> species of the Indian subcontinent                      |                                          |                        |                         |                                                          |
|----------------------------------------------------------------------------|------------------------------------------|------------------------|-------------------------|----------------------------------------------------------|
| Sl. No.                                                                    | Species                                  | Abdomen Length (in mm) | Hindwing length (in mm) | Distribution & Status                                    |
| <b>GROUP-I: Labrum metallic, anal appendages variable length</b>           |                                          |                        |                         |                                                          |
| 1                                                                          | <i>A. pygmaea</i> (Rambur, 1842)         | 16-17                  | 9.5-10                  | All over India. Very common                              |
| 2                                                                          | <i>A. femina</i> (Brauer, 1868)          | 16-17                  | 10.5-11                 | Scattered in India in wet areas. Relatively rare.        |
| <b>GROUP-II: Labrum non metallic, anal appendages more or less similar</b> |                                          |                        |                         |                                                          |
| <b>GROUP-IIa: Without “cobra hood mark”</b>                                |                                          |                        |                         |                                                          |
| 3                                                                          | <i>A. lacteola</i> Selys, 1877           | 16-18                  | 9.5-10.5                | Central, Eastern & NE India<br>Locally common            |
| 4                                                                          | <i>A. pieris</i> Laidlaw, 1919           | 16-19                  | 9 to 10                 | S. Western & NE India.<br>Locally common                 |
| 5                                                                          | <i>A. splendidissima</i> Laidlaw, 1919   | 18                     | 10                      | Scattered in India in wet areas. Relatively rare.        |
| <b>GROUP-IIb: With “cobra hood mark”</b>                                   |                                          |                        |                         |                                                          |
| 6                                                                          | <i>A. clauseni</i> Fraser, 1922          | 20-22.5                | 11-13.5                 | Uttarakhand, NE India.<br>Relatively rare.               |
| 7                                                                          | <i>A. dabruei</i> Fraser, 1919           | 13-14                  | 9-9.5                   | Central & NE India.<br>Relatively rare.                  |
| 8                                                                          | <i>A. nana</i> (Laidlaw, 1914)           | 18                     | 10                      | Eastern India.<br>Relatively rare.                       |
| 9                                                                          | <i>A. corbeti</i> Kumar and Prasad, 1978 | 19                     | 13                      | Uttarakhand.: Dehradun. Known only from type collection. |
| 10                                                                         | <i>A. keralensis</i> Peters, 1981        | 13-14                  | 9-9.5                   | S.W. India, Kerala and Goa.<br>Locally common.           |
| 11                                                                         | <i>Agriocnemis kalinga</i> sp.nov.       | 13-14                  | 8-10                    | Eastern India<br>relatively rare.                        |

**Table-2.** Measurements of specimens studied.

| Measurements (mm)                | Holotype (male) | Paratype (male) | Female from type locality | Male from Howrah | Female from Howrah |
|----------------------------------|-----------------|-----------------|---------------------------|------------------|--------------------|
| Abdomen                          | 13.43           | 12.33           | 14.23                     | 13.67            | 14.37              |
| Hind wing                        | 8.11            | 8.45            | 10.4                      | 8.52             | 10.57              |
| Max. Head width (including eyes) | 2.55            | 2.3             | 2.53                      | 2.54             | 2.59               |

PLATE I

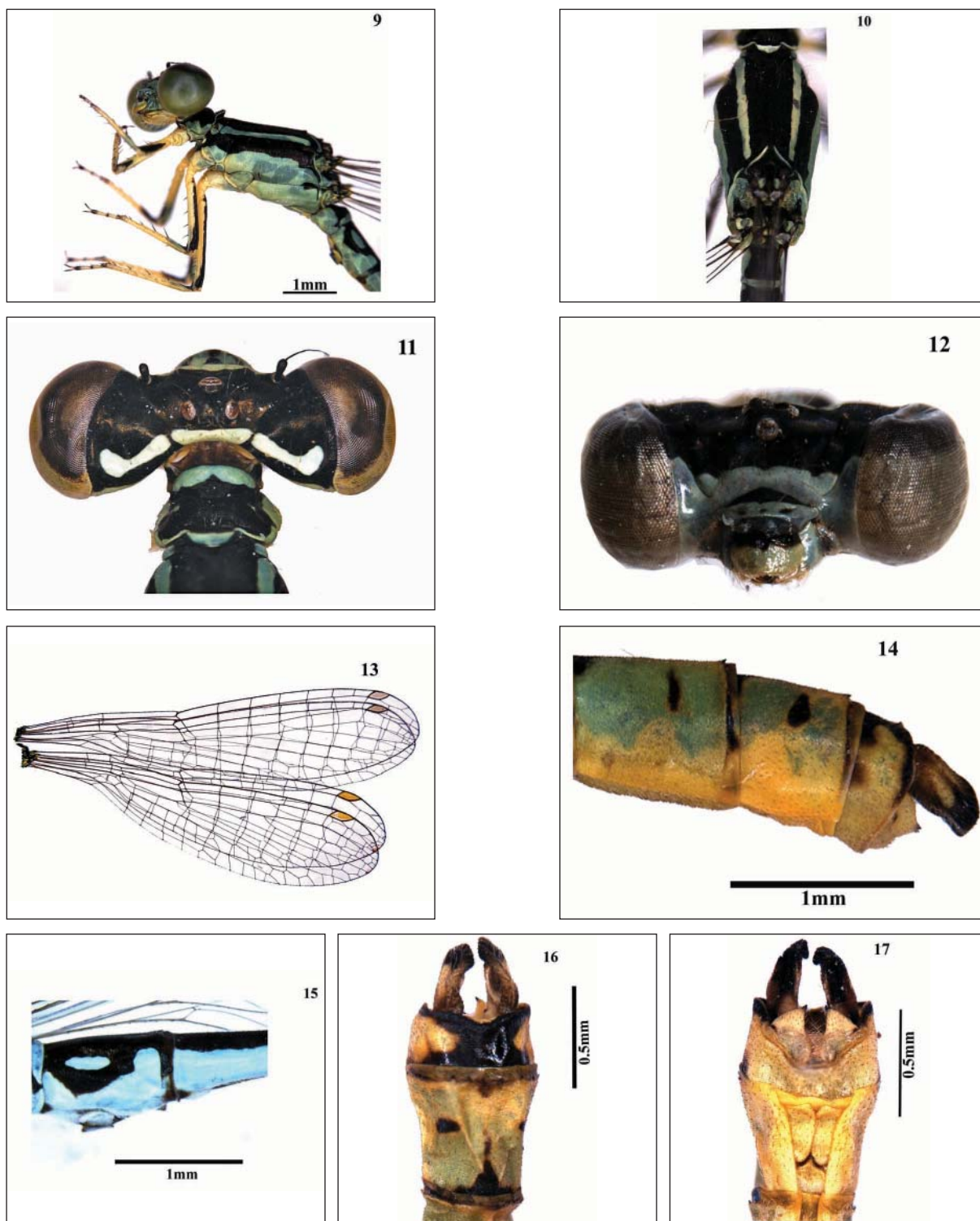


**Images 1-4:** *Agriocnemis kalinga* sp. nov. from Odisha. 1&3 Male; 2&4 Female. Image 3 inset: Head of male *Agriocnemis kalinga* sp. nov. showing post ocular spots. (Photo. M.V. Nair)

**Images 5-6:** *Agriocnemis keralensis* from Kerala. 5. Male; 6. In copula. Image 5 inset: Head of male *Agriocnemis keralensis* showing post ocular spots. (Photo. M.V. Nair)

**Images 7-8:** Habitat of *Agriocnemis kalinga* in Odisha. (Photo. M.V. Nair)

## PLATE II



**Images 9-17:** *Agriocnemis kalinga* sp.nov. Holotype male. 9. Head and thorax ventro –lateral view; 10. Thorax dorsal view; 11. Head dorsal view; 12. Head front view; 13. Wings; 14. Lateral view of abdominal segments VIII-X and anal appendages; 15. Lateral view of secondary genitalia; 16 & 17. Dorsal and ventral view of 10<sup>th</sup> abdominal segment and anal appendages. (Photo. K.A. Subramanian)

PLATE III



*Agriocnemis femina* (Brauer, 1868)



*Agriocnemis splendidissima* Laidlaw, 1919



*Agriocnemis splendidissima* Laidlaw, 1919 in coupla



*Agriocnemis lacteola* Selys, 1877 Male



*Agriocnemis lacteola* Selys, 1877 Female



*Agriocnemis pieris* Laidlaw, 1919 Male



*Agriocnemis pieris* Laidlaw, 1919 Female



*Agriocnemis clauseni* Fraser, 1922 Male

## PLATE IV

*Agriocnemis pygmaea* (Rambur, 1842) Male*Agriocnemis pygmaea* (Rambur, 1842) Female*Agriocnemis pygmaea* (Rambur, 1842) Female*Agriocnemis pygmaea* (Rambur, 1842) Female*Agriocnemis nana* (Laidlaw, 1914) Male*Agriocnemis nana* (Laidlaw, 1914) Female

### SUMMARY

A new species of *Agriocnemis* Selys, 1869 (Zygoptera: Coenagrionidae) is described from Odisha and the status of *Agriocnemis keralensis* Peters, 1981 is discussed. Based on recent field studies, *A. keralensis* is redescribed. A revised key to *Agriocnemis* of India is also provided.

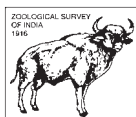
### ACKNOWLEDGMENTS

Authors thank Dr. K.Venkataraman, Director,

Zoological Survey of India, Kolkata and Odisha Forest Department for extending facilities to conduct this study. We sincerely thank Dr. R. Babu, Scientist, SRC, ZSI, Chennai for providing critical comments on earlier version of the manuscript and Mr. Prosenjit Dawn, ZSI, Kolkata for providing specimens from West Bengal for analysis. We are also thankful to Mr. Dennis Farrell, Thailand for providing photographs of some species.

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## EARTHWORMS OF SOUTH 24 PARGANAS WITH ECOLOGICAL NOTES

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### INTRODUCTION

Earthworms occur in diversified habitats from organic heaps (manure, compost, litter, humus, kitchen drainage, etc.) to forest land, grassland, agricultural land, plant nursery, etc. They are omnivorous, but most of them derive nutrition from dead organic matter. The beneficial effect of earthworms in increasing soil fertility has been documented since the time of Darwin (1881). Presently, earthworms are not restricted as a basic biology material but is being established as basic material for biotechnology (vermitechnology). Because of the vast number of species available in India and also because of the economic value, understanding of the distribution, abundance and ecological condition of the species has become very important.

There are more than 4400 species of earthworms in the world, where as in India 560 (Julka *et al.*, 2009). From the literature (Halder, 1998) it reveals that there are seven species of earthworms in South 24 Parganas namely *Pontodrilus bermudensis* Beddard, 1891, *Metaphire houlleti* (Perrier, 1872) *Lampito mauritii* Kinberg, 1867 *Metaphire posthuma* (Vaillant, 1868), *Perionyx excavatus* Perrier, 1872, *Polypheretima elongata* (Perrier, 1872), *Eutyphoeus orientalis* (Beddard, 1833), *Octochaetona beatrix* (Beddard, 1902).

Authors collected seven species of earthworms from south 24 parganas during 2012-2013 survey. Out of seven species of earthworms, three species *\*Glyphidrilus tuberosus* Stephenson, 1916, *\*Dichogaster bulaui* (Michaelsen, 1891), and *\*Amynthes diffringens* (Baird, 1869) are new in the district.

Species marked with asterix (\*) are recorded for the first time from the District.

### LIST OF THE EARTHWORMS RECORDED SO FAR IN SOUTH 24 PARGANAS

#### Family ACANTHODRILIDAE

1. *Pontodrilus bermudensis* Beddard, 1891

#### Family MEGASCOLECIDAE

2. *\*Amynthes diffringens* (Baird, 1869).
3. *Lampito mauritii* Kinberg, 1867
4. *Metaphire houlleti* (Perrier, 1872)
5. *Metaphire posthuma* (Vaillant, 1868),
6. *Perionyx excavatus* Perrier, 1872,
7. *Polypheretima elongata* (Perrier, 1872),

#### Family OCTOCHAETIDAE

8. *Eutyphoeus orientalis* (Beddard, 1833),
9. *Octochaetona beatrix* (Beddard, 1902).
10. *\*Dichogaster bulaui* (Michaelsen, 1891),

#### Family ALMIDAE

11. *\*Glyphidrilus tuberosus* Stephenson, 1916,

### SYSTEMATIC ACCOUNTS

#### Family ACANTHODRILIDAE

#### Genus *Pontodrilus* Beddard, 1874

1. *Pontodrilus bermudensis* Beddard, 1891

1891 *Pontodrilus burmudensis* Beddard, *Ann. Mag. nat. Hist.*, (ser.6), 7: 96.

**Diagnosis:** Length within 32-120 mm. Segments 78-125. Prostomium epilobic, tongue open. Clitellum saddle-shaped within segment XIII-XVII. Genital markings unpaired, median in 19/20, occasionally in 12/13, 13/14 segment.

**Distribution:** India: Andaman & Nicobar Island;

Andhra Pradesh; Goa; Kerala; Lakshadweep Islands; Maharashtra; Orissa; Tamil Nadu; West Bengal.

*Outside India:* Africa, Madagascar, Sri Lanka, Maldives, Myanmar, Vietnam, Indonesia; Australia, Some Islands in the Pacific Ocean; USA; West Indies, South America.

*Remarks:* This is a peregrine species inhabiting in mud with organic matter and salt on sea shore and margins of estuaries and brackish water lakes.

Family MEGASCOLECIDAE

Genus *Lampito* Kinberg, 1867

## 2. *Lampito mauritii* Kinberg, 1867

*Material:* 18 exs., Canal side, Bamanghata, South 24 Parganas; 11.07.2012, Dr. C.K.Mandal; Registration No. An 3939/1.

*Diagnosis:* Length 90 –115 mm, diameter 3-5 mm, segments 150 –178. Clitellum annular, dorsal pores present. Digestive system with a single esophageal gizzard in V segment. Male pores paired on XVIII. Female pores paired on XIV.

*Distribution:* India: All over India and world.

*Ecological Notes:* Greyish-yellow in living condition; living in top 10 cm of semi-moist sandy-loam soil, sometimes blackish soil; castings abundantly available in lawns and grass beds on the border line of grassy area and open area, deposited on the surface of the soil in the form of small heaps of spherical or nearly globular pellets.

*Remarks:* These worms are reported to the utilised as waste conditioners. But survival rate of this species is very poor in artificial culture beds.

Genus *Metaphire* Sims and Easton, 1972

## 3. *Metaphire houlleti* (Perrier, 1872)

*Diagnosis:* Length 40-130 mm, diameter 3-5 mm. Segments 90-120. Genital markings none externally. Prostates in XVI-XXIII segment. Castings are scattered or low piles.

*Distribution:* India: Uttarakhand; West Bengal; Meghalaya; Andaman and Nicobar Islands, Uttar Pradesh.

*Outside India:* Central America; West Indies.

## 4. *Metaphire posthuma* Vaillant, 1868

*Material examined:* 2 exs., Paddy field Budge budge, South 24 Parganas; 11.07.2012. Rinku Goswami.

*Diagnosis:* Length 60-140 mm, diameter 3-8 mm. Segments 91-124. Prostomium epilobic. Genital markings paired. Female pore single, mid-ventral on XIV segment. Male pores, minute and invaginate, on XVIII segment.

*Distribution:* India: Almost all over India.

*Outside India:* Pakistan; Bangladesh; Myanmar; Thailand; Vietnam; Malay Peninsula; Indonesia; Philippines; U.S.A.

Genus *Perionyx* Perrier, 1872

## 5. *Perionyx excavatus* Perrier, 1872

*Material examined:* 2 exs., Canal side, Bamanghata, South 24 Parganas; 11.07.2012, Dr. C.K. Mandal.

*Diagnosis:* Length 30 –180 mm, diameter 3-7 mm, segments 123-178. Colour deep purple. Prostomium epilobic, tongue open. Clitellum on XIII- XVII segment. Female pore on segment XIV. Gizzard absent or rudimentary. Prostrate in XVIII segment.

*Ecological Notes:* Colour deep purple to reddish brown dorsally, pale ventrally; castings deposited on the soil surface in the form of short threads or rods, deposited also beneath the surface in compost heaps; abundantly available in manure & compost heaps – under logs, bricks, rocks, near water line with rich organic deposits, canals, swamps, debris in axel of plantain leaves, just below the surface, even under rotten leaves and in forks of trees; lives in aquatic plants, soil near water courses, saturated with water from bathrooms, cookhouse, dhobi compound, black earth and paddy fields.

*Distribution:* India: Almost all over India.

*Outside India:* Madagascar and its adjacent islands; Sri Lanka; Myanmar; Thailand; Malay Peninsula; Indonesia; Philippines; Taiwan; West Indies.

*Remarks:* This species is largely used as waste conditioner. These worms are also cultured for utilisation as animal protein in poultry and fish feed.

Genus *Polypheretima* Michaelsen, 1934

6. *Polypheretima elongata* (Perrier, 1872)

**Diagnosis:** Length 40-360 mm, diameter 1.5-10 mm, segments 136-297. Prostomium rudimentary. Genital markings transversely elliptical, paired, presetal on XIX and successive segments in line with or slightly median to male pores. Female pore single, mid-ventral, on XIV. Male pores on segment XVIII.

**Distribution:** India: West Bengal; Andaman and Nicobar Islands; Andhra Pradesh; Karnataka; Madhya Pradesh; Maharashtra; Tamil Nadu

**Outside India:** Africa; Madagascar; Comoro Island; Pakistan; Sri Lanka; Myanmar; Bangladesh; Thailand; Malay Peninsula; Indonesia; Philippines; Taiwan; Australia; Papua New Guinea; New Britain; New Caledonia; Caroline Islands; Ryuku Islands; Hawaii; Tahiti; West Indies; South America.

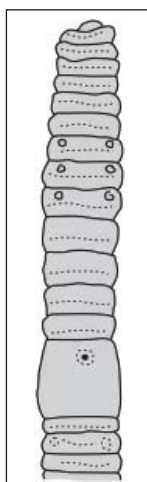
**Ecological Notes:** Under compost and manure heaps, rubbish, soils-red, black cotton or black taro; castings are found on soil surface in the form of cords of about 2 mm thickness and 20-24 mm in length or in irregular piles of 10-20 mm high and 20-35 mm wide.

**Economic Importance:** In Karnataka, this species was found to have the soil compact.

**Remarks:** The species was originated from the region including Indonesia and Philippines.

Genus *Amyntas* Kinberg, 1867

7. *Amyntas diffringens* (Baird, 1869)



*Amyntas diffringens*      *Amyntas diffringens*(Ventral)

Cited from Fauna of India (J.M. Julka, 1988)

**Material examined:** 2 exs., Reg. No. An 3954/1, near canal, Budge Budge, South 24 Parganas, 11.07. 2012, Rinku Goswami.

**Diagnosis:** Length 45-170 mm. Diameter 3-6 mm. Segment 79-121. Prostomium epibolic, tongue open. Clitellum on XIV-XVI segment. Genital markings small.

**Distribution:** India: Uttarakhand; West Bengal; Himachal Pradesh; Jammu and Kashmir; Sikkim; Tamil Nadu; Uttar Pradesh; Arunachal Pradesh; Assam; Karnataka; Manipur; Meghalaya.

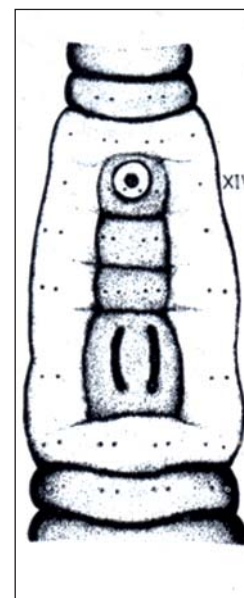
**Outside India:** Africa; Madagascar; Europe; China; Korea; Japan; Sri Lanka; Nepal; Bhutan; Bangladesh; Myanmar; Indonesia; Philippines; Hainan; Hong Kong; Taiwan; Australia; New Zealand; Some islands in the Pacific Ocean; U.S.A; Central America; West Indies; South America.

**Remarks:** The species have been recorded first time from South 24 Parganas District.

Family OCTOCHAETIDAE

Genus *Dichogaster* Beddard, 1888.

8. *Dichogaster bolaui* (Michaelsen, 1900)



*Dichogaster bolaui*

Cited from Fauna of India  
(J.M. Julka, 1988)  
(Genital markings are shown)

**Material examined:** 2 exs., An 3931, Rose garden, Budge Budge, South 24 Parganas. 11.07.2012, Rinku Goswami.

**Diagnosis:** Length 19-23 mm, diameter 1-3mm. Segments 70-98. Prostomium epilobous. Tongue closed. Clitellum on XIII-XXI. Male pores minute on XVIII segment.

Female pores single, median, and presetal. Genital markings absent.

**Distribution:** India: Uttarakhand; West Bengal; Andaman and Nicobar Islands; Andhra Pradesh; Himachal Pradesh; Jammu and Kashmir; Sikkim; Tamil Nadu; Uttar Pradesh; Arunachal Pradesh; Karnataka; Kerala; Assam; Karnataka; Manipur; Meghalaya; Goa; Gujarat; Maharashtra; Orissa; Sikkim; Rajasthan.

**Outside India:** Africa; Madagascar; Europe; China; Korea; Japan; Sri Lanka; Nepal; Bhutan; Bangla Desh; Myanmar; Indonesia; Philippines; Hainan; Hong Kong; Taiwan; Australia; New Zealand; Some islands in the Pacific Ocean; U.S.A; Central America; West Indies; North America; South America; Vietnam; Some Islands of Pacific ocean.

Genus *Eutyphoeus* Michaelsen 1900

9. *Eutyphoeus orientalis* (Beddard, 1833)

**Material:** 2 exs., Garden, Bamanghata, South 24 Parganas, West Bengal. 27.09.2011, Coll. Dr. C.K.Mandal and Rinku Goswami; Registration No. An 3957/1.

**Diagnosis:** Length 130-250 mm, diameter 5-10 mm. Segments 164-220. Clitellum on XIV-XVI segment. Female pore single on left side. Spermathecal pores paired. Penis short and annular.

Female pores paired. Genital markings absent.

**Distribution:** India: West Bengal; Bihar; Uttar Pradesh.

**Outside India:** Bangladesh.

**Ecological Notes:** Dark grey in living condition; top 15-35 cm of soil; grass bed on soil heaps.

Genus *Octochaetona* Gates, 1862

10. *Octochaetona beatrix* (Beddard, 1902)

**Diagnosis Measurements:** length 70-150 mm, diameter 3-7 mm, segments 131-176.

Prostomium proepilobous. Tongue closed. Clitellum on XIII-XVIII. Male pores minute.

Female pores paired. Genital markings absent.

**Distribution:** India: Uttarakhand; Uttar Pradesh; Madhya Pradesh; Arunachal Pradesh; Maharashtra; Gujarat; West Bengal; Karnataka.

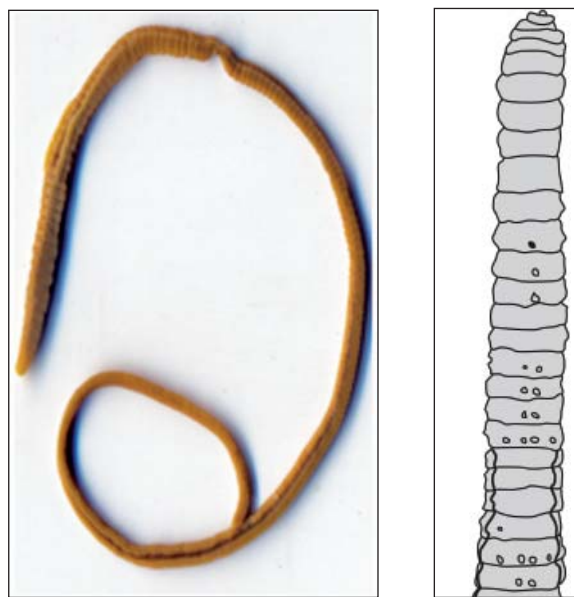
**Outside India:** Pakistan; Myanmar; Malay Peninsula; Philippines

**Ecological Notes:** In living condition pale grey, clitellum orange; top 5-10 cm of soil littered with twigs, flowers and fruity parts of trees; very moist clay loam below Maddar trees; pellet like castings.

Family ALMIDAE

Genus *Glyphidrilus* Horst, 1889

11. *\*Glyphidrilus tuberosus* Stephenson, 1916,



*Glyphidrilus tuberosus* Cited from Fauna of India (J.M. Julka, 1988)

(Genital markings are shown)

**Material examined:** 3 exs., Paddy field, Bhangar, West Bengal, 15.08.2012; Coll. Dr. C.K. Mandal.

**Diagnosis:** Length 60-118 mm, diameter 2.5-3 mm, Segments 221. Clitellum annular, wings XX-XXIV. Genital markings small, circular to elliptical tubercles. Female pores paired on XIV.

**Remarks:** First recorded from South 24 Parganas District.

**Distribution:** India: Uttarakhand; Uttar Pradesh; Madhya Pradesh.

**Outside India:** Myanmar.

**Background Information:** Most of the earthworms feed decaying organic matter in the soil and after its assimilation in the alimentary canal, excrete the soil as cast (veremicast) which is rich in nutrients. This vermicast contains various amino acids, minerals and microorganism's which humify the organic matter in the surrounding soil and act as soil conditioners and bio fertilisers. However, the capability of decomposing organic matter varies from species to species. It is very essential to select suitable species of earthworms for the purpose of waste conversion by vermicomposting. Therefore,

a detail information is needed about the availability of earthworm species their habit, conditions of living, and nature in a particular area.

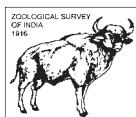
**Importance of the Work:** The present study includes an elaborate information on the habitat condition, colour in living condition, natural size, type of castings, abundance and seasonal occurrence of the earthworm fauna in South 24 Parganas. Moreover, the well-known worm (*Lampito mauritii*) has been recorded abundantly in a particular locality. This locality may serve as a natural store house for the species.

**Results:** Three species \**Glyphidrilus tuberosus* Stephenson, 1916, *Dichogaster bulau* (Michaelsen, 1891), and *Amyntas diffringens* (Baird, 1869) which are new in this district. Now the total number of species of earthworms of South 24 Parganas is 11.

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## DESCRIPTIONS OF FOUR NEW SPECIES OF PHYTOSEIID MITES (ACARI: MESOSTIGMATA) FROM WEST BENGAL, INDIA

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### INTRODUCTION

The mites of the family Phytoseiidae have received worldwide attention because of their importance in biological control of not only mite pests but also of some of the soft-bodied insects attacking various crops. This is probably the most explored and exploited among all the predatory mites. In view of their importance, these mites have been explored from India and many new species have been described since 1960.

Gupta 1986, (2003), Moraes *et al.*, 2003, Chant and McMurtry 2007 listed most of the known India phytoseiid mites from India and recently, Gupta and Karmakar 2014-in press) updated the same. The four new species which are being described here will add to 207 species already listed in Gupta and Karmakar (2014-in press) raising the total species to 211 so far known from India. All the measurements given in the text are in microns. The entire collection was made by senior author and all the type materials are in the collection of AINP on Agricultural Acarology laboratory, Bidhan Chandra Krishi Viswavidyalaya, Kalyani-741235, to be deposited to the National Collection of Zoological Survey of India as well as National Bureau of Agriculturally Important Insect, Bangalore after acceptance of the paper.

### DESCRIPTIONS OF NEW SPECIES

#### 1. *Amblyseius metaliensis* sp. nov.

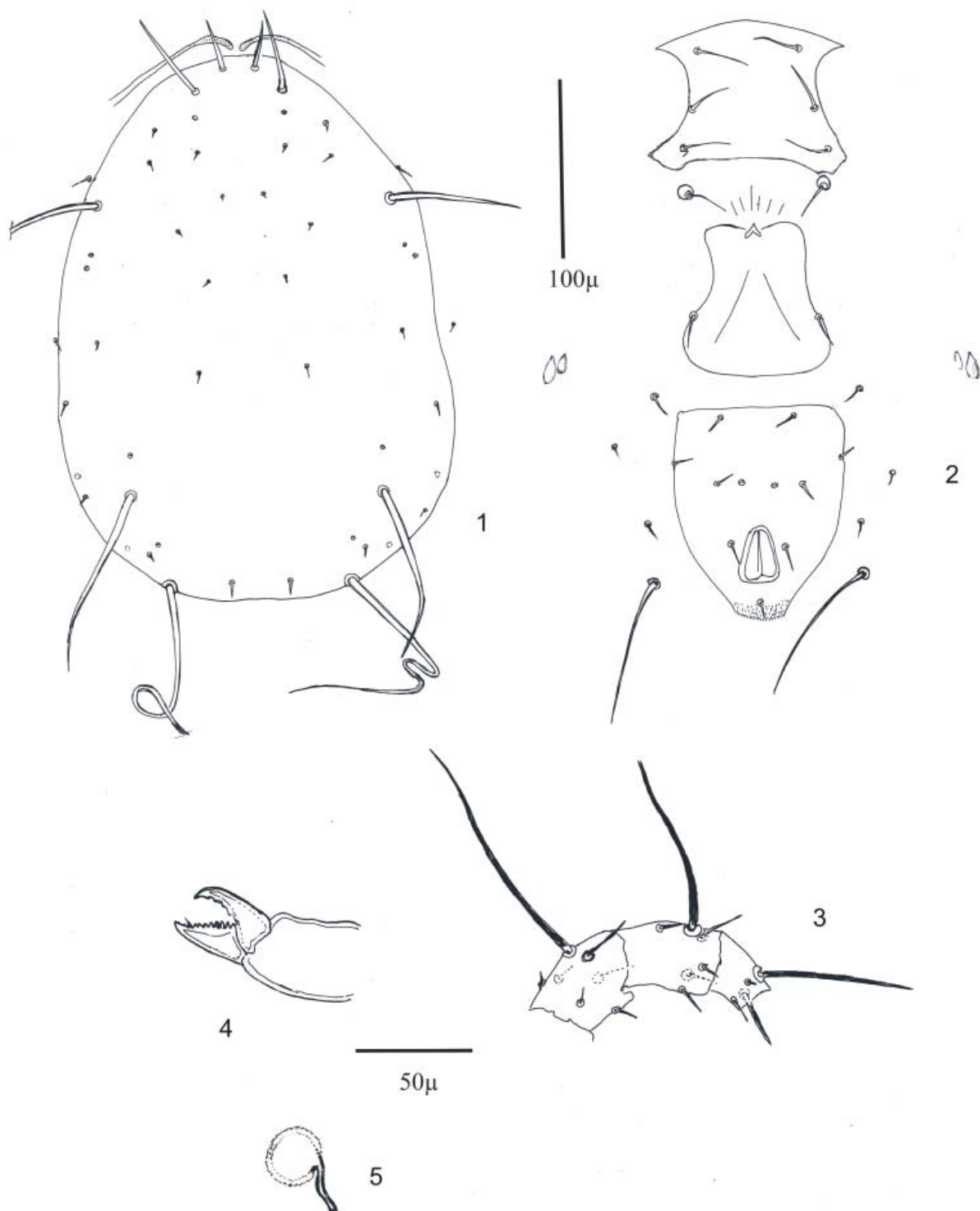
(Figs. 1–5, Plates-I)

*Female*: Dorsal shield ovoid, smooth, length 352 and width 251 (at the base of leg IV) with 17 pairs of setae and five pairs of pores, (Fig. 1, plate A). Seta  $j_3$  longer than  $j_1$  but shorter than  $s_4$ , barring  $Z_4$  and  $Z_5$  all other setae are very short or minute,  $r_3$  longer than  $R_1$ .

*Measurements of setae*:  $j_1$  33,  $j_4$ ,  $j_5$ ,  $j_6$ ,  $J_2$ , and  $J_5$  almost equal, measuring 5–11,  $j_3$  57,  $z_2$  5,  $z_4$  5,  $s_4$  88,  $Z_1$  6,  $S_2$  9,  $S_4$  6,  $S_5$  6,  $Z_5$  226 (setae characteristically looped),  $z_5$  5,  $Z_4$  127,  $r_3$  14,  $R_1$  6, last two on interscutal membrane. The setae on dorsal shield are smooth.

Ventrally (Fig. 2), sternal shield wider than long, 75 long and 79 width with three pairs of sternal setae, measuring  $ST_1$ ,  $ST_2$ ,  $ST_3$  each measuring 34, metasternal plate absent, metasternal seta  $ST_4$  34, present on interscutal membrane, genital shield 86 long and 79 wide with  $ST_5$  measuring 34. A fold present between genital and ventrianal shields. Ventrianal shield much longer than wide 123 long and 94 wide, with three pairs of preanal setae in triangular line, measuring  $JV_1$  14,  $JV_2$  13,  $ZV_2$  13, pair of paraanal  $a_1$ ,  $a_2$  and one postanal seta  $a_3$  present each measuring 16,

**Key words:** Phytoseiidae, description, new species.



Figs 1-5. *Amblyseius metaliensis* Karmakar & Gupta sp. nov., Female holotype, 1. Dorsal view of idiosoma, 2. Ventral view of idiosoma, 3. Genu, tibia and tarsus of leg IV, 4. Chelicera, 5. Spermatheca.

one pair of crescent shaped preanal pores present; setae around ventrianal shield measuring  $ZV_1$  15,  $ZV_3$  8,  $JV_4$  8,  $JV_5$  94; metapodal plate not discernible due to position of leg IV. Spermatheca with looped cervix, peritreme extend anteriorly beyond  $j_1$  seta. Macroseta on leg IV genu 112, tibia 73 and besitarsus 75. The tip of the macroseta pointed. Fixed digit of chelicera with two apical teeth followed by 10 sharp teeth, pilus dentilis not discernible, movable digit with four teeth placed medially. Leg chaetotactic formula genu II-2 2/0, 2/0-1, genu III 2 2/1, 2/1 1, tibia III 1 1/1, 2/1 1.

*Male*: Unknown.

**Collection record–Holotype** (female) – India, West Bengal, District Jalpiguri, Metali tea garden, on tea (*Thea chinensis* L.) (coll. K. Karmakar) in association with tea red spider mite, *Oligonychus coffeae* (Nietner) 7 May 2009 (Acc. No. AINP/Acar. Lab./BCKV/5138/2009, deposited in the collection of AINP, Acarology Laboratory, BCKV.

*Etymology*: The species was named after the type locality- Metali Tea Garden, Jalpiguri.

*Remarks*: Because of having tubular looped cervix in this new species it is very close to *Abylseius paraarealis* but differs in dentition pattern of chelicerae, in leg chaetotactic formula where genu III 1 2/0 2/1 1 in *A. paraarealis* Muma (1967) whereas in this new species it is 2 2/1, 2/1 1. Metapodal plate clearly discernible in case of *A. paraarealis* but not discernible in this new species.

## 2. *Euseius sativum* sp. nov.

(Figs. 6-9, Plates-II)

*Female*: Dorsal shield highly reticulated and fish-scale-like, (Fig. 6, Plate C), 355 long, 267 wide, with 17 pairs of setae and five pairs of pores. Seta  $j_1$  and  $j_3$  almost of same length.  $j_3$  slightly longer than  $j_1$ ,  $j_3$  slightly longer or of same length as that of  $s_4$ , but longer than  $z_2$  and  $z_4$  which are equal,  $Z_1$  shorter than  $S_2$  and  $S_4$ , the later two are of almost the same length,  $S_5$  longer than  $S_2$  and  $S_4$ ,  $Z_4$  longer than  $Z_1$  but shorter than  $S_2$  and  $S_4$ ,  $Z_5$  being the longest seta and gently barbed,  $r_3$  and  $R_1$  are almost of same length.

*Measurements of setae*:  $j_1$  33,  $j_4$ ,  $j_5$ ,  $j_6$ , 13–14 each  $J_2$  20,  $J_5$  6,  $j_3$  36,  $z_2$  24,  $z_4$  28,  $s_4$  39,  $Z_1$  20,  $S_2$  28,  $S_4$  31,  $S_5$  38,  $Z_5$  68,  $z_5$  16,  $Z_4$  27,  $r_3$  20,  $R_1$  22, both on interscutal membrane on the right hand side but on the left  $r_3$  appears to be on dorsal shield. All the setae on dorsal shield smooth, but  $s_4$ ,  $S_4$ ,  $S_5$ , and  $Z_5$  weakly serrated.

Ventrally (Fig. 7, Plate D), sternal shield with three pairs of sternal setae, measuring  $ST_1$ -35,  $ST_2$ -31,  $ST_3$ -31, metasternal plate absent, metasternal seta ( $ST_4$ ) present on interscutal membrane, measuring 25, genital shield wide with  $ST_5$  measuring 24. Ventrianal shield characteristically shaped, 111 long 84 wide, with three pairs of preanal setae almost in transverse line, measuring  $JV_1$  22,  $JV_2$  22,  $ZV_2$  20, pair of paraanal setae  $a_1$  14,  $a_2$  14 and one post anal seta  $a_3$  15 also present, one pair of crescent-shaped preanal pores present; setae around ventrianal shield measure  $ZV_1$  27,  $ZV_3$  11,  $JV_4$  9,  $JV_5$  39. Metapodal plate one pair, measuring 30, peritreme extends anteriorly and ends before the base of seta  $j_3$ . Macro setae on genu, tibia and tarsus of leg IV (Fig. 8) genu 46, tibia 36, and besitarsus 57. The tip of the macro setae gently spatulate. Chelicerae (Fig. 9, Plate F) fixed digit with two teeth, *pilus dentilis* not discernable, moveable digit with a tiny tooth. Leg chaetotactic formula genu II-2 2/0, 2/0-1, tibia II 1 1/1, 2/1 1, genu III 1 2/1, 2/1 1, tibia III 1 1/1, 2/1 1.

*Male*: Unknown.

**Collection record–Holotype** (female) – India, West Bengal, District Nadia, Kalyani, District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya, on garlic, (*Allium sativum* L.) in association with *Aceria tulipae* (Keifer) which was found severely infested, 22 February 2011 (coll. K. Karmakar), deposited in the collection of AINP, (Acc. No. AINP/Acar. Lab./BCKV/5116/2011.

*Etymology*: The species was named after the name of the host plant on which it was collected.

*Remarks*: This species is very close to *Euseius ahaioensis* (Gupta, 1992), described from West Bengal, in having tubular spermathecae but it differs in having deeply indented anterior margins



Figs 6-9. *Euseius sativum* Karmakar & Gupta sp. nov., Female holotype, 6. Dorsal view of idiosoma, 7. Ventral view of idiosoma, 8. Genu, tibia and tarsus of leg IV, 9. Chelicera.

of ventrianal shield,  $Z_4$  much longer than that in *E. ahaioensis* and in dentition pattern of chelicerae as this new species has two teeth on fixed digit and one minute tooth on movable digit whereas, in *E. ahaioensis* there are three teeth on the fixed digit and two teeth on the movable digit, in addition the macrosetae on genu and tibia IV, which are almost of same length in *E. ahaioensis* and in the new species the macrosetae on genu IV are much longer than that of tibia IV. This new species is also close to *E. alstoniae* (Gupta, 1975) but differs in spermathecal character and in the shape of ventrianal shield.

### 3. *Euseius vikrami* sp. nov.

(Figs. 10–14, Plates-III)

**Female:** Dorsal shield (Fig. 10, Plate G) 369 long and 267 wide, narrow anterior lateral region with longitudinal striation but absent dorsocentrally and posterolaterally, with five pairs of pores and 17 pairs of setae, all short or minute except  $j_1$  and  $Z_5$ , which are the only long and stout setae.

**Measurements of setae:**  $j_1$  41,  $j_4$ ,  $j_5$ ,  $j_6$ ,  $J_2$ ,  $J_5$  8–11 each  $j_3$  17,  $z_2$  13,  $z_4$  13,  $s_4$  15,  $Z_1$  9,  $S_2$  11,  $S_4$  12,  $S_5$  11,  $Z_5$  55,  $z_5$  7,  $Z_4$  13,  $r_3$  11,  $R_1$  11, the last two on lateral interscutal membrane. The setae on dorsal shield smooth,  $Z_5$  thick and weakly barbed.

Ventrally (Fig. 11, Plate H) sternal shield barely visible with three pairs of setae, measuring  $ST_1$  33,  $ST_2$  31,  $ST_3$  32, metasternal plate absent, setae present on interscutal membrane measuring  $ST_4$  25, genital shield present with one pair of setae measuring  $ST_5$  25. The region between ventrianal and genital shields transversely striated and region lateral to that longitudinally striated. Ventrianal shield characteristically shaped having a depression at the anterior margin with three pairs of preanal setae measuring  $JV_1$  35,  $JV_2$  28,  $ZV_2$  24 and with a pair of typical ellipsoidal preanal pores. Spermatheca minute, barely visible as figured (Fig. 14). Anal and postanal setae present as usual, measuring  $a_1$  13,  $a_2$  13, and  $a_3$  17, four pairs of setae present around the ventrianal shield measuring  $ZV_1$  24,  $ZV_3$  16,  $JV_4$  11, and  $JV_5$  39. Metapodal plate one pair measuring 25.

Macrosetae on leg IV (Fig. 12) genu 41, tibia 44, and basitarsus 58, with tip spatulate. Leg chaetotactic formula, genu II 2, 2/0, 2/0, 1, tibia II 1, 2/0, 2/1, 1, genu III 1, 1/1, 2/1 1, tibia III 1, 2/1, 1/1, 1. Chelicerae (Fig. 13) with two sharp teeth placed anteriorly on fixed digit, movable digit with one short tooth, peritreme extends anteriorly and terminate between  $z_2$  and  $j_3$  setae.

**Male:** Unknown.

**Collection record–Holotype** (female) – India, West Bengal, District Nadia Kalyani, District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya, on Jute (*Chorchorus olitorius* L.) in association with jute yellow mite, *Polyphagotarsonemus latus* (Banks) (coll. K. Karmakar), 3 August 2010, deposited in the collection of AINP, (Acc. No. AINP/Acar. Lab./BCKV/5120/2010).

**Etymology:** The species was named honouring Dr. Vikram Prasad, recognizing his outstanding contribution in the field of world Acarology.

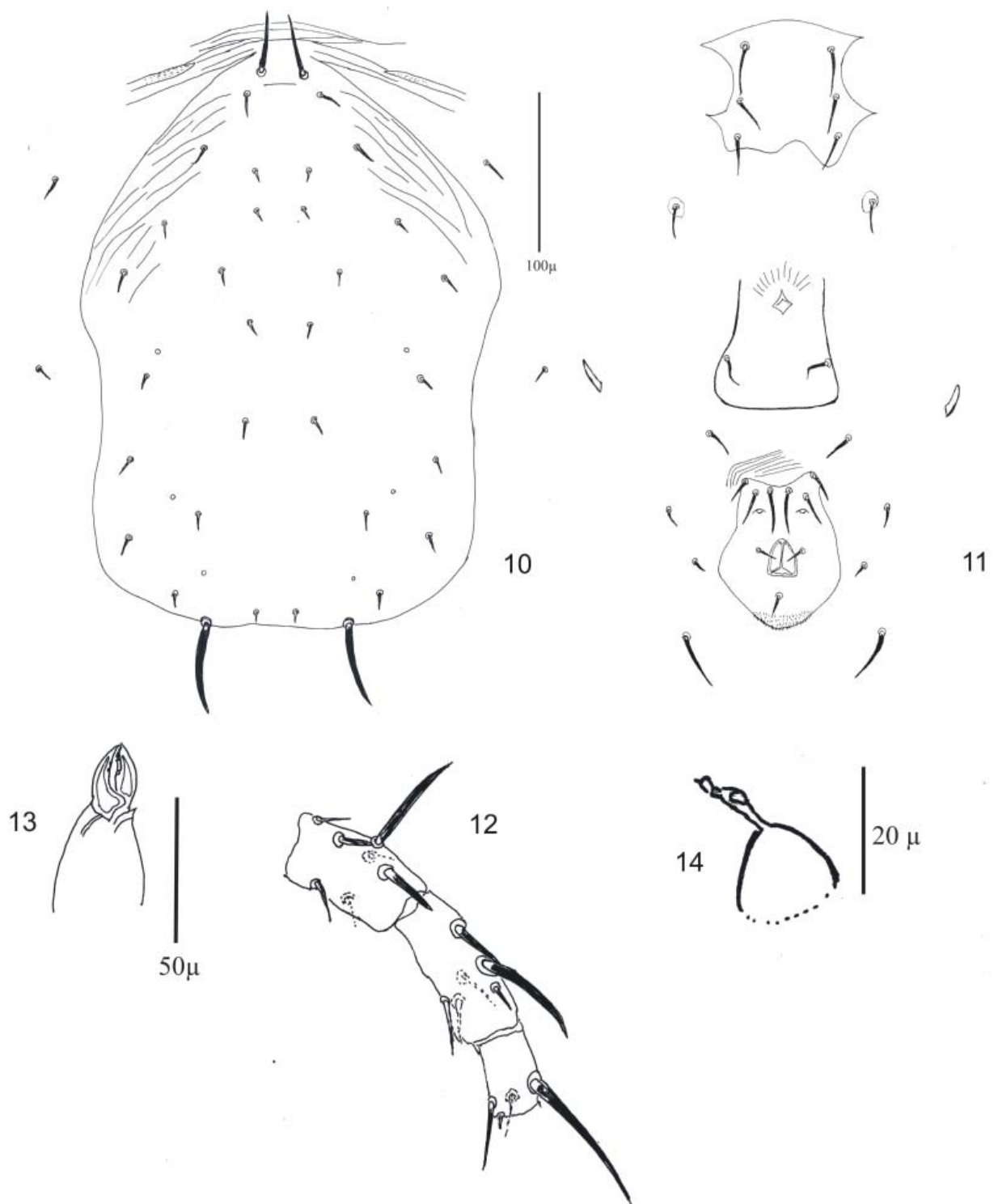
**Remarks:** This new species is close to *Euseius macrospatulatus* (Gupta, 1986) as well as *E. ovalis* (Evans, 1953). But from the former it differs in lacking spatulate macrosetae on leg IV and from the latter in having a difference in the leg chaetotactic formula. It differs from both species in having a ventrianal shield, the anterior margin of which is deeply depressed, and that is not found anywhere else.

### 5. *Neoseiulus pranadae* sp. nov.

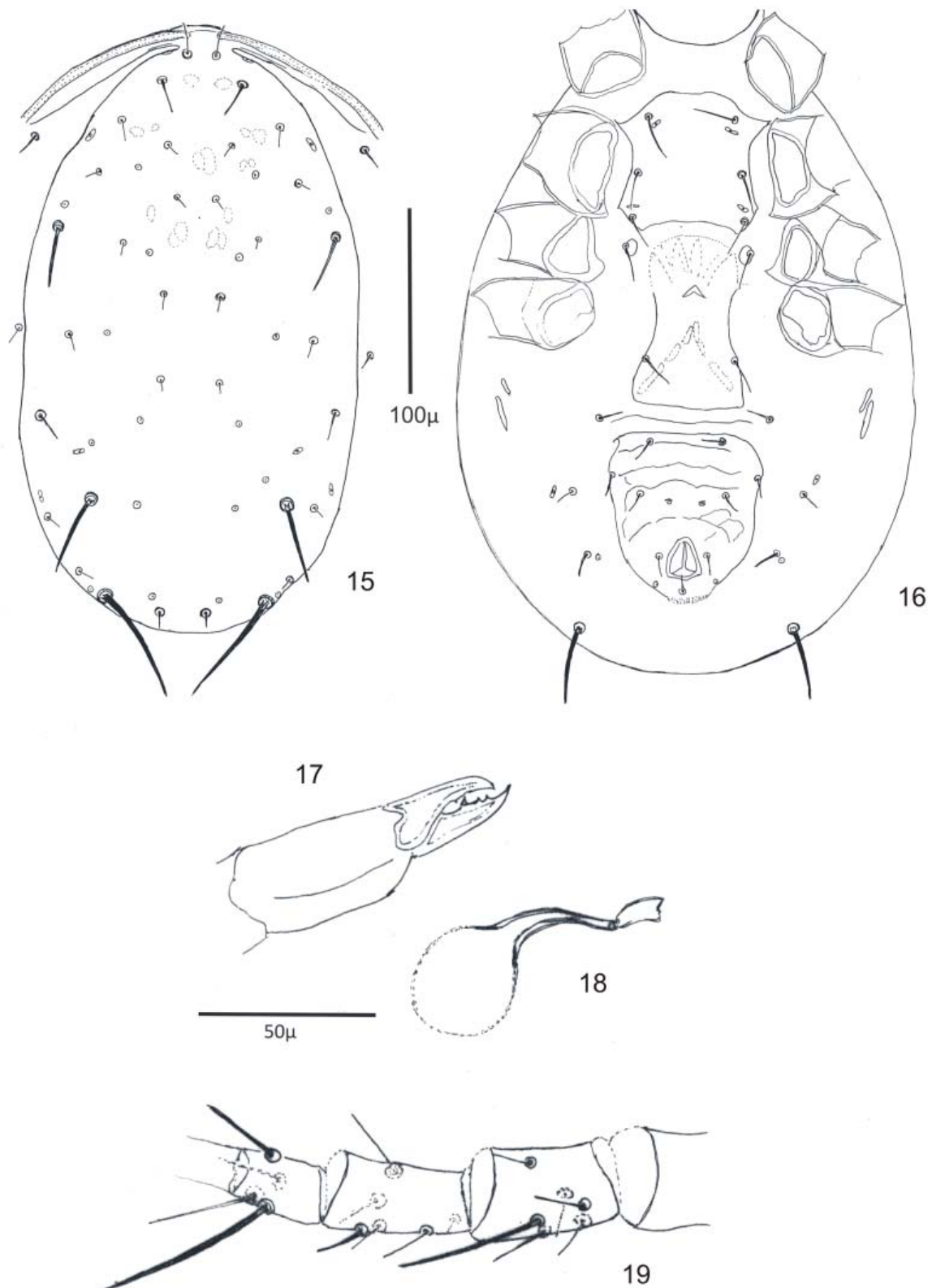
(Figs. 15–19, Plates-IV)

**Female:** Dorsal shield length 342 and width 184 smooth with 17 pairs of setae, three pairs of pores and two pairs of lyrifissures on propodosoma and opisthosoma with six pairs of pores and two pairs of lyrifissures (Fig. 15, Plate I). Seta  $j_1$  and  $j_3$  almost of same length 20–22.  $j_1$  slightly longer than  $j_3$ ,  $s_4$ , longer than  $z_2$  and  $z_4$ , the latter two being equal,  $Z_1$  shorter than  $S_2$  and  $S_4$ ,  $S_5$  shorter than  $S_2$  and  $S_4$ ,  $Z_4$  shorter than  $Z_5$ , does not reach the base of  $Z_5$ ,  $Z_5$  being the longest seta,  $r_3$  longer than  $R_1$ .

**Measurements of setae:**  $j_1$  22,  $j_4$ ,  $j_5$ ,  $j_6$ ,  $J_2$ ,  $J_5$



Figs 10-14. *Euseius vikrami* Karmakar & Gupta sp. nov., female holotype, 10. Dorsal view of idiosoma, 11. Ventral view of idiosoma, 12. Genu, tibia and tarsus of leg IV, 13. Chelicera, 14. Spermatheca.



Figs 15-19. *Neoseiulus pranadae* Karmakar & Gupta sp. nov., female holotype, 15. Dorsal view of idiosoma, 16. Ventral view of idiosoma, 17. Chelicera, 18. Spermatheca, 19. Genu, tibia and tarsus of leg IV.

8–11 each  $j_3$  20,  $z_2$  16,  $z_4$  16,  $s_4$  38,  $Z_1$  10,  $S_2$  19,  $S_4$  13,  $S_5$  11,  $Z_5$  47,  $z_5$  9,  $Z_4$  41,  $r_3$  20,  $R_1$  16, the latter two on interscutal membrane. Most of the setae on dorsal shield smooth only  $s_4$ ,  $Z_4$ , and  $Z_5$  gently barbed.

Ventrally sternal shield (Fig. 16, Plate J) with three pairs of sternal setae, measuring  $ST_1$ -27,  $ST_2$ -27,  $ST_3$ -24, with three pairs of pores and three pairs of lyrifissures, metasternal plate present oblong, metasternal setae  $ST_4$  present on outer margin of metasternal plate, measuring 24, genital shield width 69 with  $ST_5$  measuring 13. Ventrianal shield typically shield-shaped, transversely striated 110 long 90 wide with three pairs of preanal setae, measuring  $JV_1$  20,  $JV_2$  17,  $ZV_2$  24, pair of paraanal  $a_1$  25,  $a_2$  25 and one postanal seta  $a_3$  31 present, one pair of ellipsoidal preanal pores present; setae around ventrianal shield measure  $ZV_1$  25,  $ZV_3$  13,  $JV_4$  11,  $JV_5$  49. Metapodal plate two pairs, primary one measuring 24 and secondary 8. Spermatheca (Fig. 18, Plate L) with inflated major duct followed by horn-like cervix, peritreme extends anteriorly beyond  $j_1$  setae. Macrosetae on leg IV (Fig. 19, Plate K) genu 52, tibia 25, and basitarsus 53. The tip of the macrosetae pointed. Chelicerae (Fig. 17) fixed digit with two large teeth apically followed by two small teeth and *pilus dentilis*, movable digit with one sharp tooth. Leg chaetotactic formula genu II-2 2/0, 2/0-1, tibia II 1 1/1, 2/1 1, genu III 1 2/1, 2/1 1, tibia III 1 1/1, 2/1 1.

*Male*: Unknown.

**Collection records–Holotype** (female)– India, West Bengal, District Nadia, Kalyani, on Rice (*Oryza sativa* L.) in association with rice sheath mite, *Steneotarsonemus spinki* Smiley 13 September 2011, (coll. K. Karmakar), deposited in the collection of AINP, (Acc. No. AINP/Acar. Lab./BCKV/5118/2011).

**Paratypes** (two females) : West Bengal, District Nadia, Kalyani, District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya, one each on Jute (*Chorchorus olitorius* L.) (Acc. No. AINP/Acar. Lab./BCKV/5115/1/2011, 13 September 2011, and bean (*Phaseolus mungo* L.) in association with jute

yellow mite, *Polyphagotarsonemus latus* (Banks), 24 April 2010, (coll. K. Karmakar): (Acc. No. AINP/Acar. Lab./BCKV/5115/2/2011., deposited in the collection of AINP, Acarology Laboratory, BCKV. **1 female**: District Murshidabad, Dhananjoypur, on garlic in association with *Aceria tulipae* (Keifer) (Acc. No. AINP/Acar. Lab./ BCKV/5115/3/2012, 25-02-2012).

**Etymology**: The species was dedicated in memory of the late mother of one of the authors (K. Karmakar).

**Remarks**: This new species is very close to *Neoseiulus cynodona* (Gupta, 1977) but differs in having a narrower horn-like cervix on spermatheca rather than a wide funnel-shaped cervix as in *N. cynodona*, Macrosetae on basitarsus IV little less than one and half times that on genu IV in case of *N. cynodona* whereas, in new species the macrosetae on genu IV and basitarsus IV almost equal or the former is slightly shorter than that on basitarsus IV and in chaetotactic formula of genu III where it is 1 2/1 2/0 1 but in case of new species it is 1 2/1, 2/1 1.

## SUMMARY

This paper provides description of four new species, one each under *Amblyseius* and *Neoseiulus* and two under *Euseius* from West Bengal, India.

## ACKNOWLEDGEMENTS

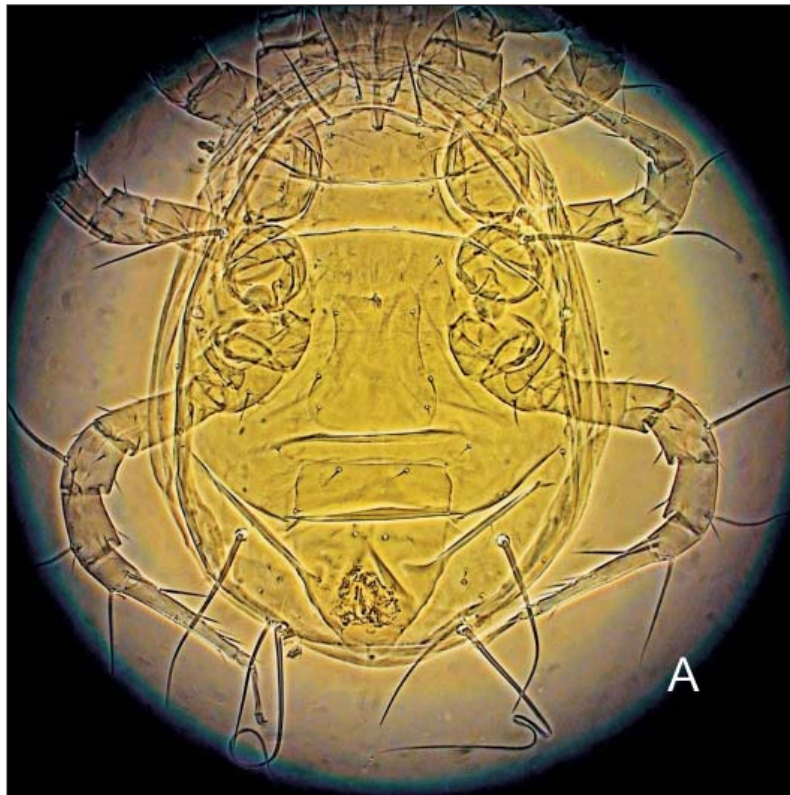
The authors are grateful to the Indian Council of Agricultural Research, New Delhi for the financial assistance, to the Vice Chancellor and Director of Research, Bidhan Chandra Krishi Viswavidyalaya for providing infrastructure facilities and to both Dr. V. Prasad, Indira Publishing House, West Bloomfield, MI, USA and Dr. Gilberto J. de Moraes, USP, ESALQ, Piracicaba, Brazil, for constant encouragement, moral support and technical guidance. Lastly, the authors are also indebted to the Director, Zoological Survey of India, for giving permission to examine the type material of Phytoseiidae deposited in National Zoological Collection of ZSI, Kolkata.

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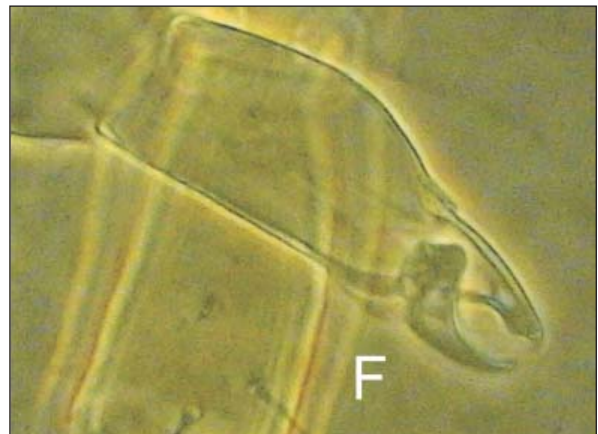
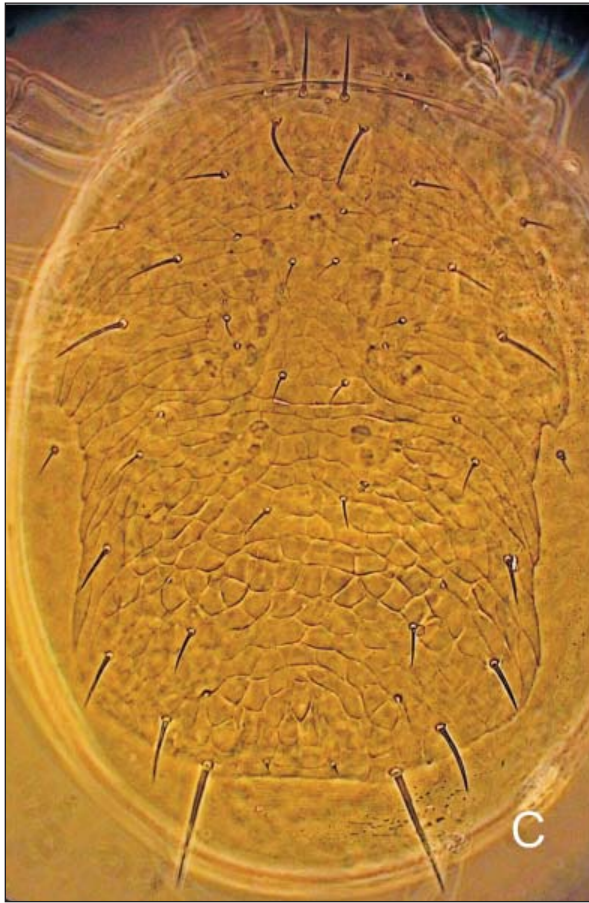


PLATE-I



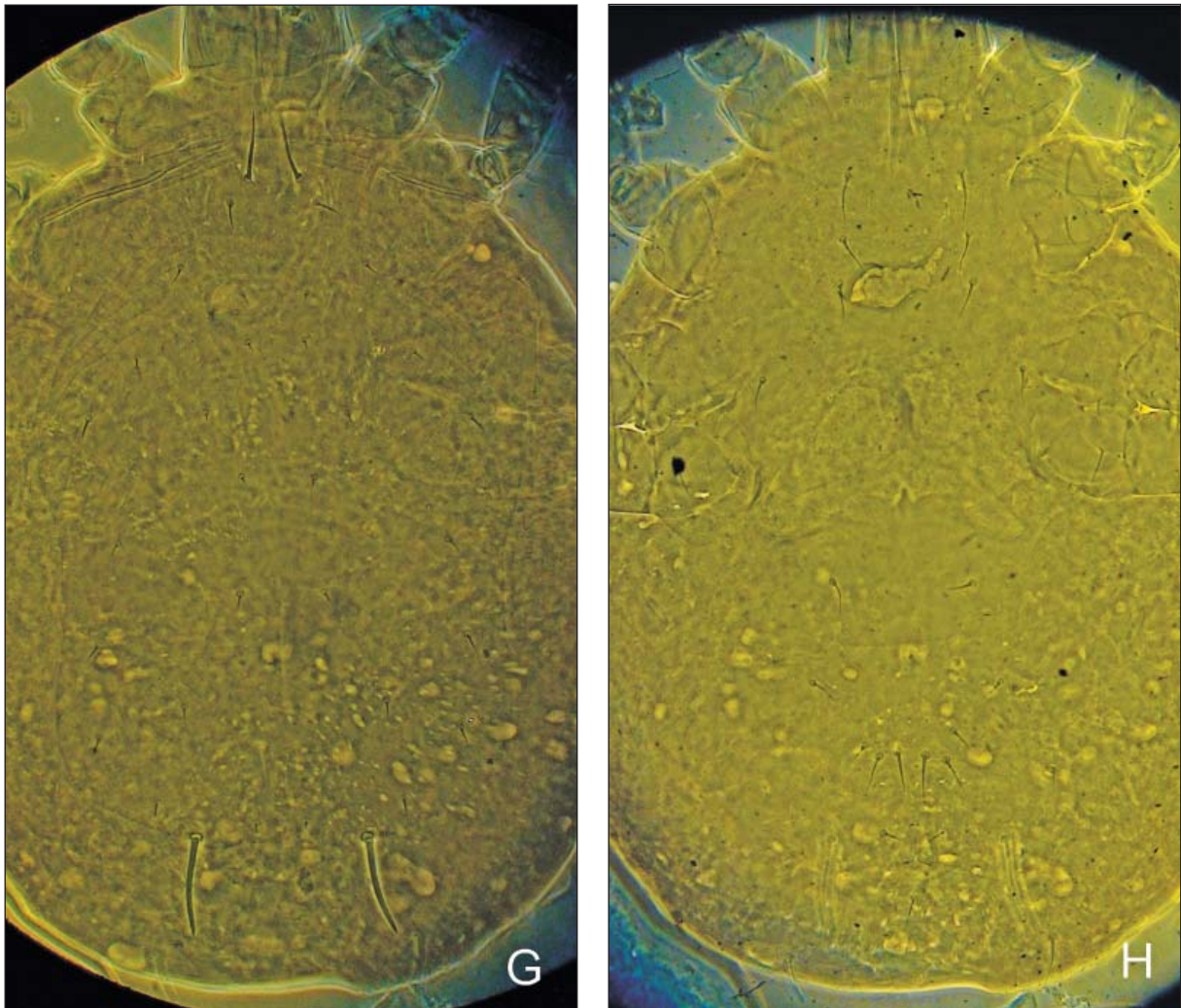
*Amblyseius metaliensis* Karmakar & Gupta sp. nov., female holotype, A. Dorsal view, B. Chelicera

## PLATE-II



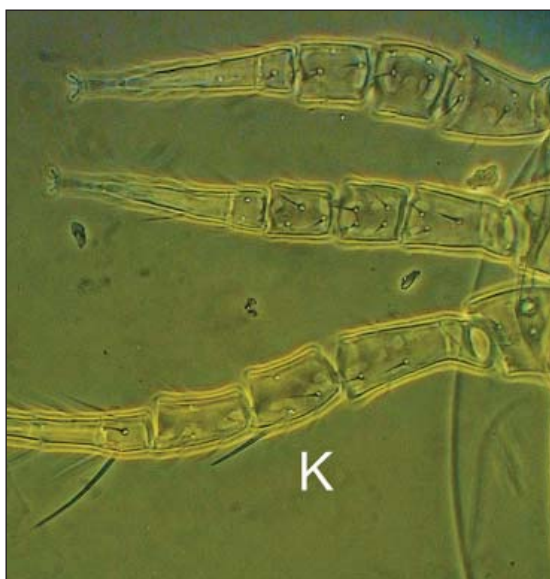
*Euseius sativum* Karmakar & Gupta sp. nov., female holotype, C. Dorsal view, D. Ventral view,  
E. Genu, tibia and tarsus of leg IV, F. Chelicera

PLATE-III

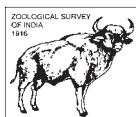


*Euseius vikrami* Karmakar & Gupta sp. nov., female holotype, G. Dorsal view, H. Ventral view.

## PLATE-IV



*Neoseiulus pranadae* Karmakar & Gupta sp. nov., female holotype, I. Dorsal view, J. Ventral view, K. Leg II, III and IV, L. Spermatheca



## Short Communication

### A NEW RECORD OF *FABAEFORMISCANDONA SUBACUTA* (YANG, 1982) (CRUSTACEA: OSTRACODA: CANDONIDAE) FROM INDIA

Globally, 55 species of ostracods belonging to the genus *Fabaeformiscandona* were documented (Martens and Savatnalaton, 2011). The taxonomy and global distribution of the species *Fabaeformiscandona subacuta* (Yang, 1982) was reviewed by Escriva *et al.*, (2012). It was originally described by Yang (Hou *et al.*, 1982) as *Candona subacuta* Yang, 1982 from fossil of Neogene sediment (Jiangsu province) in China. According to Escriva *et al.*, (2012) *F. subacuta* was recorded from China, Japan, Korea, Thailand, Australia and Colombia. This has disjunction distribution, widespread in Eastern Asia, and also found in South America and Iberian Peninsula. The copulatory behaviour and sexual morphology of *Fabaeformiscandona* was well documented by Smith and Kamiya, 2007. It is hypothesized that *F. subacuta* is an invasive species in the Iberian Peninsula. Earlier there was no recorded of this species from Indian Peninsula, through globally it has been recorded from 78 locations. Interestingly, while studying the ostracods of Andhra Pradesh, first time the authors have recorded *F. subacuta* from Deccan plateau of Indian subcontinent and also a first record of its distribution from South Asia, might be a 79<sup>th</sup> locality on the globe (Fig. 1).

Plankton samples were collected during 2013-14 from two different freshwater habitats viz. Osmansagar reservoir (17°21'57" N & 78°18'14"

E), Ranaga Reddy district and Manjeera dam (17°23'14" N & 78°18'34" E), Medak District, Telangana State, India (Fig. 1). The samples were collected from the littoral region by using plankton net and preserved with 4% neutralized formalin solution. While analysing Ostracod specimens, some were identified as *Fabaeformiscandona subacuta*. A sorted male and female specimen were placed on different clean glass slides contain in 1:1 ratio of glycerine and water for dissection under stereo binocular microscope (Olympus SZ10X). The dissected animal parts were shielded with DPX mount. The camera lucida drawings were made under light microscope (Carlzeiss). All the specimens were deposited with the National Zoological Collections of Freshwater Biology Regional Centre, Zoological Survey of India, Hyderabad.

#### SYSTEMATIC ACCOUNT

Class OSTRACODA

Subclass PRODOCOPA

Order PDOCOPIDA

Suborder CYPRIDOCOPINA

Super family CANDONINAE

Family CANDONIDAE

***Fabaeformiscandona subacuta* (Yang, 1982)**

1982. *Candona subacuta* Yang (In Hou *et al.*), Geological Publishing House, Pekin, China.

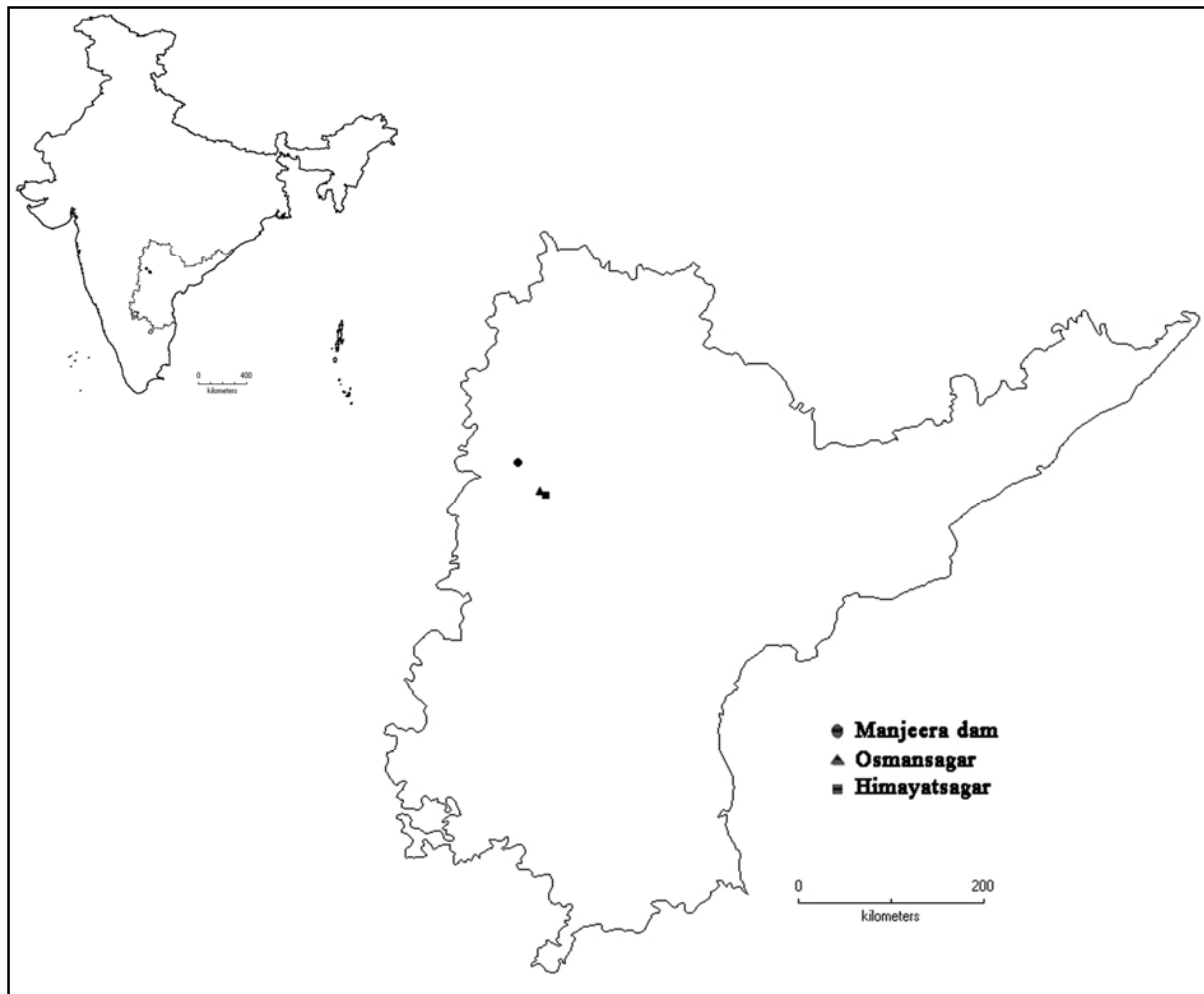


**Fig. 1.** Distribution of *Fabaeformiscandona subacuta* from Telangana, India.

**Material examined:** 05 exs., Osmansagar, 18.05.2013, Reg. No: FBRC/ZSI/N: 953; 1ex., Manjeera dam, 23.03.2014, Reg. No: FBRC/ZSI/N: 1027; 01ex., Himayatsagar, 05.08.2014, Reg. No: FBRC/ZSI/N: 1028.

**Morphological features:** Carapace in female elongated, length 0.9mm and width 0.45mm (Fig. 3A), dorsal margin straight sloping towards anterior, ventral concave in the medially, posterior and anterior margins are round. The maximum height in mid-posterior. Posterior ventral margin inner crescent layer slightly concave. In male, anterior and posterior margins are round, posterior broader than anterior, maximum height in the posterior dorso-ventrally, ventral medially concave (Fig. 2A). Antennula seven segmented

(Fig. 2B&3B). Natatory setae are absent in antenna (Fig. 3C). In Male, Y aesthetasc slender and long,  $t_2$ ,  $t_3$  setae are thick with round end on the fourth segment,  $t_2$  longer than  $t_3$  (Fig. 3C). Mandibula coxal plate elongated, median is broad (Fig. 3E). Terminal segment of second thoracopoda with long distal claw  $h_2$  and two setae,  $h_1$  longer than  $h_3$  (Fig. 3F). Uropodal ramus slightly curved, symmetrical, posterior and anterior setae are present (Fig. 2F). Hemipenis large, elongated and wide,  $a$  lobe has a shallow ridge,  $m$  processor elongated terminated with  $h$  lobe (Fig. 2D&E). Female reproductive organ anteriorly round.

**Distribution:** India: Telangana. Elsewhere: Japan, S. Korea, Australia, Russia, Spain, Thailand, New Zealand, Colombia.

**ACKNOWLEDGEMENTS**

The authors are grateful to Dr. K. Venkataraman, Director, Zoological Survey of India, Kolkata, for the facilities provided and

constant encouragement. Also, thankful to Dr Rabin J. Smith, Lake Biwa Museum, Japan for identification and suggestions.

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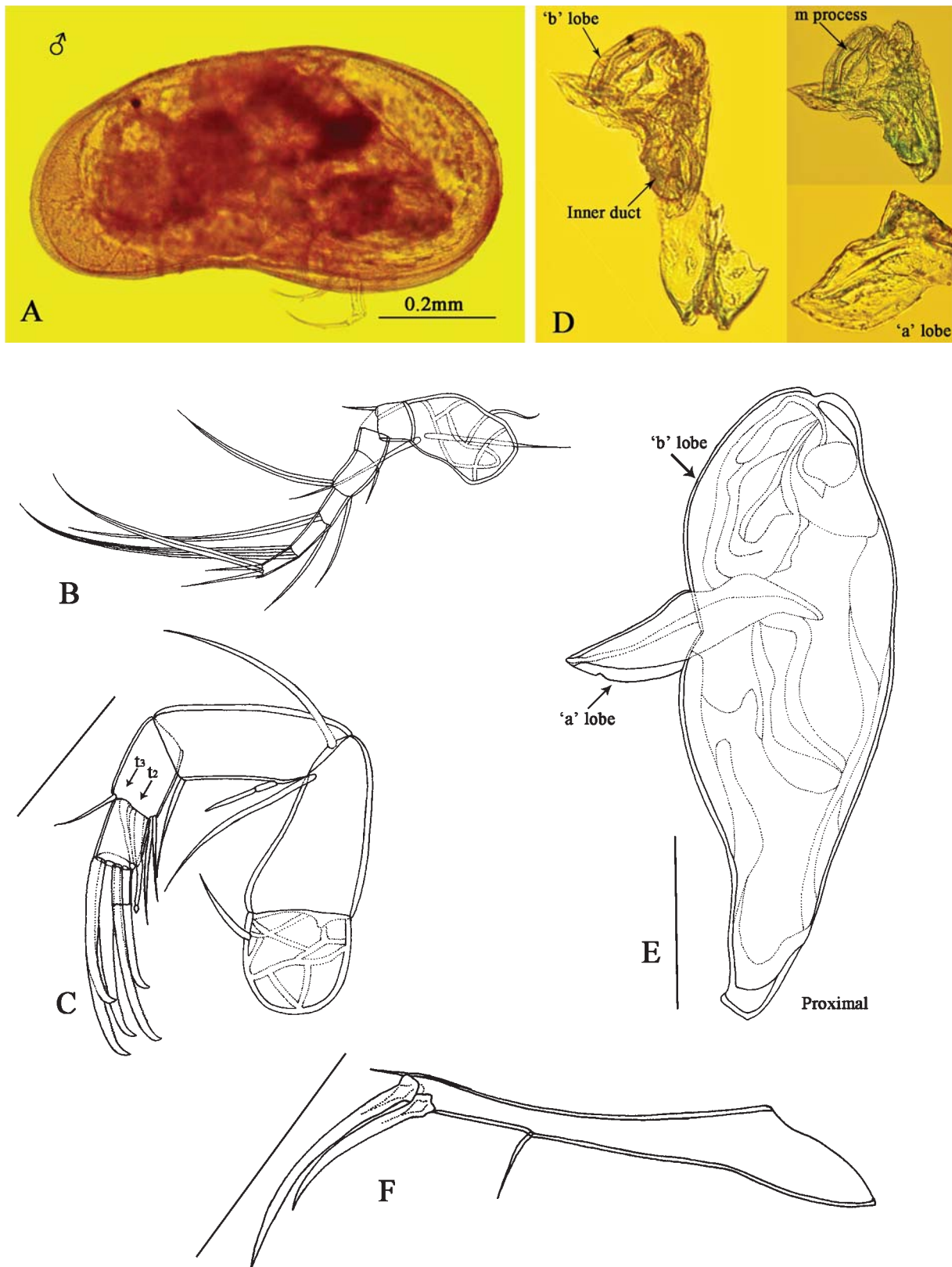


**Fig. 2.** *Fabaeformiscandona subacuta* (Yang, 1982) ♂; A- Carapace of the male animal; B- Antennula; C- Antenna; D and E- Hemipenis; F- Uropodal ramus. Scale = 0.1mm

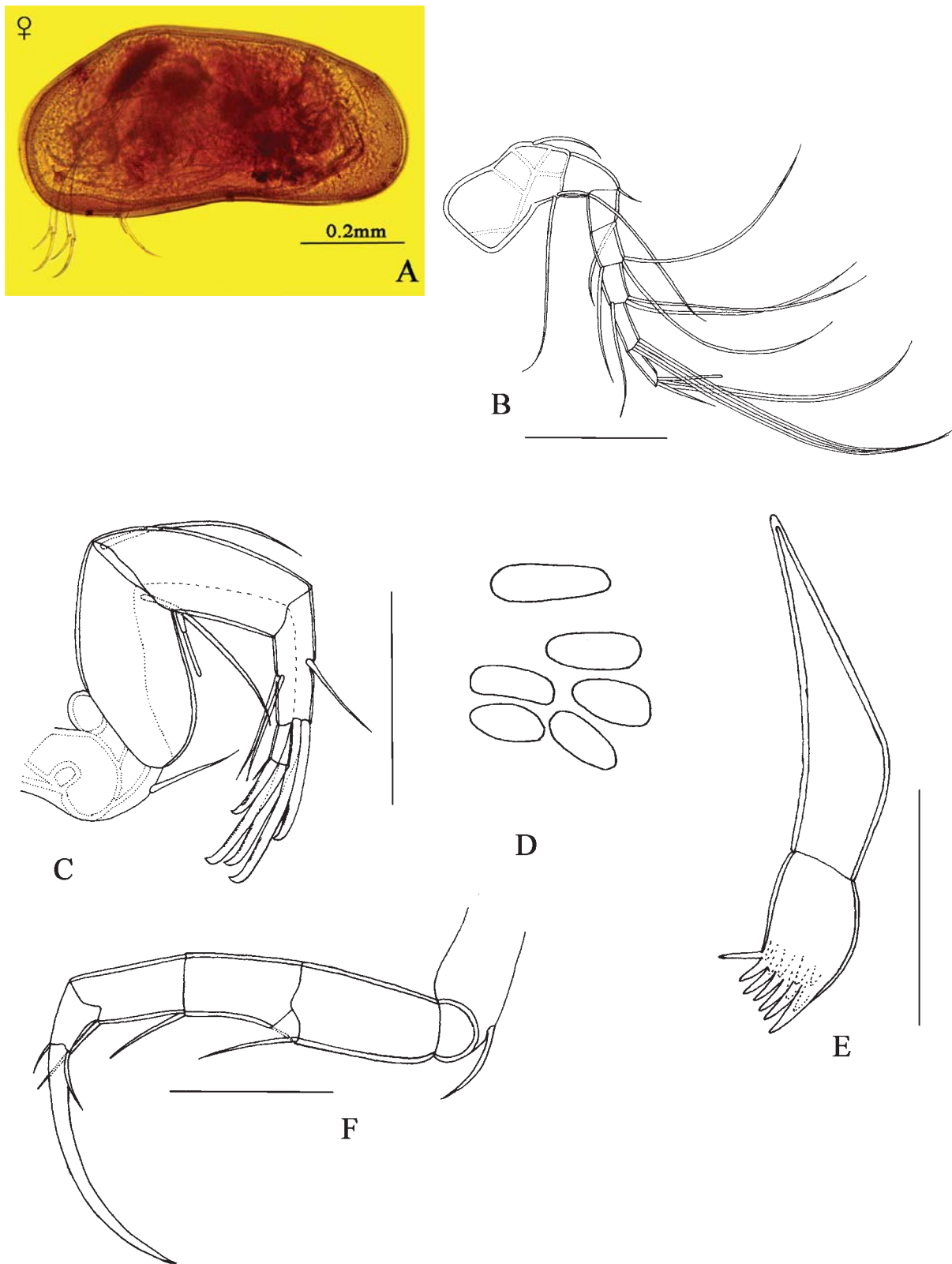


**Fig. 3.** *Fabaeformiscandona subacuta* (Yang, 1982) ♀; A- Carapce of the female animal; B- Antennula; C- Antenna; D- Adductor muscle scar; E- Mandibular coxal plate; F- Second thoracopoda. Scale = 0.1mm