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## MONOGRAPH

### WATER BUGS (INSECTA: HEMIPTERA: HETEROPTERA) OF HIMALAYAN AND SUB-HIMALAYAN REGIONS OF WEST BENGAL, INDIA

Srimoyee Basu, Kailash Chandra, Kumrapuram Apadodharanan Subramanian &  
Goutam Kumar Saha

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## WATER BUGS (INSECTA: HEMIPTERA: HETEROPTERA) OF HIMALAYAN AND SUB-HIMALAYAN REGIONS OF WEST BENGAL, INDIA

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**Abstract:** The present study reports a total of 61 Species belonging to 34 genera and 14 families from Darjeeling Himalaya and Jalpaiguri sub Himalaya regions of West Bengal. The study documented 11 new species to science, which were already published, 15 new records to the state and one new record to India. The study showed that the Nepomorphan families are mostly restricted to the slow flowing or to the stagnant ecosystems like ponds or lakes and the running waters are dominated mainly by the Gerromorpha. The key to all family, genera and species of aquatic Hemiptera are provided with their distribution in India and globally. The description of all species with their detail photographs and distribution map were also presented here. The diagnostic characters supported with photographs for each species are also presented here.

**Keywords:** Darjeeling, Eastern Himalaya, Heteroptera, Jalpaiguri, water bugs, West Bengal.

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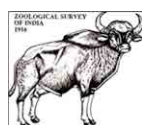
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**Author Contribution:** SB - conducted the field survey, identification of specimens, photography of specimens and prepared the manuscript. The present Communication is a part of her PhD thesis. KAS - designed the study, carried out GIS map preparation and edited the manuscript. KC and GKS - edited the manuscript.

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## INTRODUCTION

The Eastern Himalaya region (EH) is one of the 'Biodiversity Hotspots', and also physiographically diverse encompassing mountains, valleys and floodplains. This region is located at the junction of the Indo-Malayan, Palaearctic, and Sino-Japanese biogeographical realms (CEPF 2005) and is ecologically rich associated with diverse flora and fauna. In fact, the variation in altitude, landscape profiles, climatic condition and geographic complexity of EH region considerably affect formation of varied eco-regions that favour great assemblages of vegetation and unique fauna with a high proportion of endemism and diversity. A recent estimate describes 3,624 species of insects, 50 molluscs, 236 fishes, 64 amphibians, 137 reptiles, 850 birds, and 397 mammalian species from the northeastern states of India (Maheswaran 2012). The largely inaccessible landscape, however, makes biological surveys in this region extremely difficult. As a result, many floral and faunal groups in the unexplored vast forest ranges of this region are taxonomically understudied. Many small invertebrates like insects, in particular, have been neglected or virtually ignored except for the documentation of Lepidoptera (Mani 1986) and of Odonata (Mitra et al. 2010). As this region harbours numerous critical habitats and several protected areas, there is a high possibility to explore many unknown species of insects.

The diversity of aquatic and semi-aquatic Hemiptera comprises all lotic or lentic species that are found in different altitudes. The perennial water bodies ranging from rivers, torrential streams, and tiny steep streams in hilly montane areas, slow-flowing marshy streams, open marshes in valleys, stagnant pools or forested swamps, ponds, lakes, and ditches at lower altitudes, and seasonal ponds during the monsoon are the habitats of these bugs. They, commonly known as 'water bugs', are the integral components of freshwater ecosystems and play an important role in the food web of freshwater ecosystems as predators of other aquatic invertebrates or scavengers (Murdoch et al. 1984). Knowledge of their biology, feeding habits, pre-predator relationship is essential to study the fish biology and for proper management of hatcheries (Thirumalai 1999). Besides, they also serve as zoogeographical indicators due to their poor dispersal capabilities (Jordon 1951; Hungerford & Matsuda 1958a b; Thirumalai 1999) and proved as bio-indicators of long-term environmental changes. Knowledge about the diversity and distribution of this group helps in understanding the functional aspects of

community structure of aquatic ecosystem and provides the baseline data required for developing strategies for the effective conservation and management of freshwater ecosystems. Some of them are efficient bio-control agents of mosquito larvae (Saha et al. 2010). However, documentation of these bugs in the current study area is still insufficient. The present study, hence, focuses on the taxonomy, and distribution of aquatic and semi-aquatic Heteroptera in the Himalayan and sub-Himalayan regions of West Bengal.

## MATERIALS AND METHODS

### Study Area

The present study was conducted in two regions of West Bengal—in Darjeeling region, a part of Eastern Himalayan Biodiversity Hotspots, and in Jalapiguri region that encompasses the Himalayan foothills of West Bengal (Fig. 1).

### Darjeeling Himalaya

**Geography:** Darjeeling Himalaya is bounded by the State of Sikkim on the north, Uttar Dinajpur District of West Bengal in the south, Bhutan on the east, and Nepal on the west. It is situated between 26°31'–27°13' °N and 87°59'–88°53' °E, with an area of 3,149 km<sup>2</sup>. Heavy precipitation during monsoon results in landslides. The river Teesta divides the region into two parts: (a) the hills to the east of Teesta and (b) the hills to the west of Teesta. In the hill to the west of Teesta, there are two distinct ranges—the Singalila Range and the Darjeeling-Kurseong Range. The hill to the east of Teesta is the Chola Range; Kalimpong Town is situated here.

**Rivers and Forests:** River Teesta is the major river flowing in this area. Besides Teesta, the rivers that drain this region are Mechi, Balason, Mahananda, Gheesh, Leesh, Chel, Neora, Jaldhaka and Rangit — they originate from the Himalaya and are perennial in nature. Darjeeling encompasses two national parks — Neora Valley National Park and Singalila National Park, and three wildlife sanctuaries — Jorpokhri, Mahananda, and Senchal. The four major types of forests found in this region according to altitudinal gradients are (1) tropical moist deciduous forest, (2) tropical evergreen lower montane forest, (3) tropical evergreen upper montane forest, and (4) temperate forest.

**Climate:** Spring and autumn are the seasons most favoured by tourists. The monsoon is a period of continuous rainfall and the winter is unpleasant and extremely cold (after December). A very high intensity



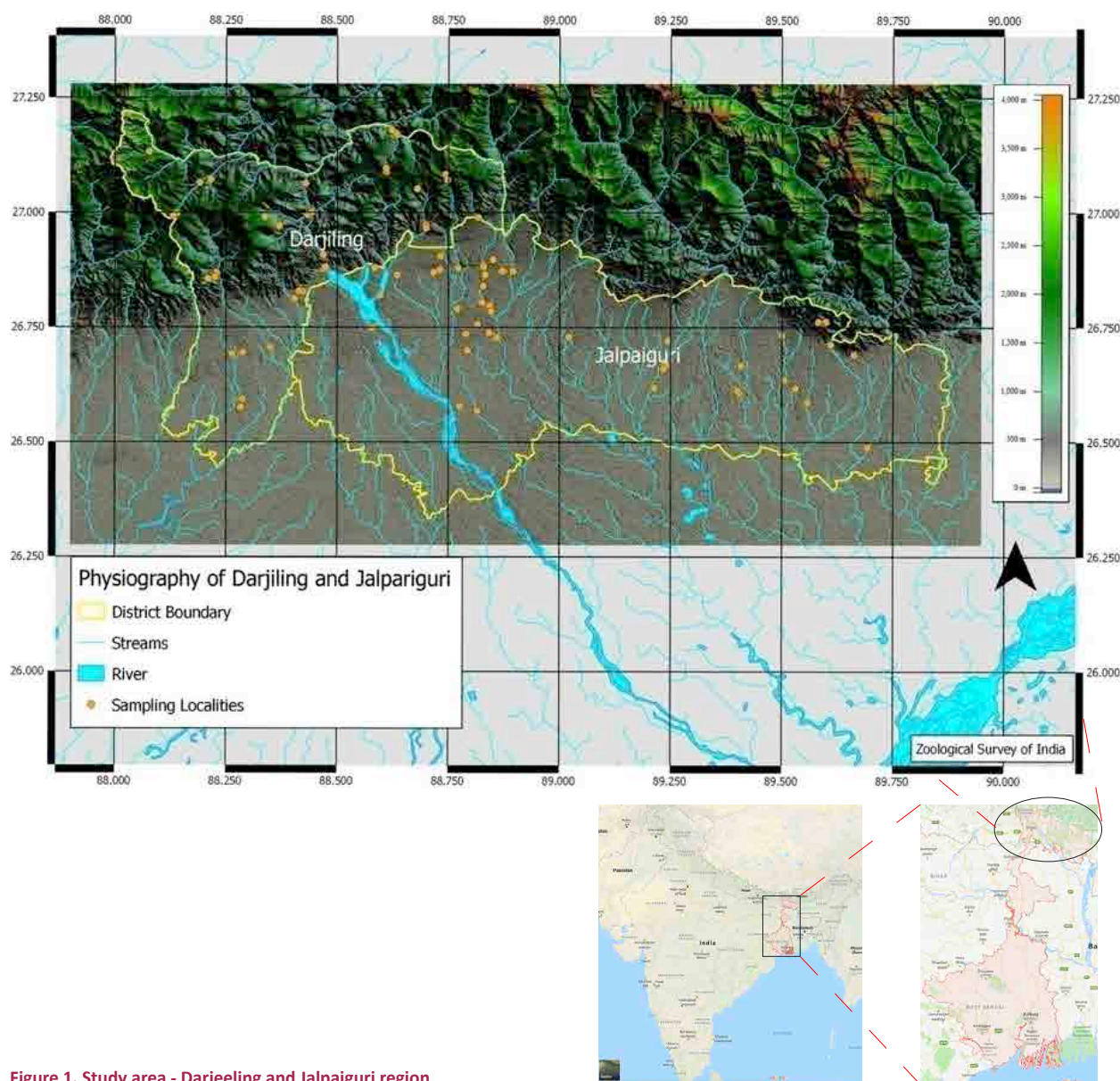


Figure 1. Study area - Darjeeling and Jalpaiguri region

of rainfall within a short span of time is common in the hills of Darjeeling. The annual total rainfall varies from 1870–3690 mm. The mean annual temperature fluctuates from 24°C in the plains to below 10°C on the ridges.

#### Jalpaiguri sub-Himalaya

Jalpaiguri region is a narrow stretch of land that lies between the Sikkim-Darjeeling Himalayas and the Gangetic plains of West Bengal, covering an area of 6, 245 sq. km.

**Geography:** It is situated between 26°16'N–27°N and 88°4'E–89°53'E. The district has a major part of undulating Himalayan foothills called Dooars and its

southern part is plains. It has international borders with Bhutan and Bangladesh in the north and south, respectively, and is marked with Assam, Darjeeling, and Coochbehar in the east, west, and westwards respectively.

**Rivers and Forests:** The entire region is crisscrossed by many rivers and their tributaries. The major rivers in the region are Teesta, Torsa, Jaldhaka, Raidhak, Dyna, Murti, Neora, Mal, Karola, Mujnai, Sankosh, etc. They are rain-fed rivers and cause floods every year. A major part of this area is covered by forests. It encircles several wildlife sanctuaries, national parks, and reserve forests such as Gorumara National Park, Chapramari Wildlife Sanctuary, Jaldapara Wildlife Sanctuary, Chilapata

Forest, Buxa Tiger Reserve, North Khairabai and South Khairabari Reserve Forests, and Jayanti Forest. The main forest cover comprises of semi-moist deciduous vegetation. In addition, this region has grassland forests, evergreen forests, riverine forests, savanna grasslands, and swamps that harbour a wide spectrum of wildlife.

**Climate:** Jalpaiguri is a part of the monsoon climate zone of Southeast Asia. May is the hottest month with an average minimum temperature of about 35°C, whereas January is the coldest month with an average of 10°C. This region is humid with the annual average humidity of 82%. July is the wettest month with more than 800mm of rainfall. The annual average rainfall is 4099 mm. Thunderstorms and hailstorms are common in Jalpaiguri during April–May.

## METHODS

### Collection of Samples

Systematic stratified random sampling was carried out to collect all the families of aquatic and semi-aquatic Heteroptera in different wetlands (Image 1) ranging from ponds, lakes, waterfalls, hill streams, rivers, riffles, runs, roadside seeps, forested pools, and irrigation canals (those within paddy fields, agricultural fields and tea gardens etc.) in the study area. The aquatic and semi-aquatic Heteroptera were sampled from 86 localities located between 26.48°N–27.17°N and 88.07°E–89.69°E across Darjeeling and Jalpaiguri Districts of West Bengal from March, 2011 to October, 2013. Global Positioning System (GPS) was used to determine the latitude, longitude, and altitude of the region. Details of the study sites, altitudes, latitudes, longitudes, habitat types, and land use patterns are provided in Appendix 1.

The aquatic and semi-aquatic Heteroptera were collected from different habitats using kick nets, pond nets, dip nets, fine-meshed fish nets held between two people, or a rectangular net with a small handle following 'all out search method' (Subramanian & Sivaramakrishnan 2007). Within each sampling area, all possible microhabitats such as bedrocks, cobbles, water surface, between boulders, dead wood fallen on the streams, floating aquatic vegetations like water hyacinth, duckweeds, pond weeds, etc were sampled. Samples were carefully taken by hand-picking or using forceps and brush to avoid any kind of injury.

### Preservation of samples

Collected samples were immediately transferred

to Borosil glass vials containing 75% ethyl alcohol from each sampling site and were labeled properly with the field ID. A good number of individuals of each species were collected to maximize the likelihood of obtaining intact specimens from each sampling site.

### Sorting and Identification

Collected samples were brought to the laboratory and sorted using a stereoscopic Binocular (LeicaEZ4HD). They were identified using standard taxonomic literature and measurements were taken for each body parts. The male genital segment was removed and immersed in 10% Potassium hydroxide (KOH) solution for half an hour to dissolve the muscle tissues and then dissected to confirm the species. The camera lucida line drawing was undertaken using the same microscope for a few species. All measurements are taken in millimeters (mm).

### Data Analysis

The species distribution across the study area was geo-referenced. The distribution maps were then prepared using the geo-referenced data by using DIVA GIS version 7.5.0 (Hijmans et al. 2012) and QGIS 2.0.1-Dufour (QGIS Development team 2013). The species diversity and richness were also mapped using DIVA GIS software.

### Taxonomic documentation

A total of 61 species under 34 genera and 14 families of aquatic and semi-aquatic Heteroptera were collected during 2011 and 2013 from the Himalayan and sub-Himalayan regions of West Bengal. An identification key is provided for all the families, subfamilies, genera, and species of water bugs coupled with their diagnostic characters.

### Systematic list

**Class** Insecta

**Order** Hemiptera

**Suborder** Heteroptera

**Infraorder** Nepomorpha Popov, 1968

**Superfamily** Naucoroidea Leach, 1815

**Family** Aphelocheiridae Fieber, 1851

**Genus** *Aphelocheirus* Westwood, 1833

**Subgenus** *Aphelocheirus* Westwood, 1833

*Aphelocheirus pradhanai* Zettel, 1998\*

*Aphelocheirus thirumalaii* Basu, Subramanian & Saha, 2013

**Family** Naucoridae Leach, 1815  
**Subfamily** Laccocorinae Stal, 1876  
**Genus** *Heleocoris* Stal, 1876  
*Heleocoris bengalensis bengalensis* Montandon, 1910

**Superfamily** Nepoidea Latreille, 1802  
**Family** Belostomatidae Leach, 1815  
**Subfamily** Belostomatinae Leach, 1815  
**Genus** *Diplonychus* Laporte, 1833  
*Diplonychus annulatus* (Fabricius, 1781)  
*Diplonychus rusticus* (Fabricius, 1781)

**Subfamily** Lethocerinae Lauck & Menke, 1961  
**Genus** *Lethocerus* Mayr, 1853  
*Lethocerus indicus* (Lepeletier & Serville, 1825)

**Family** Nepidae Latreille, 1802  
**Subfamily** Nepinae Latreille, 1802  
**Genus** *Laccotrephes* Stal, 1866  
*Laccotrephes griseus* (Guerin-Meneville, 1844)

**Subfamily** Ranatrinae Douglas & Scott, 1865  
**Genus** *Cercotmetus* Amyot and Serville, 1843  
*Cercotmetus pilipes* (Dallas, 1850)\*

**Genus** *Ranatra* Fabricius, 1790  
*Ranatra digitata* Hafiz & Pradhan, 1947  
*Ranatra filiformis* Fabricius, 1790  
*Ranatra varipes varipes* Stal, 1861  
*Ranatra varipes atrophata* Montandon, 1903\*

**Superfamily** Notonectoidea Latreille, 1802  
**Family** Notonectidae Latreille, 1802  
**Subfamily** Anisopinae Hutchinson, 1929  
**Genus** *Anisops* Spinola, 1837  
*Anisops breddini* Kirkaldy, 1901  
*Anisops nasutus* Fieber, 1851  
*Anisops sardeus sardeus* Herrich-Shaffer, 1850  
*Anisops paranigrolineatus* Brooks, 1951\*

**Subfamily** Notonectinae Latreille, 1802  
**Genus** *Enithares* Spinola, 1837  
*Enithares mandalayensis* Distant, 1910\*  
*Enithares unicata* Lundblad, 1933\*\*

**Genus** *Nychia* Stal, 1860  
*Nychia sappho* Kirkaldy, 1901

**Superfamily** Corixoidea Leach, 1815  
**Family** Corixidae Leach, 1815

**Subfamily** Corixinae Leach, 1815  
**Genus** *Sigara* Fabricius, 1775  
**Subgenus** *Tropocorixa* Hutchinson, 1940  
*Sigara promontoria* (Distant, 1910)

**Subgenus** *Vermicorixa* Walton, 1940  
*Sigara kempii* (Hutchinson, 1940)

**Family** Micronectidae Jaczewski, 1924  
**Subfamily** Micronectinae Jaczewski, 1924  
**Genus** *Micronecta* Kirkaldy, 1897  
**Subgenus** *Basilonecta* Hutchinson, 1940  
*Micronecta scutellaris scutellaris* (Stal, 1858)

**Subgenus** *Dichaetonecta* Hutchinson, 1940  
*Micronecta desertana desertana* Distant, 1920\*

**Subgenus** *Unguinecta* Nieser, Chen and Yang, 2005  
*Micronecta khasiensis* Hutchinson, 1940\*

**Subgenus** *Sigmonecta* Wroblewski, 1962  
*Micronecta quadristrigata* Breddin, 1905

**Subgenus** *Pardanecta* Wroblewski, 1962  
*Micronecta haliploides* Horvath, 1904  
*Micronecta ludibunda* Breddin, 1905 (subgenus position not clear, Thirumalai, 2007)\*

**Superfamily** Pleoidea Fieber, 1851  
**Family** Pleidae Fieber, 1851  
**Genus** *Paraplea* Esaki and China, 1928  
*Paraplea frontalis* (Fieber, 1844)

**Family** Helotrephidae Esaki and China, 1927  
**Genus** *Tiphotrephes* Esaki and China, 1928  
*Tiphotrephes indicus* (Distant, 1910)

**Infraorder** Gerromorpha Popov, 1971  
**Superfamily** Mesovelioidae Douglas and Scott, 1867  
**Family** Mesoveliidae Douglas and Scott, 1867  
**Subfamily** Mesoveliinae Douglas and Scott, 1867  
**Genus** *Mesovelia* Mulsant and Rey, 1852  
*Mesovelia horvathi* Lundblad, 1934\*  
*Mesovelia vittigera* Horvath, 1895

**Superfamily** Hydrometroidea Billberg, 1820  
**Family** Hydrometridae Billberg, 1820  
**Subfamily** Hydrometrinae Esaki, 1927  
**Genus** *Hydrometra* Latreille, 1796  
*Hydrometra greeni* Kirkaldy, 1898

- Superfamily** Gerroidea Reuter, 1910  
**Family** Veliidae Amyot & Serville, 1843  
**Subfamily** Microveliinae China & Usinger, 1949  
**Genus** *Microvelia* Westwood, 1834  
*Microvelia albomaculata* Distant, 1910  
*Microvelia douglasi* Scott, 1874
- Subfamily** Rhagoveliinae China & Usinger, 1949  
**Genus** *Rhagovelia* Mayr, 1865  
**Subgenus** *Neorhagovelia* Matsuda, 1956  
*Rhagovelia sumatrensis* Lundblad, 1936 \*
- Subfamily** Veliinae China & Usinger, 1949  
**Genus** *Velia* Latreille, 1804  
**Subgenus** *Cesavelia* Koçak & Kemal, 2010  
*Velia mitrai* Basu, Subramanian & Polhemus, 2013
- Family** Gerridae Leach, 1815  
**Subfamily** Rhagadotarsinae Lundblad, 1934  
**Genus** *Rhagadotarsus* Breddin, 1905  
*Rhagadotarsus kraepelini* Breddin, 1905
- Subfamily** Eotrechinae Matsuda, 1960  
**Genus** *Amemboa* Esaki, 1925  
*Amemboa kumari* (Distant, 1910)\*  
*Amemboa mahananda* Basu, Subramanian & Polhemus, 2014  
*Amemboa bifurcata* Basu, Subramanian & Polhemus, 2014  
**Genus** *Chimarrhometra* Bianchi, 1896  
*Chimarrhometra orientalis* (Distant, 1879)
- Genus** *Onychotrechus* Kirkaldy, 1903  
*Onychotrechus dooarsicus* Subramanian, Basu & Zettel, 2014
- Subfamily** Cylindrostethinae Matsuda, 1960  
**Genus** *Cylindrostethus* Mayr, 1865  
*Cylindrostethus productus* (Spinola, 1840)
- Subfamily** Gerrinae Bianchi, 1896  
**Genus** *Aquarius* Schellenberg, 1800  
*Aquarius adelaides* (Dohrn, 1860)
- Genus** *Gerris* Fabricius, 1794  
**Subgenus** *Gerris* Fabricius, 1794  
*Gerris nepalensis* Distant, 1910\*
- Subgenus** *Macrogerris* Andersen, 1993  
*Gerris gracilicornis* (Horvath, 1879)
- Genus** *Neogerris* Matsumura, 1913  
*Neogerris parvulus* (Stal, 1859)
- Genus** *Limnogonus* Stal, 1868
- Subgenus** *Limnogonus* Stal, 1868  
*Limnogonus fossarum fossarum* (Fabricius, 1775)  
*Limnogonus nitidus* (Mayr, 1865)
- Subfamily** Halobatinae Bianchi, 1896  
**Genus** *Metrocoris* Mayr, 1865  
*Metrocoris anderseni* Chen & Nieser, 1993\*  
*Metrocoris murtiensis* Basu, Polhemus & Subramanian, 2016  
*Metrocoris lavitra* Basu, Polhemus, Subramanian & Saha, 2016  
*Metrocoris dinendrai* Basu, Polhemus & Subramanian, 2016  
*Metrocoris deceptor* Basu, Polhemus & Subramanian, 2016  
*Metrocoris darjeelingensis* Basu, Polhemus & Subramanian, 2016
- Genus** *Ventidius* Distant, 1910  
**Subgenus** *Ventidius* Distant, 1910  
*Ventidius sushmae* Gupta, 1981
- Subfamily** Ptilomerinae Bianchi, 1896  
**Genus** *Heterobates* Bianchi, 1896  
*Heterobates rihandi* (Pradhan, 1950)\*
- Genus** *Pleciobates* Esaki, 1930  
*Pleciobates bengalensis* Jehamalar, Basu & Zettel, 2014
- Genus** *Ptilomera* Amyot & Serville, 1843  
**Subgenus** *Proptilomera* Hungerford & Matsuda, 1958  
*Ptilomera himalayensis* Hungerford & Matsuda, 1958
- Subgenus** *Ptilomera* Amyot & Serville, 1843  
*Ptilomera laticaudata* (Hardwicke, 1823)
- Superfamily** Hebroidea Amyot & Serville, 1843  
**Family** Hebridae Amyot & Serville, 1843  
**Subfamily** Hebrinae Amyot & Serville, 1843  
**Genus** *Timasius* Distant, 1909  
*Timasius* sp.

Among these, 15 species (marked with\*) are new records to the State of West Bengal and one species (marked with\*\*) is new record to India.





Image 1. Different habitats in the study area  
a - pool, b - pond, c - lake, d - irrigation canal, e - cascades, f - riffle g - run.

#### Infraorder Nepomorpha Popov, 1968

##### Family Aphelocheiridae Fieber, 1851

Carnivorous, small flattened oval bugs. Body 8–10mm long, with head as broad as long. Fore legs non-raptorial, hind legs fringed with swimming hairs without respiratory siphon, mostly without wings.

##### Genus *Aphelocheirus* Westwood, 1833

**Diagnosis:** Body elongated, oval, dark brownish to grayish species. Length more or less than 6.0 mm. Wing pads of brachypterous forms large, covering at least half of the metanotum laterally. Inner propleural projection notched apically. Abdominal scent gland located closer to midline than to lateral margin of abdomen. Spiracular rosettes present in the abdominal sternites of both sexes. Peg-like spines present on the posterior margin of abdominal ventrites medially. A pair of hydrostatic sense organs present on the second abdominal ventrite in adults. Male parameres are asymmetrical. Female sub-genital plate usually with small peg-like setae.

##### *Aphelocheirus (Aphelocheirus) pradhanai* Zettel, 1998 (Image 2 a–g)

**Material examined:** Reg.no. 3143/H15, 1 female, 22.iii.1973, Durbin forest, Ghoombhanjang, Darjeeling District, West Bengal, India, coll. Dr. P.K. Maiti, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length 7.8–8.8mm; maximum width of body across third abdominal

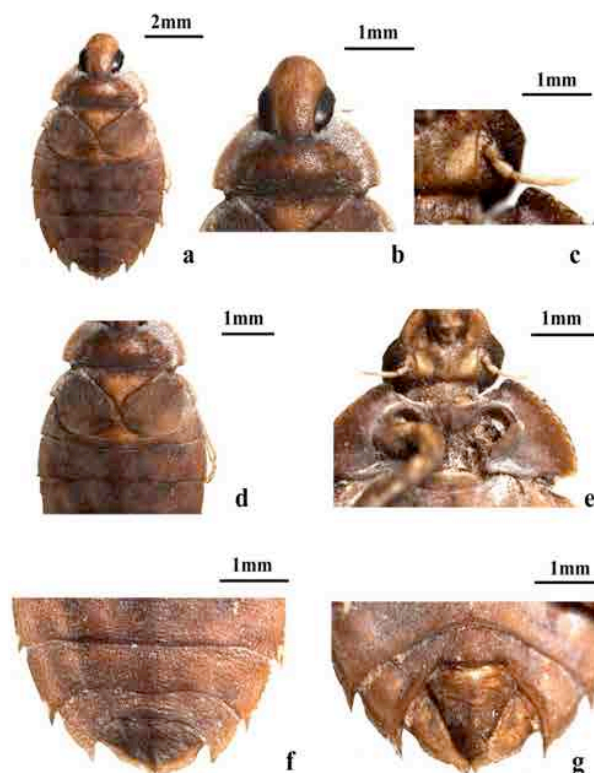


Image 2. a–g. *Aphelocheirus (A.) pradhanai* Zettel, 1998. a. Dorsal view of female; b. Head and pronotum of female; c. Antennae; d. Hemelytra pattern of brachypterous female; e. Inner propleural projection; f. Dorsal view of female genital segment; g. Female sub-genital plate, ventral view

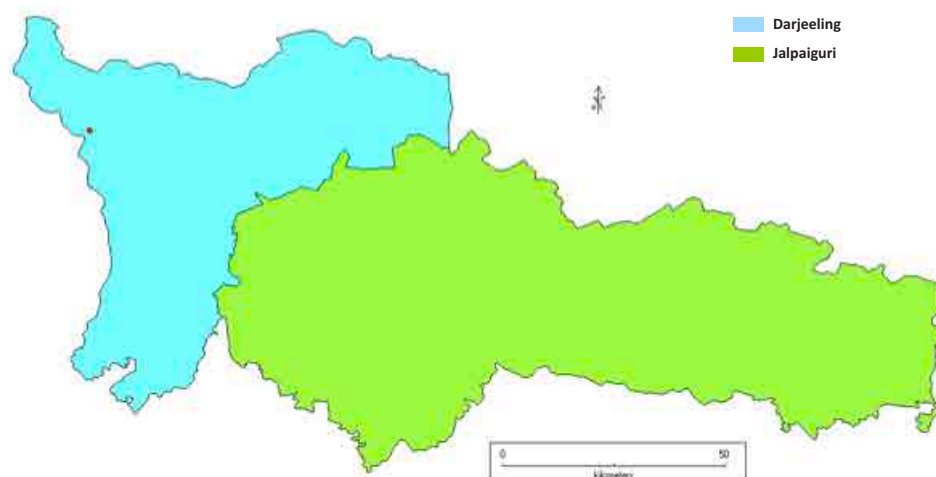


Figure 2. Distribution of *A. pradhanai* Zettel in the study area

segment 4.8–5.7mm.

**Description:** Head 0.95 times as long as wide. Eye 0.80mm in length and 0.30mm in width. Rostrum reaching up to meso coxae, 3.2mm in length. Hemelytra narrowly separated from each other in brachypterous forms (Image 2d). Pronotum 3.45 times as broad as long. Propleura rounded bluntly (Image 2e). Inner propleural projection notched apically. Abdominal sternite without spine-like bristles. Abdomen 4.9mm in width and 4.4mm in length.

**Genital segment:** Female seventh abdominal sternite 1.36mm in length and 1.91mm in width. Female subgenital plate rounded at apex (Image 2f,g). Presence of long thick hair tufts at distal half, but without distinct sub-apical hair cluster.

**Global distribution:** Nepal and India.

**Distribution in India:** Sikkim and West Bengal (Fig. 2).

**Habitat:** Riffles, streams, lakes, and shallow ponds within tea gardens.

**Remarks:** This species is a new record to the State of West Bengal; sorted from the backlog collection of Zoological Survey of India. This tropical bottom bugs mainly inhabit the shallow bottom of streams and riffles. They are very difficult to collect and can easily escape viewer's eyes.

***Aphelocheirus (Aphelocheirus) thirumalaii* Basu, Subramanian & Saha, 2013 (Image 3 a–d; Image 4 e–j)**

**Material examined:** Regn.no. 2775-2776/H15, 5 males, 11 females, 17.iii.2012, Dhupjhora, Murti River within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length 7.0–7.7 mm; ovate

in appearance (Image 3a); maximum body width across third abdominal segment 4.3–4.6 mm; width of pronotum 2.8mm; maximum width of head (including eyes) 1.6mm; width of head (excluding eyes) 1.2mm.

**Description:** Dorsally, colour varies from pale brown to dark brown. Head yellow with an inverted V-shaped marking towards the anterior margin, a more or less triangular fuscous spot posteriorly. Pronotum overall brown with a more or less rectangular yellow spot medially, lateral margin pale. Head dorsally, with fine punctures, slightly produced ahead of eyes. Head length 1.4mm. Eyes 2.3 times longer than broad. Interocular region three times as wide the eye width. Antenna glabrous, length of antennal segments 1–4: 0.12mm, 0.16mm, 0.22mm, 0.31mm. Pronotum's length 0.73mm, width 2.85mm, with dense punctures, denticulate laterally; posterior margin nearly straight. Hemelytra touching each other at mid-line (Image 3d), each 1.5 times longer than broad, with intense punctures, embolium with sparse, black, short hairs. Propleura rounded posteriorly, with blunt inner propleural projection. Metasternum weakly carinated, metaxipus small, laterally concave with apex more or less acuminate. Abdominal tergites with dense black short hairs, laterally on each side. Tergites II–IV symmetrical, sternum IV–VI with median protrusion, but without peg-like setae. Fore femora with prominent golden setae, mid and hind femora and tibia with dense long golden hairs, claws well-developed and curved.

**Male Genitalia:** Genital capsule broadly rounded (Image 4f), with scattered golden, prominent hairs. Parandria as in Image 4e, left parandrium much longer and more acuminate towards apex than the right one and right parandrium wide with truncated apex. Aedeagus (Image 4e) elongated and slender, well-

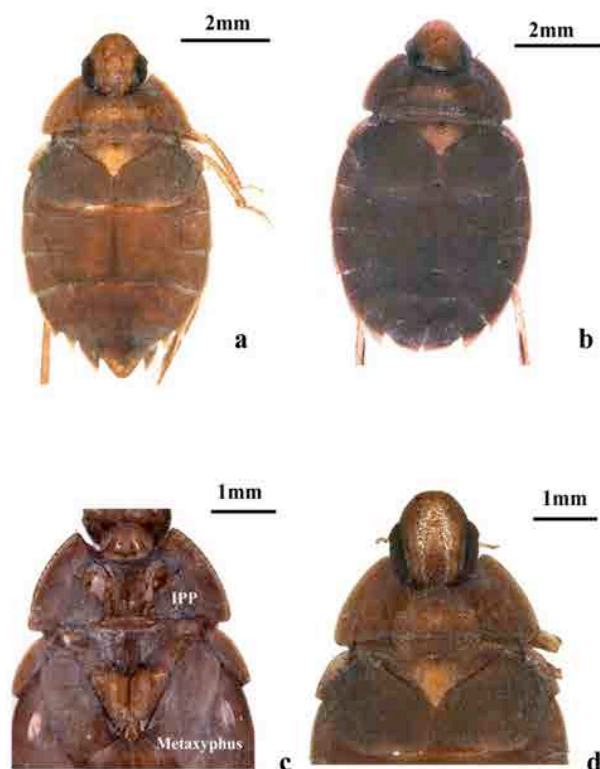


Image 3. a–d. *Aphelocheirus (A.) thirumalaii* Basu, Subramanian & Saha, 2013. a. Dorsal view of brachypterous male; b. Dorsal view of brachypterous female; c. Inner propleural projection and metaxyphus; d. Hemelytral pattern

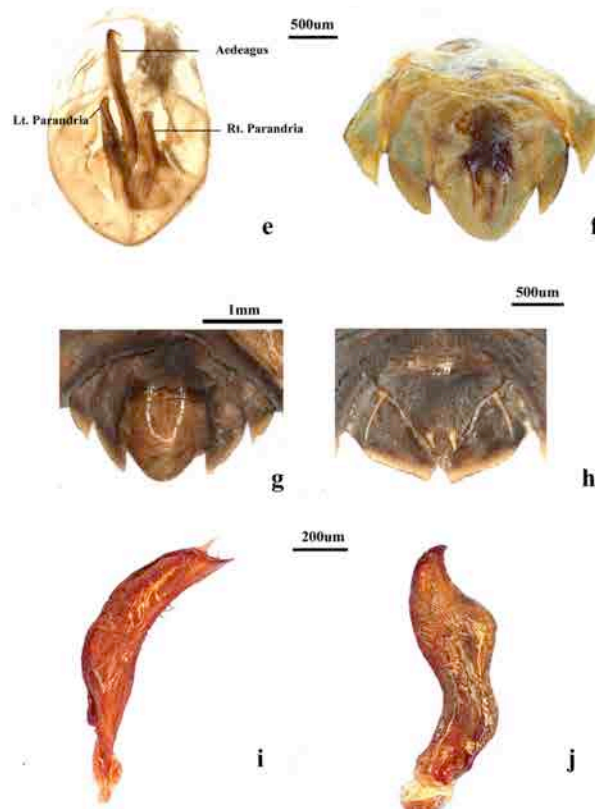


Image 4. e–j. *Aphelocheirus (A.) thirumalaii* Basu, Subramanian & Saha, 2013. e. Male left and right parandria and aedeagus of male; f. Genital capsule of male; g. Male genital segment, ventral view; h. Female sub-genital plate, ventral view; i. Right paramere of male; j. Left paramere of male

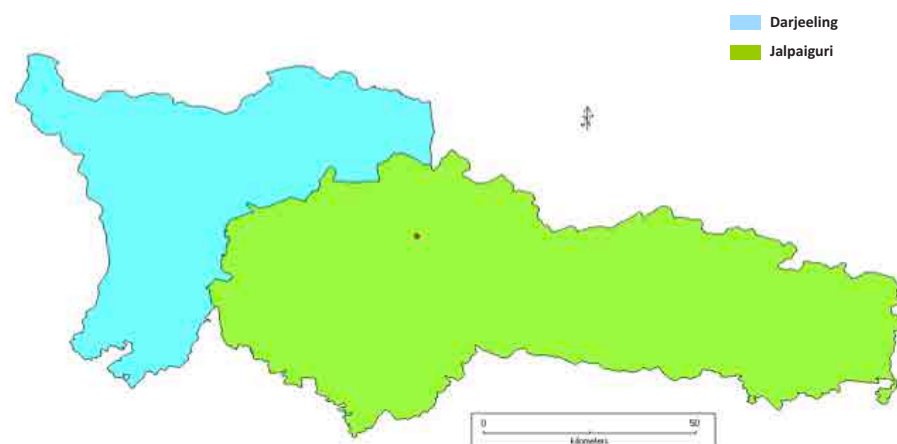


Figure 3. Distribution of *A. thirumalaii* Basu et al. in the study area

sclerotized, its apex slightly acuminate. Left paramere distinctly wider than the right one. Left paramere (Image 4j) stout, gently curved, widened sub-basally and at distal two-thirds of length, slightly constricted near mid-length, tapering towards its narrowly rounded apex, seven spines arranged in two parallel rows. Right paramere (Image 4i) relatively slender, acuminate

basally, with nearly uniform width and more concave apically, six stout spines located medially and bunch of setae arising from the concave margin.

Female Genitalia: Subgenital plate (Image 4h) narrowly triangular, with sub-apical and lateral setal tuft and extreme lateral long setal tuft on each side; a broad medial zone, clothed with golden setae.



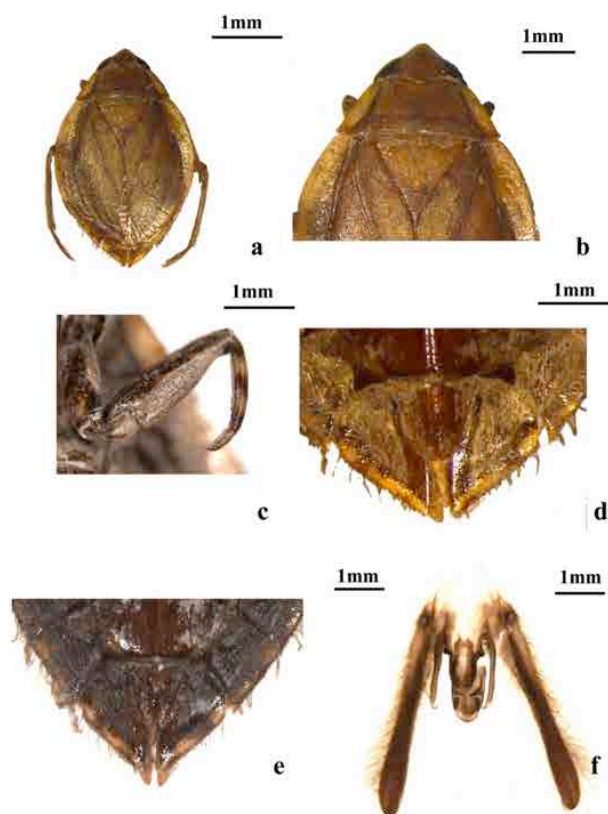


Image 5. a–f. *Diplonychus annulatus* (Fabricius, 1781). a. Dorsal view of male; b. Head, pronotum and scutellum of male; c. Fore leg of male; d. Female sub-genital plate, ventral view; e. Male genital segment; f. Male paramere with respiratory straps

*boukali* Zettel, 2000. But, can be easily distinguished by the relatively small and slender body, and by its paramere structure and subgenital plate of the female.

#### Family Belostomatidae Leach, 1815

Largest bug among all aquatic hemipterans and also called as 'giant water bug'. Size ranges from 10–110 mm, flat, brown, oval or oblong insects. The most distinctive feature is presence of a pair of retractile, strap-like appendages at the abdominal apex, possessing a spiracle basally.

#### Genus *Diplonychus* Laporte, 1833

**Diagnosis:** Relatively small, ovate and yellowish-brown bugs. Body length less than 20mm. Body dorso-ventrally flattened. Head produced ahead of eyes, apex of head sub-triangular, head width less than twice the maximum interocular width. Eyes with inner margins convergent. Mid and hind tibiae not flattened.

#### *Diplonychus annulatus* (Fabricius, 1781) (Image 5a–f)

1781. *Nepa annulata* Fabricius, *Carol. Ernest. Bohn lii, Hamburger et Kiloni*, 333.

1833. *Sphaerodema rotundata* Laporte, *Systematique Hemipteres, Zoologie, Paris*, 18.

1863. *Sphaerodema annulatum* (Fabricius): Dufour, *Annales de la Societe Entomologique de France*, 4(3):

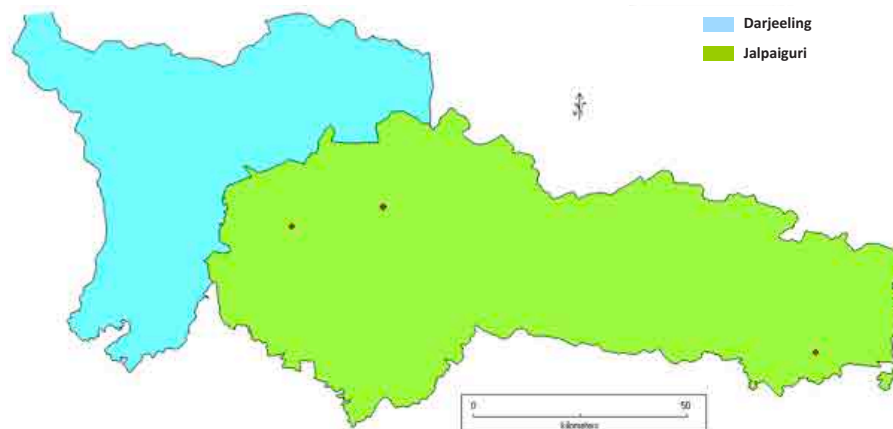


Figure 4. Distribution of *D. annulatus* (Fabricius) in the study area

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** Shallow, swiftly flowing streams with rocky substratum and full of loose gravels and pebbles covered with algae.

**Remarks:** *Aphelocheirus* (A.) *thirumalaii* Basu, Subramanian & Saha, 2013 is closely related A. (A.)

397.

**Material examined:** Regn. no. 3139/H15, 1 female, 17.ix.2011, pond (1) near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 3males, 1female, 17.ix.2011, pond (2) near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1male, 19.iv.2013, Raidhak River, Alipurduar District,



West Bengal, India, coll. S. Basu; 4males, 3females, 13.iii.2011, Teesta Canal, Teesta Barrage, Gajaldoba, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of adult insects ranges from 19–22mm.

Description: Apex of head acute, length of head ranges from 2.1 to 2.4 mm, width 5.4–5.5 mm. Posterior pronotal angle acute with setae. Hemelytra broad, 2.2 times longer than width ( $L/W=15.5/6.8$ ). Wing membrane small, not extended to inner margin. Fore tarsus two-segmented. Fore femora broad. Males are without tuft of setae on their respiratory strap.

Genitalia: Male genital plate more acute. Male parameres almost straight. Female sub-genital plate truncated near end.

**Global distribution:** India, Bangladesh, Pakistan, Taiwan, and China

**Distribution in India:** Andhra Pradesh, Assam, Bihar, Chandigarh, Delhi, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, and Himachal Pradesh

**Habitat:** Ponds, pools found within aquatic vegetation such as water hyacinth, and rivers.

**Remarks:** *D. annulatus* is the largest species among all *Diplonychus* having the maximum length and width. Male of *D. annulatus* carries eggs on their back until they hatch. These predatory bugs feed on other aquatic insects, crustaceans, mosquito larvae (Saha et al. 2010) and even small fishes.

#### *Diplonychus rusticus* (Fabricius, 1781) (Image 6a–h)

1781. *Nepa rustica* Fabricius, *Carol. Ernest. Bohnii, Hamburgi et Kiloni*, 333.

1871. *Diplonychus rusticum* (Fabricius): Mayr, *Verhandlungen der Zoologisch-Botanischen Gesellschaft*

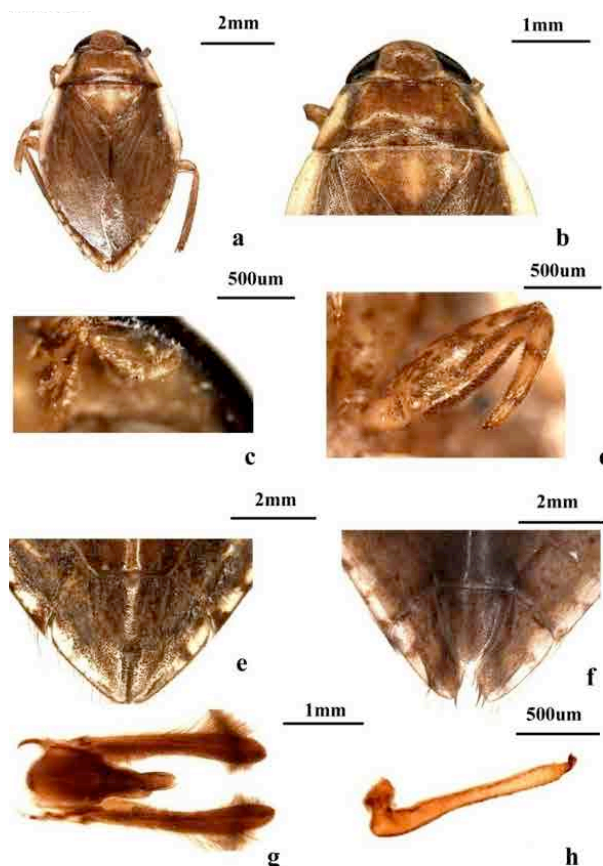


Image 6. a–h. *Diplonychus rusticus* (Fabricius, 1781). a. Dorsal view of male; b. Head and pronotum of male; c. Antennae; d. Male fore leg; e. Female sub-genital plate, ventral view; f. Male genital segment, ventral view; g. Male genitalia with respiratory straps; h. Paramere of male.

in Wien, 21: 437.

1906. *Sphaerodema rusticum* (Fabricius): Distant, *Fauna of British India*, 3: 36.

1915: *Sphaerodema rustica* (Fabricius): Bergroth,

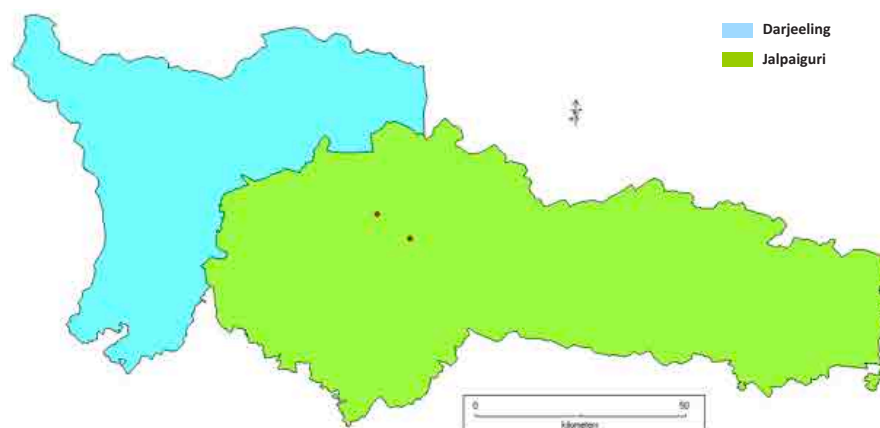


Figure 5. Distribution of *D. rusticus* (Fabricius) in the study area

*Journal of Bombay Natural History Society*, 24: 179.

1980. *Diplonychus indicus* (Fabricius): Venkatesan and Rao, *Journal of Bombay Natural History Society*, 77: 299.

**Material examined:** Regn.no. 3140/H15, 1 male, 1 female, 4 nymphs, 17.iii.2012, Kalipur Wetland, within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 females, 17.ix.2011, pond (2) near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Adult insects may attain a length of 15.4–16.5 mm.

**Description:** Apex of head blunt, posterior pronotal angle less acute, without setae. Length of head 1.2–1.4 mm, width 3.9–4.1 mm. Hemelytra 11.9–12.2 mm in length, width 4.7–5.4 mm. Wing membrane small and extended to inner margin, spiny patch of corium almost oblong. Hind wings broad. Anterior tarsus single segmented and with a small claw. Pubescent stripe of abdominal sternum is distinct.

**Genitalia:** Male genital plate more obtuse. Male with tuft of setae on respiratory strap. Male paramere curved, pointed at apex. Female subgenital plate as in Image 4f.

**Global distribution:** India, Australia, Myanmar, China, Indonesia, Formosa, Japan, Malaysia, New Guinea, New Zealand, Sri Lanka, and Thailand.

**Distribution in India:** Andaman and Nicobar Islands, Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chandigarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.

**Habitat:** Ponds, pools, and lakes with rich aquatic vegetation.

**Remarks:** *Diplonychus rusticus* (Fabricius) is closely related to *Diplonychus molestus* Dufour, but can be distinguished by the posterior pronotal angle and male genitalia. This species shows cosmopolitan distribution. They are common in fish ponds and voraciously feed on fish fingerlings.

#### Genus *Lethocerus* Mayr, 1853

**Diagnosis:** Body elongated, larger species. Eyes equal to or wider than synthlipsis. Head width more than twice the interocular width. Clypeal suture nearly absent. Anterior margin of pronotum relatively straight. Fore trochanter with a depression. Fore femur wider than hind femur, inner side convex. Tibial pads

symmetrical. Second tarsal segment of fore leg shorter than third tarsal segment. Parameres symmetrical, widened and elongated, with more or less pointed apex. Female genital segment with two small protuberances.

#### *Lethocerus indicus* (Lepeletier & Serville, 1825): Image 6. a–f and Image 7. g–h

1825. *Belostoma indica* Lepeletier and Serville, *Encyclopedie Methodique Agasse, Paris*, X: 272.

1871. *Belostoma indicum* Lepeletier and Serville: Mayr, *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 21: 426.

1906. *Belostoma indicum* (Lepeletier and Serville): Distant, *Fauna of British India*, 3: 38.

**Material examined:** Regn.no.3504/H15, 1 male, 8.xi.2013, Murti River, in front of Murti Banani Bungalow, Jalpaiguri District, West Bengal, India, coll. M. Chakrabarty, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Larger species, body length of

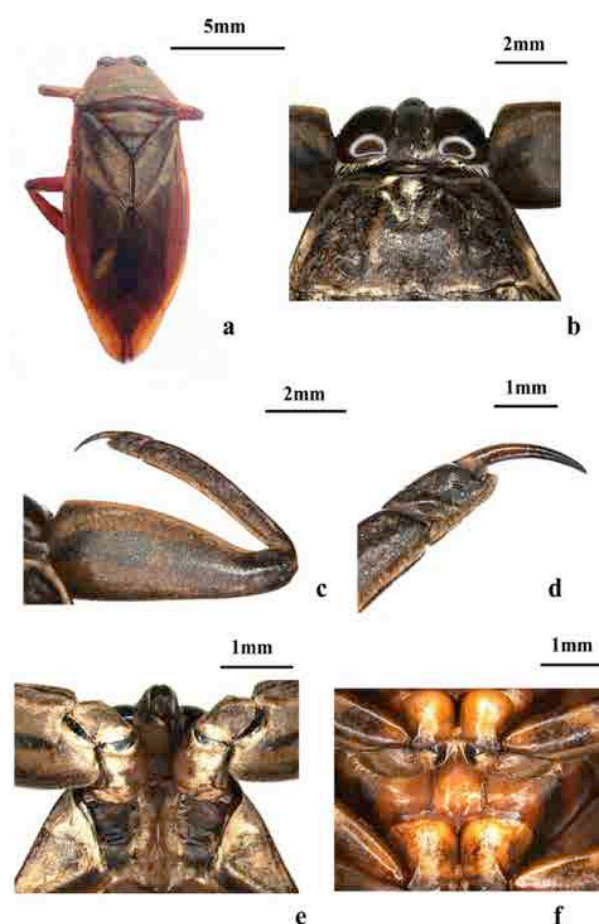


Image 7. a–f. *Lethocerus indicus* (Lepeletier & Serville, 1825). a. Dorsal view of male; b. Head and pronotum of male; c. Male fore leg; d. Fore tarsal segment of male; e. Prosternum; f. Metasternum.

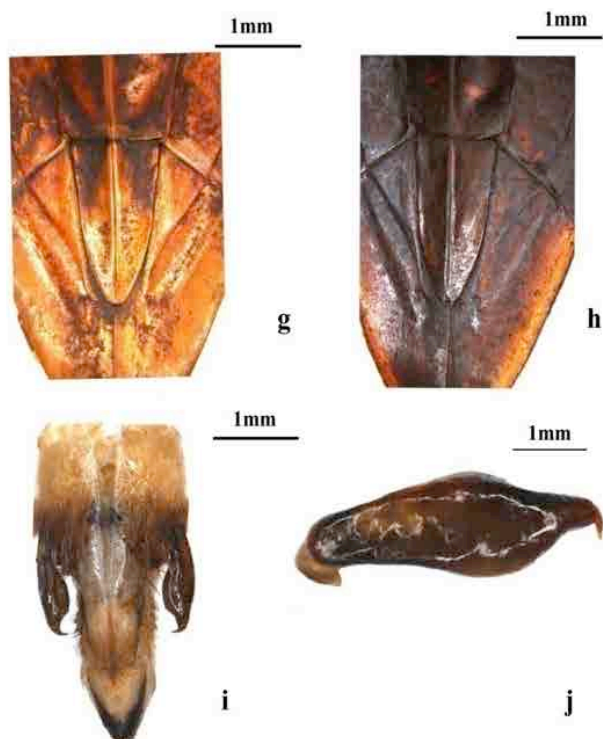


Image 7. g–j. *Lethocerus indicus* (Lepeletier & Serville, 1825). g. Male genital segment; h. Female sub-genital plate; i. Genital capsule of male; j. Paramere of male

$L=6.31/2.98$ ), with transverse fasciae at the basal end and a fine mid longitudinal carination. Scutellum a little broader than long, hemelytra with distinct membrane, provided with prominent longitudinal veins. Fore femur longer than width (length 7.37mm, width 2.95mm); fore tibia (5.25mm) little longer than mid tibia (4.92mm), with sharp claws. Mid and hind legs provided with thick sets of swimming hairs on the ventral side.

**Genitalia:** Male genital segment elongated, with two strap-like respiratory appendages, male paramere as in Image 7i,j. Female genital segment broad with two protuberances at the end.

**Global distribution:** Myanmar, India, Java, Malay Peninsula, Pakistan, Philippines, and Sumatra.

**Distribution in India:** Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Maharashtra, Meghalaya, Mizoram, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.

**Habitat:** Fresh water ecosystems like rivers, streams, ponds, and lakes.

**Remarks:** They are predaceous in nature, known to

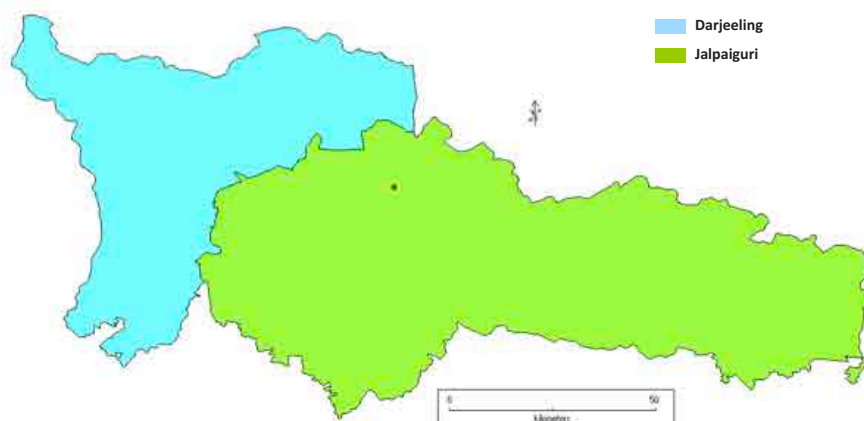


Figure 6. Distribution of *L. indicus* (Lepeletier & Serville) in the study area

male ranges from 60–85mm, maximum body width 27–30mm; female attains a length of 75–90mm, maximum body width 36–38mm.

**Description:** Body narrowly elliptical. Head in front of eyes not conically produced, length of head 1.24mm and width (including eyes) 3.99mm. Antennae small, hidden inside a groove ventrally. Rostrum sharp, stout, 2.7mm in length, interocular region (1.56mm) is little wider than the eye width (1.3mm). Length of eye 1.38mm. Pronotum 2.1 times wider than length (W/

predate on fish fingerlings, snails, and even frogs. This species is edible and used as a food in northeastern India, Thailand, and Vietnam. They often give painful bites with their sharp rostrum.

#### Family Corixidae Leach, 1815

The size ranges from 1.8–16mm, single-segmented fore tarsus called 'pala' which is flattened, scoop-shaped. The scutellum is exposed or concealed and the male abdominal segments are asymmetrical. The corixid



labium is broadly fused with the head and possesses distinct transverse grooves.

### Genus *Sigara* Fabricius, 1775

**Diagnosis:** Small to moderate, cylindrical body. Dorsally, dark black to brown. The length of adults vary from 4.5–6.2 mm. The head relatively large, its base cover the anterior margin of pronotum, the face covered by small few scattered hairs. Postnodal pruinose area longer than the one of the claval suture, a medial pronounced notch on posterior margin of the pronotal disc. The anterior tarsus spatula-like, triangular, and known as pala in males, wider basally, provided with rows of pegs. Male genital capsule large, assymetrical. Parameres small, assymetrical.

### *Sigara (Vermicorixa) kemp* (Hutchinson, 1940): Image 8. a–f

1940. *Corixa (Vermicorixa) kemp* Hutchinson, *Transactions of the Connecticut Academy of Arts and Sciences*, 33: 432.

1988. *Corixa kemp* Hutchinson: Bisht, *Recent Advances in Fish Ecology, Limnology and Eco-Conservation*, 124.

**Material examined:** Regn.no. 3164/H15, 1female, 1nymph, 12.iii.2012, from wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 6.5mm, female body length ranges from 6.7–6.8 mm.

**Description:** Head yellow. Head round in front, hardly produced in front eyes. Vertex with a low obscure longitudinal carina posteriorly. Pronotum dark blackish brown, with ten transverse yellow lines, first two and last two stripes straight and unbroken. Pronotal disc

with central carina forming a small tubercle anteriorly, posteriorly obtusely rounded. Lateral lobes of prothorax with concave margin dorsally and ventrally. Clavus with three straight and unbroken basal yellow lines. Corium with transverse yellow lines. Hind femur reaching beyond the centre of the mid line, outer margin with three spines. Fore femur in male with feeble developed

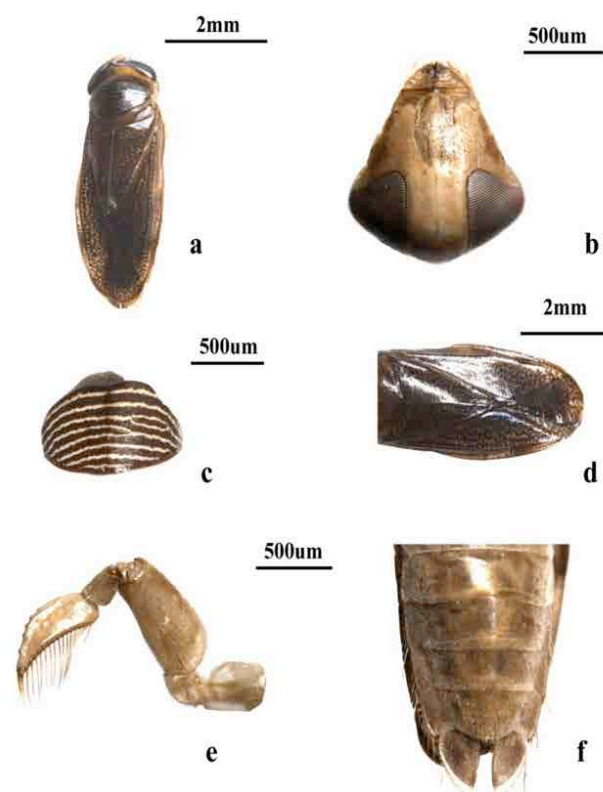


Image 8. a–f. *Sigara (Vermicorixa) kemp* (Hutchinson, 1940). a. Dorsal view of female; b. Labium and frons; c. Pronotal marking pattern; d. Wings marking pattern; e. Fore leg of female; f. Female genital segment

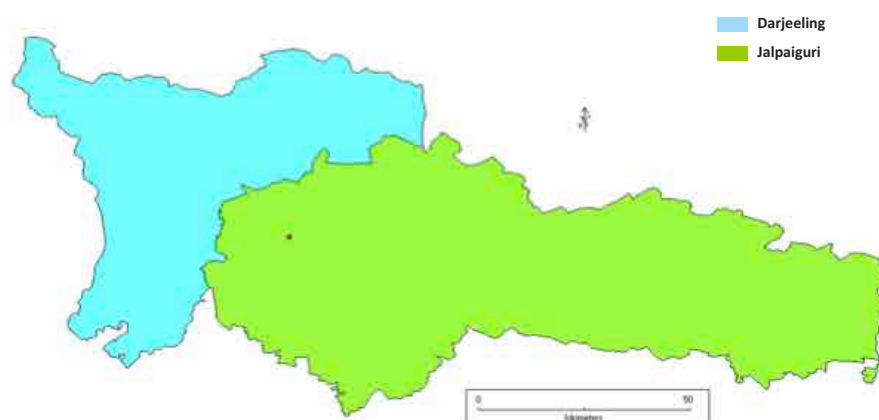


Figure 7. Distribution of *S. kemp* (Hutchinson) in the study area



stridulatory combs. Sixth abdominal segment of male with a small, subquadrate strigil.

**Genitalia:** Male right paramere arcuate and constricted centrally, left paramere narrowed apically and slightly curved. Female genital segment symmetrical.

**Global distribution:** India.

**Distribution in India:** Arunachal Pradesh, Himachal Pradesh, Meghalaya, Sikkim, Uttar Pradesh, and West Bengal.

**Habitat:** High altitudinal lakes, rivers and pools.

**Remarks:** This species is widely distributed across the Himalayan foothills and can be identified by its dark colour pattern, mainly that of the ectocorium, which is dark pitchy brown.

***Sigara (Tropocorixa) promontoria* (Distant, 1910):**  
**Image 9. a–e**

1910a. *Corixa promontoria* Distant, *Fauna of British India*, 5: 341.

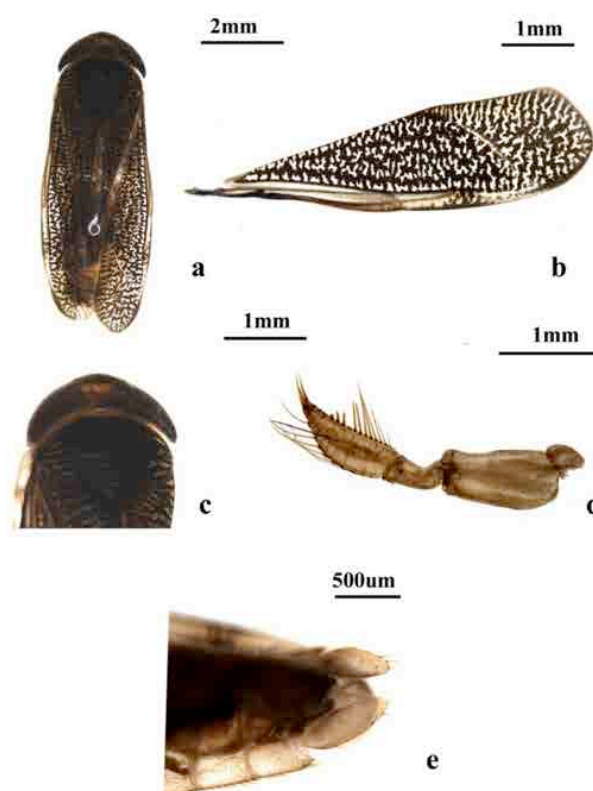
1940. *Corixa (Tropocorixa) promontoria* Distant: Hutchison, *Transactions of the Connecticut Academy of Arts and Sciences*, 33: 437.

**Material examined:** Regn.no. 3691/H15, 1female, 19.iii.2013, Buri Torsha Riverside, South Khairabari Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1female, 17.iii.2013, Kalikhola, between Gorumara and Chapramari Forests, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

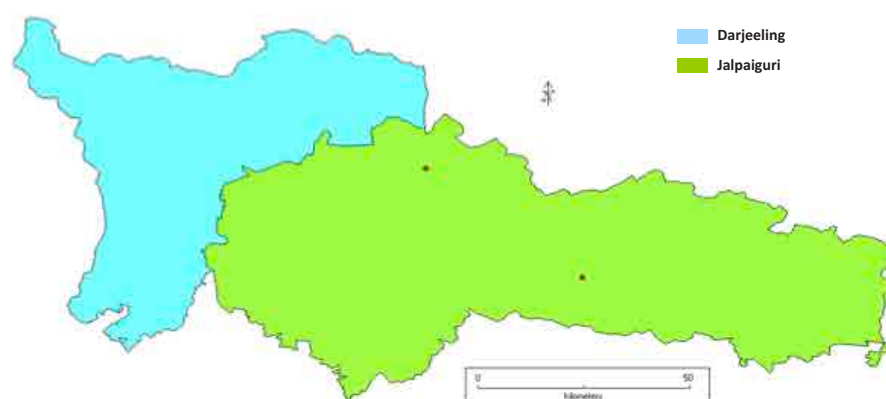
**Morphology:** Size: Adults may attain a length of 6.13–6.18mm.

**Description:** Head length 0.452mm, width 0.71mm. Vertex with rows of obscure punctures throughout the posterior half, head roundly produced in front of eyes. Pronotum black with six yellowish transverse lines. Length of pronotum 0.99mm, width 1.72mm. Eye

length 0.91mm and width 0.36mm. Pala of male simple with a curved row of 34 pegs, of which distal 10 pegs slightly more elongated than others. Clavus black with yellow transverse vermiculations which are broken, irregular, and narrower than the spaces. Corium black with fragmented yellow vermiculations. Mid femur with a few long swimming hairs. Fore femur with two pairs of small spines located distally. Strigil moderately large, oblong, consists of seven combs. In males,



**Image 9. a–e. *Sigara (Tropocorixa) promontoria* (Distant, 1910). a. Dorsal view of female; b. Wing marking pattern; c. Female head and pronotum; d. Female fore leg; e. Female sub-genital plate**



**Figure 8. Distribution of *S. promontoria* (Distant) in the study area**

seventh segment with a well-developed median lobe, its apex conexitum gently concave and bearing a small projecting lobe.

**Global distribution:** India.

**Distribution in India:** Bihar, Delhi, Karnataka, Odisha, Punjab, Rajasthan, Uttar Pradesh, and West Bengal.

**Habitat:** Stagnant ponds, river beds, pools, and lakes.

**Remarks:** This species is widely distributed in Peninsular India. They can be easily identified by the hemielytral marking pattern.

#### Family Helotrephidae Esaki & China, 1927

Body globular with head and pronotum fused. Antenna with one or two segments, a long scutellum and the male genital segments twisted to the left. The tarsi have spiniform like arolia, and a tubular membranous empodium.

#### Genus *Tiphotrephes* Esaki & China, 1928

**Diagnosis:** Body small. Lateral cephalonotal carina not incising on to eye surface. Ventral abdominal carina reaching upto sternum. Male pygophore with distinct sub-symmetrical spur-like process. Left paramere 'S' shaped, typical for this genus. Right paramere with distal half bar shaped. Female abdominal sternum VII symmetrical.

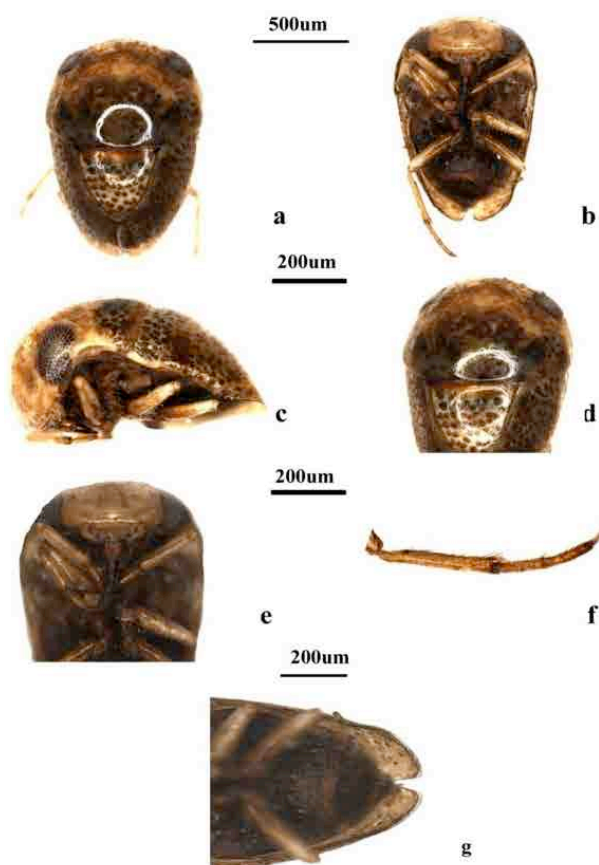
#### *Tiphotrephes indicus* (Distant, 1910): Image 10. a–g

1910a. *Helotrephes indicus* Distant, *Fauna of British India*, 5: 338.

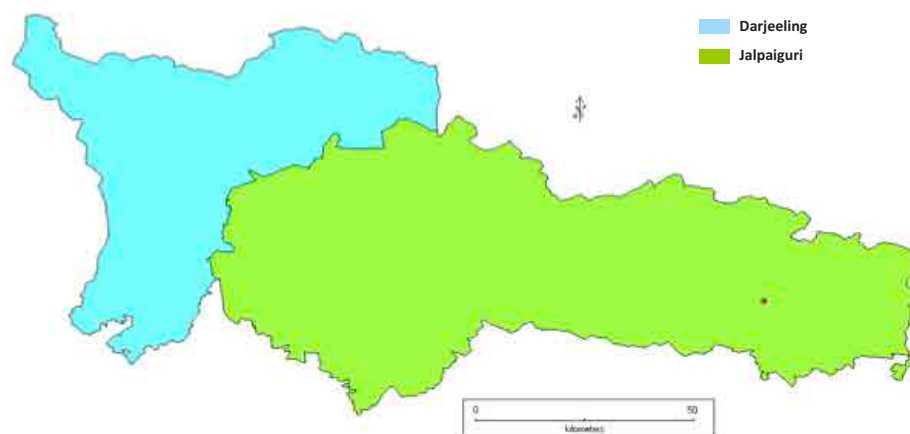
**Material examined:** Regn.no. 3505/H15, 2females, 8.iii.2011, from Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length up to 1.5mm.

**Description:** Small, oval species. Body highly emerginated anteriorly than posteriorly. Dorsally distinctly punctuate and strongly deflected with a prominent concavity at the anterior margin of head. Pronotum less coarsely punctuate. Clavus absent in elytra. Scutellum brownish with basal margin pale,



**Image 10. a–g. *Tiphotrephes indicus* (Distant, 1910). a. Dorsal view of female; b. Ventral view of female; c. Lateral view; d. Head and scutellum; e. Rostrum; f. Fore leg of female; g. Female genital segment**



**Figure 9. Distribution of *T. indicus* (Distant) in the study area**

coarsely punctuate. Corium dull yellowish. Venter dark with yellowish margin laterally.

**Global distribution:** India, Indonesia, Malaysia, Myanmar, Singapore, and Thailand.

**Distribution in India:** Maharashtra, Uttar Pradesh, and West Bengal.

**Habitat:** Water tanks and ponds.

**Remarks:** This species can be easily identified with the coarse punctures on its dorsal side of body and is commonly found in West Bengal.

#### Family Micronectidae Jaczewski, 1924

Small to very small bugs, similar to corixidae. Size ranges from 1–4 mm. Scutellum exposed, covered by pronotum only at anterior margin. Antennae three segmented. Claws of hind tarsae reaching the end of second abdominal sternite.

#### Genus *Micronecta* Kirkaldy, 1897

**Diagnosis:** Small species, length 4mm or less. Head without impression dorsally between eyes. Antenna three-segmented. Scutellum exposed. Claw of pala modified in male and able to fold in the pala without pegs. Female fore tibia and pala fused, but in males fore tibiae and pala separated. Mid tibiae shorter than tarsus. Males are usually with strigil in sixth tergite. Male right paramere basally usually with a field of ridges which helps in stridulation.

#### *Micronecta ludibunda* Breddin, 1905: Image 11. a–h and Image 12.i–l

1934. *Micronecta inconspicua* Lundblad, Archiv für Hydrobiologie - Supplement, 12: 65

1934. *Micronecta striatella* Lundblad, Archiv für Hydrobiologie - Supplement, 12: 98

1934. *Micronecta ludibunda* Breddin: Lundblad,

Archiv für Hydrobiologie - Supplement, 12: 95

**Material examined:** Regn.no.4768/H15, 1 male, 3 females, 17.iii.2012, wetland within Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

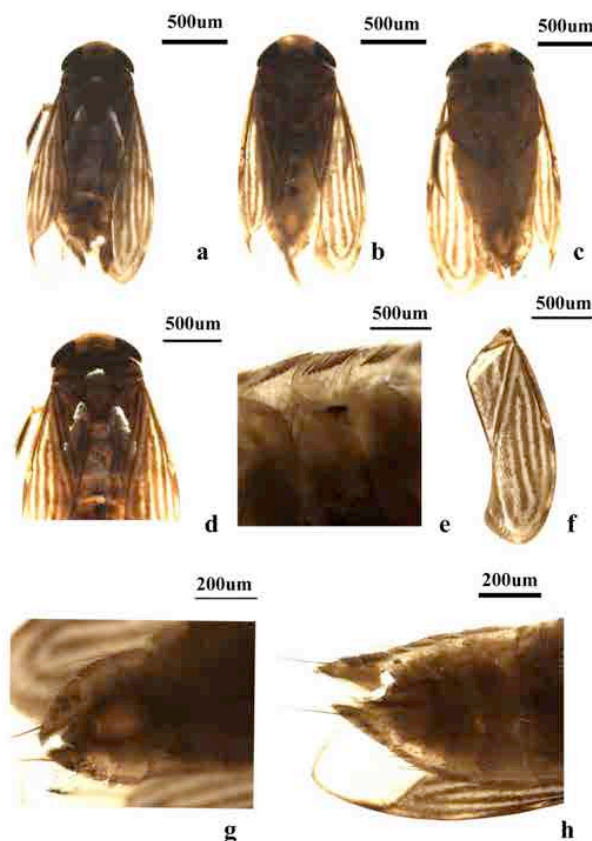


Image 11. a–h. *Micronecta ludibunda* Breddin, 1905. a. Dorsal view of male; b. Dorsal view of female; c. Ventral view of male; d. Head, pronotum and scutellum; e. Strigil of male; f. Wings marking pattern; g. Male genital segment, ventral view; h. Female genital segment, ventral view

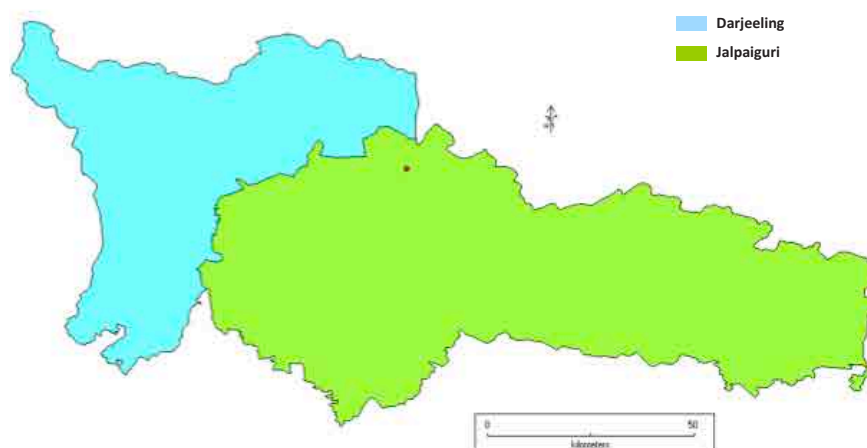


Figure 10. Distribution of *M. ludibunda* Breddin in the study area

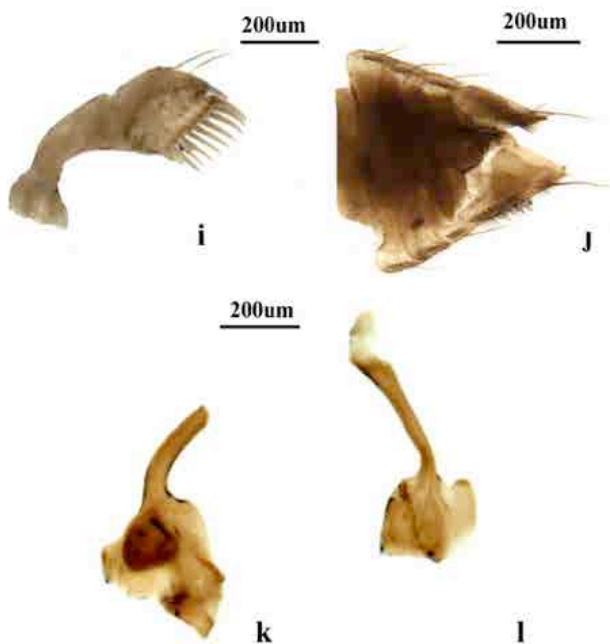


Image 12. i–l. *Micronecta ludibunda* Breddin, 1905. i. Pala of male; j. Genital capsule of male; k. Male left paramere; l. Male right paramere

**Morphology:** Size: In macropterous male, body length ranges from 1.9–2.2 mm and in macropterous females from 2.14–2.19 mm.

**Description:** A medium-sized dark brown coloured species with distinct stripes on the hemelytra. Length of head 0.13mm and interocular width 0.37mm. Eye 3.5 times longer than broad ( $L/W=0.32/0.09$ ). Head blunt at apex, light brown anteriorly. Pronotum with a pair of open, somewhat roundish patches. Length of pronotum 0.301mm, width 0.831mm. Lateral margins of hemelytra with five brown patches of which the basal two patches are often connected. Length of scutellum

0.29mm and width 0.45mm. Wings 2.04mm in length with distinct dark continuous stripes. Pala of male with distinct modifications as in Image 12i.

**Genitalia:** Male genital segments asymmetrical, 0.56mm in length and 0.57mm in width, hairy allthrough. Males are with strigil on sixth abdominal tergites. Male parameres as in Image 12k & l. Female genital segment is symmetrical, broad (Image 1g).

**Global distribution:** India, Sri Lanka, Southeast Asia, Indonesia, New Guinea, Solomon Islands (Wroblewski 1968), Malaysia, and Singapore.

**Distribution in India:** Assam and West Bengal.

**Habitat:** Freshwater ecosystems like ponds, lakes and forested pools.

**Remarks:** This species is a new record from West Bengal. A very widespread species found throughout the world. The hemelytral pattern is sufficient to separate this species from others.

#### ***Micronecta desertana desertana* Distant, 1920: Image 13.a–i**

1920. *Micronecta desertana* Distant, *Records of the Indian Museum*, 18: 206.

1940. *M. (Dichaetonecta) desertana dravida* Hutchinson, *Transactions of the Connecticut Academy of Arts and Sciences*, 33: 392.

1940. *M. (D.) desertana concanensis* Hutchinson, *Transactions of the Connecticut Academy of Arts and Sciences*, 33: 390.

**Material examined:** Regn.No. 3692/H15, 2males, 7females, 17.iii.2013, Kalikhola, border between Gorumara and Chapramari Forests, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male ranges from 2.54–2.8 mm. In female, body length ranges from 2.7–

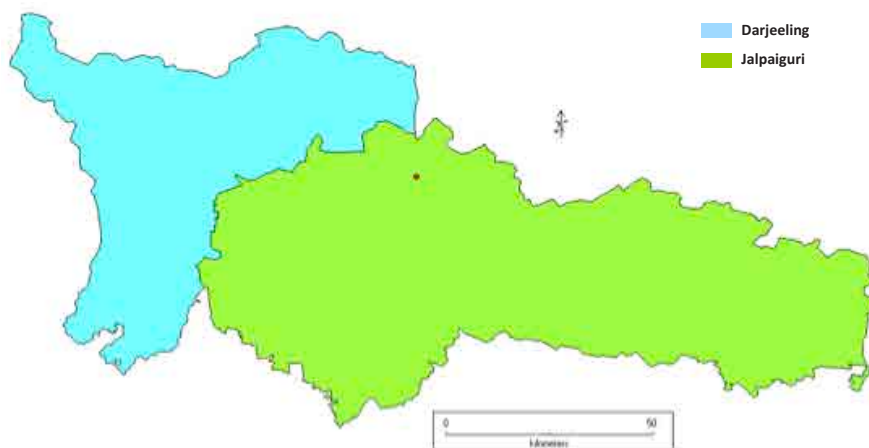


Figure 11. Distribution of *M. desertana desertana* Distant in the study area



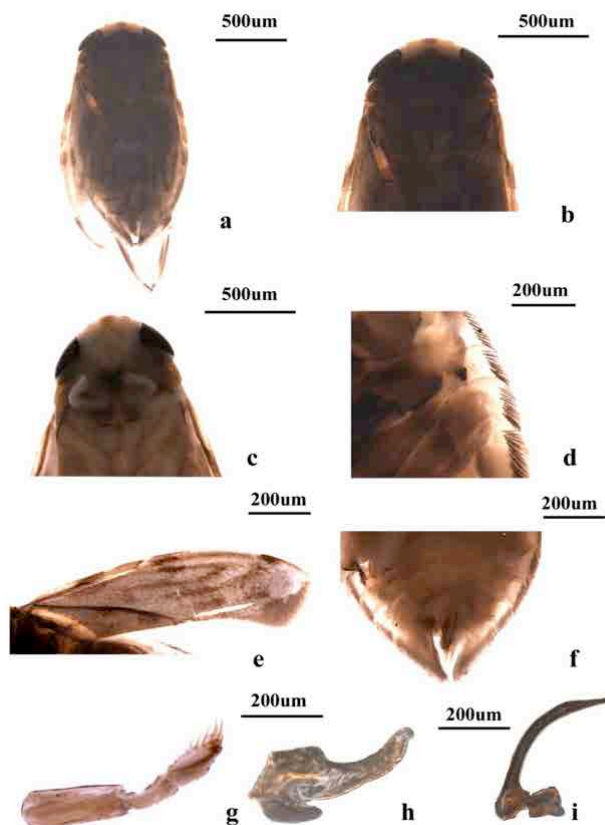


Image 13. a-i. *Micronecta desertana desertana* Distant, 192a. a. Dorsal view of male; b. Head and pronotum; c. Labium and ventral view of head; d. Strigil of male; e. Wings marking pattern; f. Male genital segment; g. Pala of male; h. Male left paramere; i. Male right paramere

2.93 mm. Maximum body width of male is 1.34mm and that of female is 1.31mm.

**Description:** Head pale yellow, with an obscure central elongate orange spot on the anterior part of vertex. A pair of orange clouded spots nears the eyes. Pronotum grayish-brown with its margin yellowish. Base of clavus grayish, corium light brown with three very obscure fragmented dark brown longitudinal stripes continued upto the right membrane. Legs pale yellow with apex of tarsus slightly darkened Venter pale yellow. Head 2.4 times as long as wide ( $L/W=0.95/0.4$ ). Interocular width 3.4 times wider than eye width ( $IW/EW=0.41/0.12$ ). Eye length 0.32mm. Length of pronotum 0.33mm and width 0.90mm. Pronotum 2.3 times wider than head. Scutellum as long as wide (0.28mm). Pronotal disc is very finely granulose, anterior margin evenly convex, posterior margin convex but, rather flat centrally. Male fore femur with a single long basal hair on its inner margin, a row of four spines just within the inner margin. Mid femora longer than mid tibiae. Abdominal segments (4th to 8th) 1.04mm in

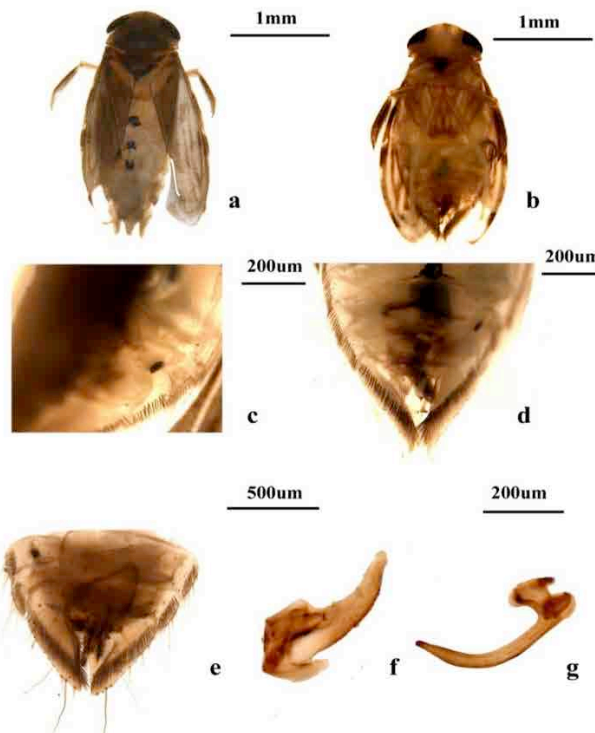


Image 14. a-g. *Micronecta scutellaris scutellaris* (Stal, 1858). a. Dorsal view of male; b. Ventral view of male; c. Strigil of male; d. Male genital segment; e. Genital capsule of male; f. Left paramere of male; g. Right paramere of male

length and 1.16mm in width.

**Genitalia:** Seventh segment wide and simply lobed on right side. Free lobe of eighth tergite well-developed, rectangular. Right paramere arcuate and rather wide, with a slightly button-like apex (Image 13i). Left paramere wide basally, narrows towards the apex (Image 13h).

**Global distribution:** India, Iran, United Arab Emirates, and Oriental Region.

**Distribution in India:** Assam, Karnataka, Maharashtra, Punjab, and Tamil Nadu.

**Habitat:** Pools and streams.

**Remarks:** This species is a new report to West Bengal. It can be distinguished from the other species by the shape of the male paramere and by the pala.

***Micronecta scutellaris scutellaris* (Stal, 1858): Image 14.a-g**

1858. *Sigara scutellaris* Stal, *Öfversigt af Svenska Vetenskaps-Akad: s förhandlingar*, 15: 319.

1908. *Micronecta malabarica* Kirkaldy, *Canadian Entomologist*, 40: 209.

1910a. *Micronecta dione* Distant, *Fauna of British India*, 5: 348.

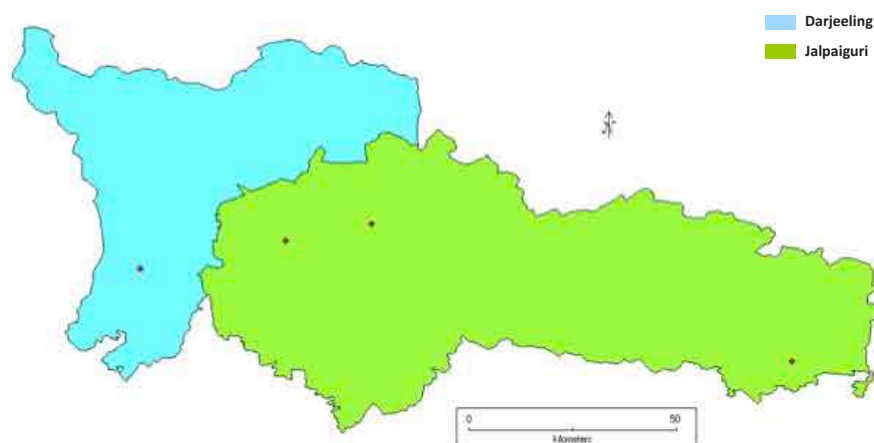


Figure 12. Distribution of *M. scutellaris scutellaris* (Stal) in the study area

1959. *Micronecta proba* Distant: Baid, *Journal of Bombay Natural History Society*, 56: 362.

**Material examined:** Regn. No. 3168/H15, 3males, 8females, 4.x.2013, jhora beside Kiranchandra Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 9males, 1nymph, 17.ix.2011, pond near Baradighi, Malbazar, Jalpaiguri District, West Bengal, coll. S. Basu; 1male, 3females, 19.iv.2013, Raidhak River, Alipurduar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 3males, 7females, 12.iii.2011, wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Males attain a length of 3.6–4.0mm and females reach upto 4.2–4.4mm.

**Description:** Large, elongate and grayish brown in colour. Head more or less projected forward, bluntly acuminate. Hemelytra with dark longitudinal stripes which may vary from distinct unbroken stripes to broken stripes. Four brown patches present on the lateral margins of hemelytra, which may also vary among individuals.

**Genitalia:** Male genitalia asymmetrical. Male left and right paramere as in Image 14f & g. Right paramere little longer than the left and acutely curved.

**Global distribution:** Africa, Arabia, India, Sri Lanka, Southeast Asia, China, Malaysia, Johor, Melaka, and Singapore.

**Distribution in India:** Andhra Pradesh, Assam, Bihar, Chandigarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Ponds, pools, water tanks, and agricultural fields.

**Remarks:** This is the largest species of *Micronecta*

and is very widespread in India and other countries.

***Micronecta haliploides* Horvath, 1904: Image 15. a–k**

1905. *Micronecta inflatula* Breddin, *Societas Entomologica*, 20: 57.

1905. *Micronecta pardalina* Breddin, *Societas Entomologica*, 20: 57.

1910a. *Micronecta merope* Distant, *Fauna of British India*, 5: 351.

1960. *Micronecta punctata* Fieber: Chen, *Journal of the Kansas Entomological Society*, 33: 117.

1983. *Micronecta merope* Distant, Bisht and Das, *Proceedings of Workshop on High Altitude Entomology and Wildlife Ecology. Zoological Survey of India*, 2.

**Material examined:** Regn.no.4614/H15, 3males, 4females, 16.ix.2011, Ghoshpukur Dighi, Kamala Bagan, Darjeeling District, West Bengal, India, coll. S. Basu; 1male, 18.iii.2013, Mujnai River, Madarihat, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 2.31–2.9 mm, maximum body width 0.92mm. Female body length 2.83–3.3 mm, maximum width 0.99mm.

**Description:** A large, elongated oval species. Pale in color with well-marked small black spots on yellowish hemelytra. Head length 0.35mm and width 0.53mm. Interocular width 1.9 times as wide as eye width ( $IW/EW=0.43/0.23$ ). Eye length 1.5 times longer than width ( $L/W=0.35/0.23$ ). Pronotum 1.5 times as wide as head width. Width of pronotum 0.79mm. Lateral pronotal margins obsolete. Yellowish hemelytra marked with distinct dark dots. Pronotum transverse and narrow, lateral margins very short. Lateral margins of elytra moderately convexly rounded. Abdominal segments are dark brown or black. Strigil present in male. Two bristles present on sixth sternite.

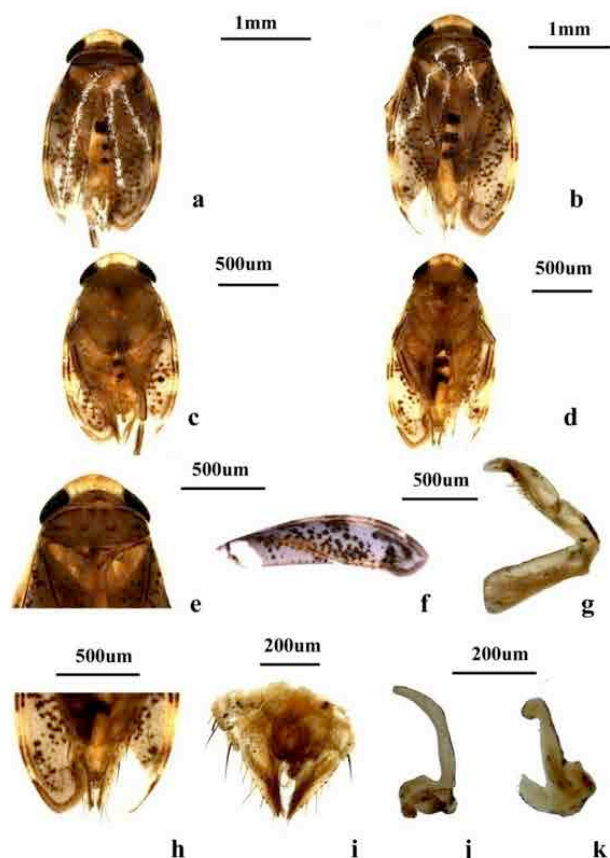


Image 15. a–k. *Micronecta haliploides* Horvath, 1904. a. Dorsal view of male; b. Dorsal view of female; c. Ventral view of male; d. Ventral view of female; e. Head and pronotum of male; f. Wings marking pattern; g. Pala of male; h. Female genital segment; i. Male genital segment; j. Right paramere of male; k. Left paramere of male

Sumatra, Java, Bali, Singapore, Thailand, Johor, Melaka, Sembilan, and Penang.

**Distribution in India:** Arunachal Pradesh, Assam, Bihar, Kerala, Madhya Pradesh, Manipur, Meghalaya, Odisha, Tripura, Uttar Pradesh, and West Bengal.

**Habitat:** Ponds, stagnant pools, and water tanks.

**Remarks:** A widespread species. This species is attracted to light and can be caught in light trap.

***Micronecta khasiensis* Hutchinson, 1940: Image 16. a–h**

1940. *Micronecta (Mesonecta) khasiensis* Hutchinson, *Transactions of the Connecticut Academy of Arts and Sciences*, 33: 396.

**Material examined:** Regn. no. 4636/H15, 1female, 6.iii.2011, Jayanti River, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Macropterous males attain a length of 2.5–2.70mm and the female body ranges 2.4–2.82 mm long. Maximum body width 1.43mm.

**Description:** Dark yellowish orange to brown. Head dull yellow, with dull orange stripe on frons and of two obscure orange spots near the inner margins of the eyes, short, anterior margin very evenly rounded. Length of head 0.23mm and width in front of eyes 0.51mm. Eye length 0.34mm and width 0.11mm. Interocular width 0.43mm. Pronotum dark brown, slightly wider than head, lateral margins narrowly dark brown anteriorly.

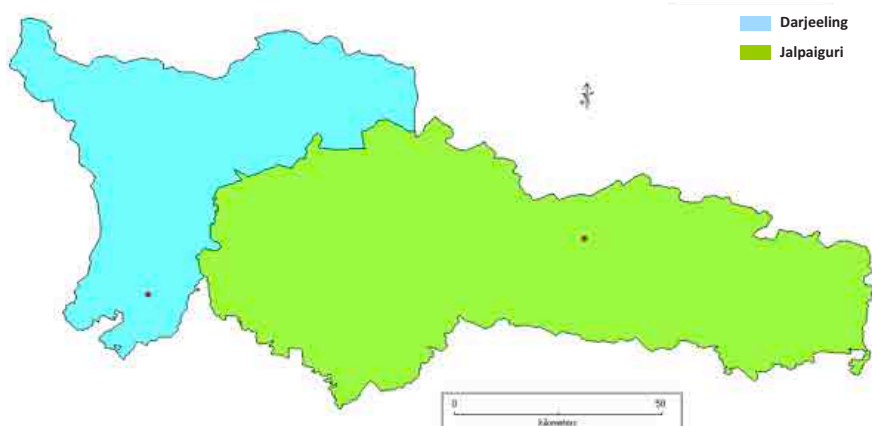


Figure 13. Distribution of *M. haliploides* Horvath in the study area

**Genitalia:** Males are with a row of hairs on the right part of eighth segment. This row is absent in the left part of eighth segment bearing the free lobe. Male right and left paramere as in Image 15j & k respectively.

**Global distribution:** India, Sri Lanka, Southeast Asia,

Scutellum brown, elytra with basal area of clavus yellowish brown. Corium grayish brown. Legs brownish yellow. In macropterous forms, elytra with sparse pale pubescence.

**Genitalia:** Female genital segment (Image 16g & h) is

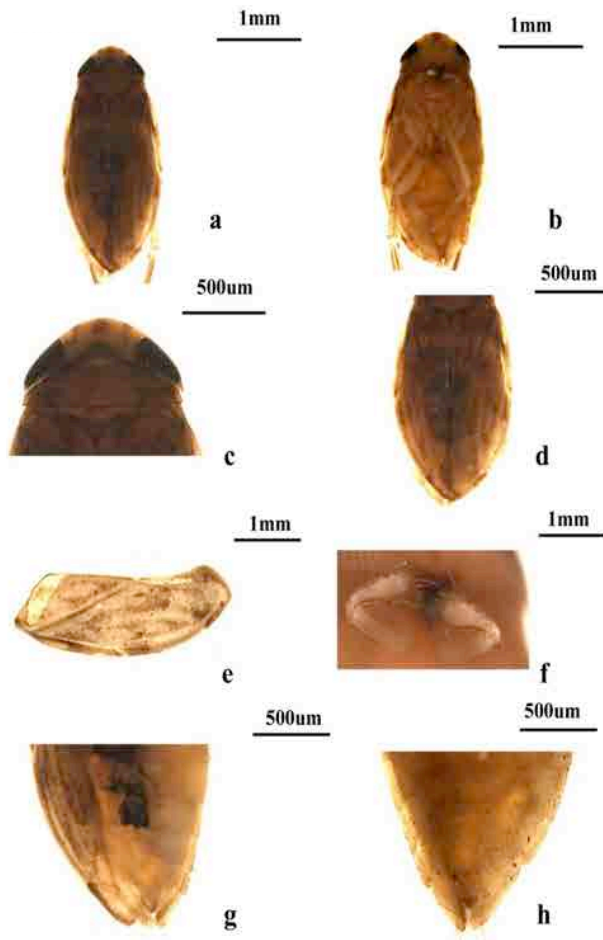


Image 16. a–h. *Micronecta khasiensis* Hutchinson, 1940. a. Dorsal view of female; b. Ventral view of female; c. Head and pronotum; d. Scutellum; e. Wings marking pattern; f. Fore leg of female; g. Female genital segment, dorsal view; h. Female genital segment, ventral view

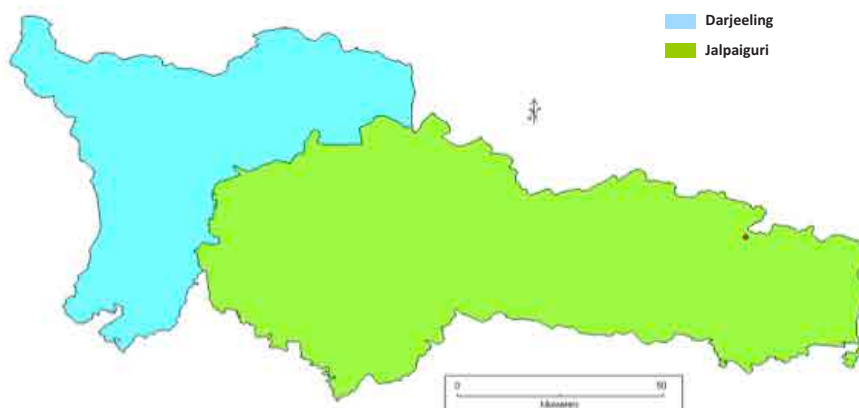


Figure 14. Distribution of *M. khasiensis* Hutchinson in the study area

symmetrical. Length of female genital segment 0.54mm and width 0.50mm.

**Global distribution:** India and Vietnam.

**Distribution in India:** Assam, Meghalaya, and West

Bengal.

**Habitat:** Stagnant pools between rocks.

**Remarks:** It is a smaller species. According to Hutchinson (1940), they have some peculiar feeding habits as compared to other species.

***Micronecta quadristrigata* Breddin, 1905: Image 17.a–k**

1959. *Micronecta minthe* Distant: Tonapi, *Proceedings of the National Institute of Sciences, India*, 25: 326.

**Material examined:** Regn no. 3166/H15, 2 males, 3 females, 12.iii.2011, wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male ranges from 2.6–2.91 mm, maximum width of body of male 1.21mm; female attains a length of 2.8–3.3 mm, maximum width of body of female 1.12mm.

**Description:** Light brown elongated species. Head length 0.27mm and width 0.67mm. Interocular width 0.38mm. Head pale yellow with one light reddish longitudinal line on vertex. Eye length 0.41mm and width 0.14mm. Pronotum brownish, length 0.95mm and width 0.36mm. Hemelytra with broken longitudinal stripes that is rarely absent. Lateral margins of hemelytra with four dark patches of which basal patch is the largest and elongated. Males with strigil on the left and the free lobe of eighth tergite on the right side. Length of wings 2.28mm. Male pala is distinct as in Image 16e.

**Genitalia:** Male genital segment is asymmetrical. The free lobe of eighth tergite sigmoid in shape at left part (Image 16j). Male right and left paramere as in Image 1 & k.



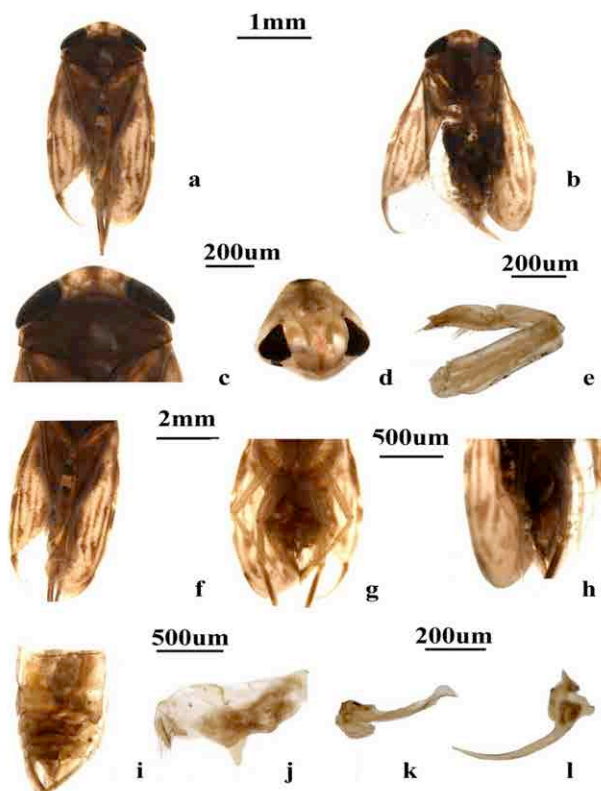


Image 17. a–l. *Micronecta quadristrigata* Breddin, 1905. a. Dorsal view of male; b. Dorsal view of female; c. Head and pronotum of male; d. Labium of male; e. Pala of male; f. Wings of male; g. Male genital segment, ventral view; h. Female genital segment, ventral view; i. Male genital capsule; j. Free lobe of eighth segment of male; k. Left paramere of male; l. Right paramere of male

Rajasthan, Tamilnadu, and West Bengal.

**Habitat:** Stagnant pools and ponds, irrigation canals in agricultural fields.

**Remarks:** A widespread species. Very common and found abundantly in light trap.

#### Family Naucoridae Leach, 1815

Oval, flattened bugs with raptorial forelegs. The size varies from 2–15mm, and the colour from brownish to blackish, often marked with yellow or green. The members of this family are easily identifiable by three-segmented simple concealed antenna, absence of ocelli, three-segmented rostrum and with a distinct claw at hind tarsi. The respiratory tube is absent.

#### Genus *Heleocoris* Stal, 1876

**Diagnosis:** Body oval, elongated. Eyes with an external process between outer margin and the anterior angle of the pronotum. Eyes subparallel and anteriorly convergent. Disk of the pronotum regularly and uniformly convex, connexivum posteriorly visible, the corium a little obliquely narrowed from above middle to apex, membrane small. Fore tarsus with two claws. Males have two segments whereas females have only one. Male phallotheca is asymmetrical. Male paramere is greatly reduced. The female subgenital plate is roughly trapezoidal.

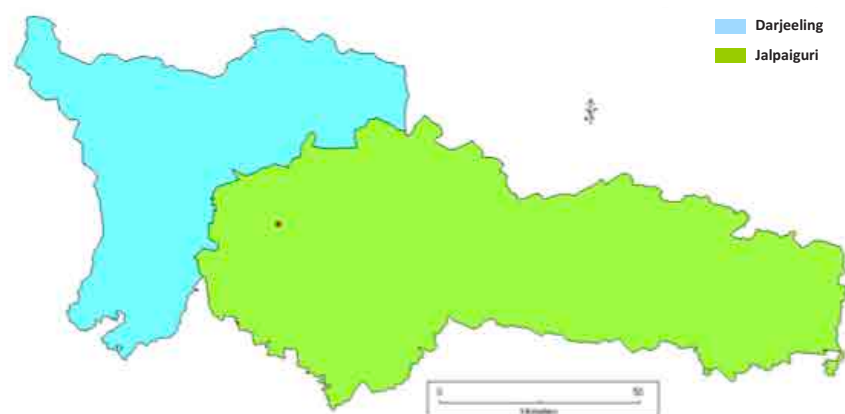


Figure 15. Distribution of *M. quadristrigata* Breddin in the study area

**Global distribution:** India, Sri Lanka, Southeast Asia, Hong Kong, Taiwan, Indonesia, Philippines, Australia, Malaysia, and Singapore.

**Distribution in India:** Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab,

*Heleocoris bengalensis bengalensis* Montandon, 1910: Image 18. a–j

1910. *Heleocoris bengalensis* Montandon, *Bulletin de la Société des sciences de Bucarest*, 19: 653.

**Material examined:** Regn.no. 4752/H15, 2males, 4females, 17.iii.2012, Dhupjhora, Gachbari, Murti

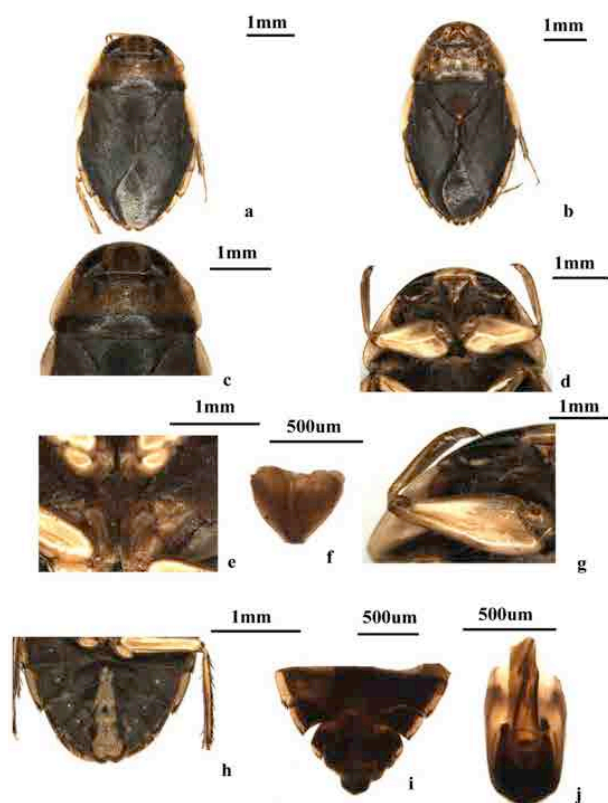


Image 18. a–j. *Heleocoris bengalensis bengalensis* Montandon, 1910. a. Dorsal view of male; b. Dorsal view of female; c. Head and pronotum; d. Rostrum and prosternum of male; e. Metasternum; f. Metaxyphus; g. Male fore leg; h. Male genital segment, ventral view; i. Dorsal view of dissected genital segment; j. Male genital capsule

**Morphology:** Size: Male body length 9.5–9.6 mm, maximum body width 6.11mm. Female body length 9.8–9.92 mm, maximum body width 6.4mm.

**Description:** Body ovate, elongated, narrower than wide. Venter dark brown. Head and pronotum dull yellowish brown spotted and maculated with dark brown or black markings. Head length not twice as broad at base between eyes. Head length 0.97mm. Length of rostrum 1.53mm. Interocular width 1.67mm. Length of eye 1.25mm and width 0.66mm. Scutellum uniformly dark brown, with tip light brown. Length of scutellum 1.98mm and width 2.91mm. Hemelytra dark brown, rugulose, except anterolateral half of embolium translucent yellow, wing membrane black, poorly defined and venation obscure. Pronotum wider than long. Metaxyphus typical for the species as in Image 18e & f. Abdominal laterotergites pale yellow. Abdomen 4.41mm in length and 5.45mm in width across fourth abdominal segment. Fore femora of male longer than wide, length 2.2mm and width 1.05mm. Mid tibia of male with numerous spines arranged on outer margin.

**Genitalia:** Male genital segment 1.23mm in length and 2.22mm in width, asymmetrical, covered with golden long hairs uniformly. Male pygophore broad, ovate in appearance (Image 18j). Female sub-genital plate wider than long, bipartite at base.

**Global distribution:** India, Southeast Asia, Great

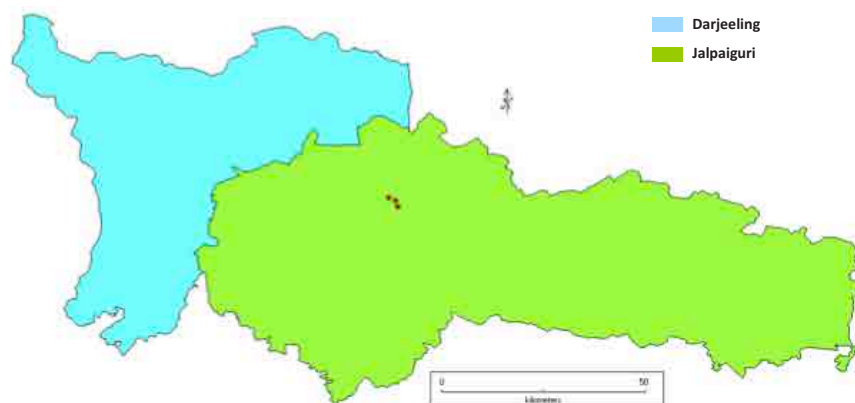


Figure 16. Distribution of *H. bengalensis bengalensis* Montandon in the study area

River, Jalpaiguri District, West Bengal, India, coll. S. Basu; 11males, 13females, 6nymphs, 17.iii.2012, Dhupjhora, Murti River, within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1female, 1nymph, 17.iii.2012, Murti River, Medla Camp, Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

Sunda Islands, Sumatra, Java, and Sri Lanka.

**Distribution in India:** Madhya Pradesh, Uttar Pradesh, and West Bengal.

**Habitat:** Small streams and riffles.

**Remarks:** *Heleocoris bengalensis* was described by Montandon (1910) and the type locality is Manbhum district of West Bengal. The status of species concepts in the *H. bengalensis* is complex and is an issue that

requires further detailed study.

#### Family Nepidae Latreille, 1802

Body dorso-ventrally flattened or cylindrical (size ranges from 15–55mm) with long and slender legs, the anterior pair being raptorial. These bugs are characterised by single-segmented tarsi and by the absence of ocelli. The long slender, non-retractile respiratory siphon is derived from the 8<sup>th</sup> abdominal tergum and has two spiracles at its base.

#### Subfamily Nepinae Latreille, 1802

##### Genus *Laccotrephes* Stal

**Diagnosis:** Body long, dorsoventrally flattened and broad. Generally, brown or grey in colour. Head distinctly narrower than pronotum and partly enclosed in the anterolateral pronotal angles. Compound eyes prominently spherical, black, with rounded margin, eye width less than interocular width. Antennae three segmented, outer margin with numerous setae. Respiratory siphon long, vary in species, may or may not be longer than the body length. Fore leg raptorial with broad femora and sharp claws. Scutellum well-developed and wider than long. Fore wings with distinct clavus, corium and membrane, the membrane with distinct venation. Prosternum with a distinct keel.

#### *Laccotrephes griseus* (Guerin-Meneville, 1844): Image 19. a–f

1844. *Nepa griseus* Guérin-Meneville, *Iconographie due Regne Animal de G. Cuvier*, 352.

**Material examined:** Regn.no.3167/H15, 2males, 2females, 17.iv.2013, Dima River, Damanpur Forest, Alipurduar District, West Bengal, India, coll. S. Basu; 2males, 9.iii.2011, Murti River, Chalsa, Jalpaiguri District,

West Bengal, India, coll. S. Basu; 1female, 9.iii.2011, Murti River, in front of Murti Banani Bungalow, Jalpaiguri District, West Bengal, India, coll. S. Basu; 6males, 6females, 19.iv.2013, Poro River, Poro Beat, Chilapata Forest Range, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of

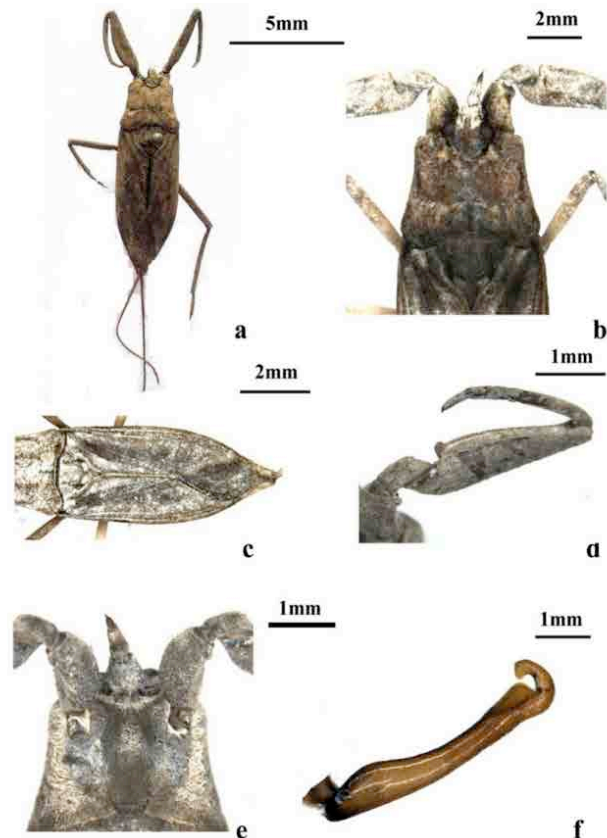


Image 19. a–f. *Laccotrephes griseus* (Guerin-Meneville, 1844). a. Dorsal view of male; b. Head, pronotum and scutellum; c. Abdominal tergites and wings; d. Male fore leg; e. Prosternum of male; f. Male paramere

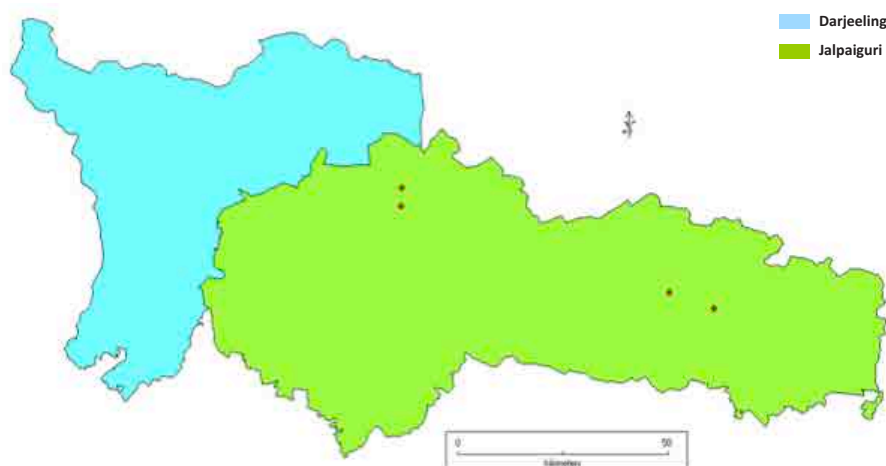


Figure 17. Distribution of *L. griseus* (Guerin-Meneville) in the study area

India, Kolkata.

**Morphology:** Size: Male body length generally ranges between 16.7–19.2mm. Female may attain a size of 18.3–20mm. Respiratory siphon always shorter than body, length 12.9–14.5 mm.

Description: Smaller in size relative to other species. Head triangular, tapering anteriorly, 1.6 times as long as wide ( $L/W=1.8/1.1$ ). Eyes oval, small, length 0.63mm. Interocular width 1.95 times wider than eye width ( $IW/EW=0.94/0.48$ ). Rostrum 1.36 times in length, stout, thick. Clypeus well-differentiated. Antennae hidden, three-segmented, with stout hairs. Pronotum distinct, almost rectangular. Length of pronotum 2.49mm and width 4.33mm. A transverse suture just above the posterior margin. Scutellum triangular, tapering posteriorly. Prosternum strongly acute along median line. Abdomen flattened, 2.2 times longer than wide ( $L/W=12.7/5.7$ ). Base of sixth abdominal sternites with small tuft of hairs covering the sub-genital plate proximally. Hemelytra parallel, thick, membrane thin with numerous reticulate veins. Abdomen beneath wings bluish in colour. Fore femora 3.66mm in length and 1.21mm in width in male, with obtusely rounded tooth at base.

Genitalia: Male genital capsule anteriorly shallow, posteriorly broad. Parameres (Image 19f) symmetrical, slightly hooked and articulated in anterior region. Female genitalia triangular and armatured, two pairs of plate like structures forming slender ovipositor.

**Global distribution:** Malaysia, Myanmar, Seychelles, Sri Lanka, Japan, and Thailand.

**Distribution in India:** Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Gujarat, Madhya Pradesh, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Tripura, West Bengal, and Uttar Pradesh.

**Habitat:** Ponds, lakes, stagnant pools, streams, and rivers.

**Remarks:** This species is cosmopolitan in distribution. It is a very sluggish species often found under weeds or at the bottom of slow or stagnant water or edges of water bodies. This species possesses sexual dimorphism.

#### Subfamily Ranatrinae Douglas & Scott, 1865

#### Genus *Cercotmetus* Amyot & Serville, 1843

**Diagnosis:** Body elongated, sub-cylindrical with a posterior respiratory siphon, which is usually shorter than the body length. Eyes large, outer margins reflexed downwards. Head with a prominent

clypeus. Vertex raised above the eyes. Antenna three segmented, lie in ventral depressions beneath the eyes. Prothorax dorsally divided into two lobes by a transverse groove. Anterior lobe much longer than the posterior lobe. Humeral width always greater than anterior width. Scutellum small, triangular. Clavus and corium coriaceous. Membrane with many small veins. Abdominal tergites flat. Metasternum posteriorly emerginated. First abdominal sternite not visible, third to sixth sternite longitudinally carinate, seventh sternite with operculum. Fore femora irregularly annulated with light and dark brown colour, with one tooth about mid-way ventrally. Mid femora shorter than hind femora. All tarsi one-segmented.

#### *Cercotmetus pilipes* (Dallas, 1850): Image 20. a–i and Image 21. j–p

1850. *Ranatra* (*Cercotmetus*) *pilipes* Dallas, *Transactions of the Royal Entomological Society of London*, 1: 9.

**Material examined:** Regn.no. 2950/H15, 2males, 17.ix.2011, pond near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length ranging from 40–41mm. Respiratory siphon 10–11 mm in length.

Description: Luteous in colour. Respiratory siphon around four times shorter than the body. Body covered with small hairs. Eyes large, prominent, globular. Head with a prominent tubercle on the vertex. Head length 1.95mm and width 1.26mm. Eyes 1.1 times wider than long ( $W/L=0.96/0.85$ ). Rostrum 2.43mm in length. Antenna 0.63mm in length. Thorax 8.91mm in length and 1.72mm in width. Forewing not reaching the abdominal apex. Abdomen 21.7mm in length and 2.89mm in width. Fore femora (Image 20h) shorter than the pronotum. Mid, hind tibiae and tarsae with spines and long yellow hairs arranged in double rows.

Genitalia: Male genital segment 3mm in length and 1.6mm in width. Male parameres (Image 21o & p) symmetrical, stout, bulged medially, narrowed apically and bifurcated.

**Global distribution:** India and Bhutan.

**Distribution in India:** Delhi, Karnataka, and Kerala.

**Habitat:** Fish ponds and lakes.

**Remarks:** The *Cercotmetus* Amyot & Serville is almost similar to *Ranatra* Fabricius, but can be distinguished by the presence of short and stout respiratory appendages. They are predatory in nature and feed on freshwater shrimps.



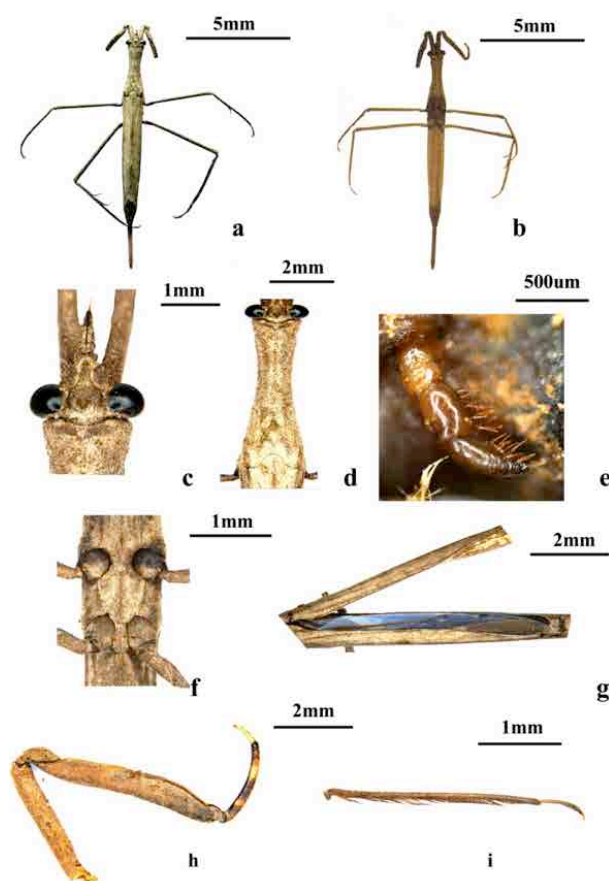


Image 20. a–i. *Cercotmetus pilipes* (Dallas, 1850). a. Dorsal view of male; b. Ventral view of male; c. Head of male; d. Pronotum of male; e. Antennae; f. Metasternal keel; g. Colour pattern of underside of wings; h. Fore leg of male; i. Hind tibia and tarsus of male

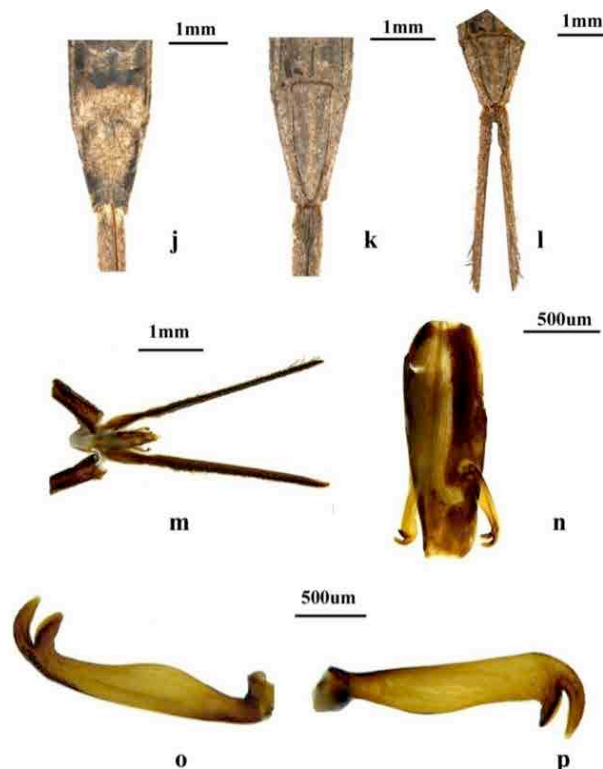


Image 21. j–p. *Cercotmetus pilipes* (Dallas, 1850). j. Dorsal view of male genital segment; k. Ventral view of male genital segment; l. Respiratory appendages; m. Male genital capsule with anal appendages; n. Male genital capsule with both paramere; o. Male paramere; p. Opposite view of male paramere

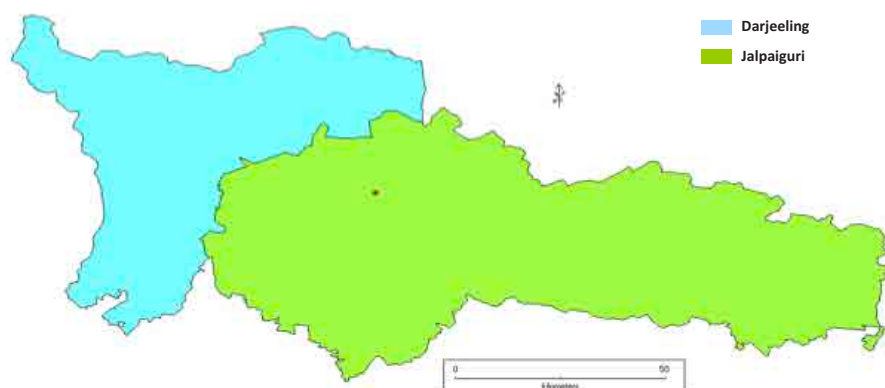


Figure 18. Distribution of *C. pilipes* (Dallas) in the study area

### Genus *Ranatra* Fabricius, 1790

**Diagnosis:** Body elongated, sub-cylindrical, with a pair of posterior respiratory siphons. Head either with a prominent tubercle between eyes or only slightly rose between eyes. Eyes large and globular. Antennae concealed beneath head, not visible from above, three-

segmented, second and third segment with numerous spines. Prothorax distally divided into two lobes by a transverse groove. Anterior lobe always longer than the posterior lobe, the posterior margin of posterior lobe always deeply emerginate. Ventrally, prosternum with a median longitudinal keel. Metasternum with a distinct modification or keel. Wing membrane small with many

irregular veins. Abdominal tergites elongated, flat. First abdominal sternite not visible, 3<sup>rd</sup> to 6<sup>th</sup> sternites longitudinally carinate. 7<sup>th</sup> sternum with an operculum or sub-genital plate. Fore femora with either one or two ventral projections about midway. All tarsi one segmented. Male genitalia enclosed in a long sclerotised capsule.

***Ranatra varipes varipes* Stal: Image 22. a–j**

**Materials examined:** Regn.no.4639/H15, 1 male, 16.ix.2011, Ghoshpukur Dighi, Kamala Baga, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 16.iii.2013, Murti River, in front of Murti Banani Bungalow, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 2 females, 1 nymph, 3.x.2013, pond at Mainaguri, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 19.iii.2012, Teesta Canal near Odlabari, Jalpaiguri District, West Bengal, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length ranges between 19–22mm. Respiratory siphon always shorter than the body, length of respiratory siphon 14–16 mm.

Description: Head length 0.48mm, 1.3 times longer than interocular width (0.35mm). Eye length 0.30mm and width 0.34mm. Vertex rounded between eyes. Pronotum 3.1 times longer than the width (length/width: 1.4/ 0.45). Posterior lobe of pronotum sparsely punctate, smaller than the darker anterior lobe

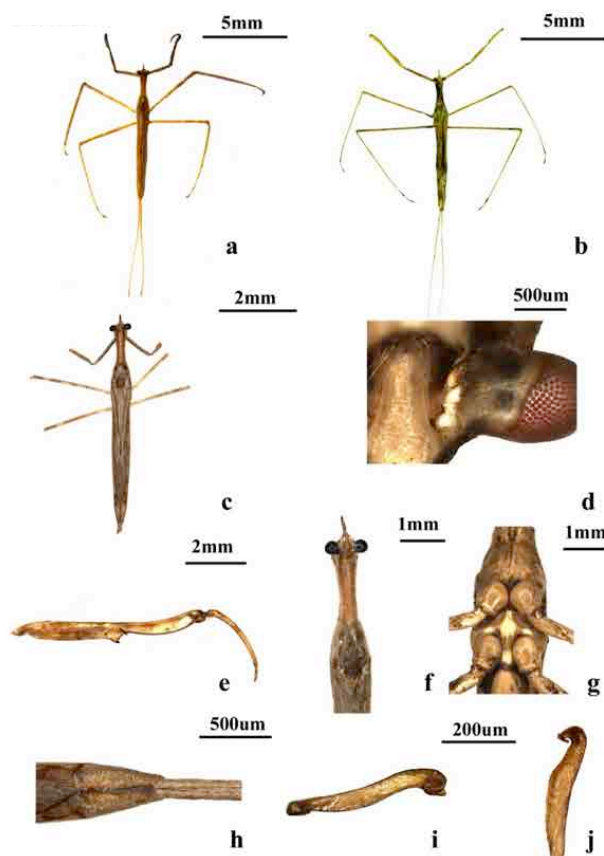


Image 22. a–j. *Ranatra varipes varipes* Stal, 1861. a. Dorsal view of male; b. Dorsal view of female; c. Full body of male; d. Antennae; e. Fore femur of male; f. Male head and pronotum; g. Metasternal keel; h. Male genital segment, dorsal view; i–j. Male paramere, two different views

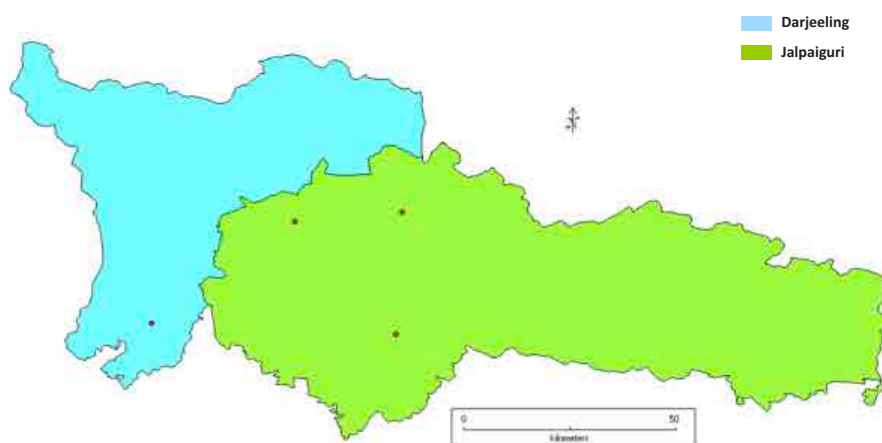


Figure 19. Distribution of *R. varipes varipes* Stal in the study area

of pronotum. Antennal segments with many stout spines, distributed mainly in second and third antennal segments. Respective length of antennal segments 1–3: 0.06mm, 0.02mm, 0.14mm. Metasternum with a prominent median keel (Image 22g), almost flat. Wing length 5.46mm, almost covering the abdomen.

Mesosternum rounded and with a V-shaped cleft between mesocoxa. Fore femora (Image 22e) 2.84mm in length and 0.20mm in width. Hind femora in both sexes reaching beyond posterior margin of sternite VI.

Genitalia: Male genital segment 0.85mm in length and 0.56mm in width, with scattered prominent black

punctures. Male parameres hatchet shaped distally as in Image 22i & j, operculum slightly shorter than conexivum with its sixth sternite distally expanded.

**Global distribution:** India, Australia, Indonesia, Malaysia, Myanmar, Taiwan, Sri Lanka, and Thailand.

**Distribution in India:** Bihar, Maharashtra, Manipur, Meghalaya, Odisha, Pondicherry, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Fish ponds, lakes, and small streams with aquatic vegetation.

**Remarks:** This species is cosmopolitan in distribution. *Ranatra varipes varipes* Stal mostly found among aquatic vegetation fringing the shallower parts of water bodies. These bugs are predatory in nature. *R. varipes varipes* Stal is closely related to *R. varipes atrophpha* Montandon. It can be distinguished mainly by the male paramere structure and shape of metasternal keel and antennal setation.

***Ranatra varipes atrophpha* Montandon, 1903: Image 23. a–h**

1903. *Ranatra atrophpha* Montandon, *Bulletin de la Société des sciences de Bucarest, Roumanie*, 12: 105.

1972. *R. varipes* var. *atrophpha* Mayr: Lansbury, *Transactions of the Royal Entomological Society of London*, 124: 317.

**Materials examined:** Regn.no.3177/H15, 2females, 16.ix.2011, Bhimbar dighi besides Sayedabad Tea Estate, Darjeeling District, West Bengal, India, coll. S. Basu, in

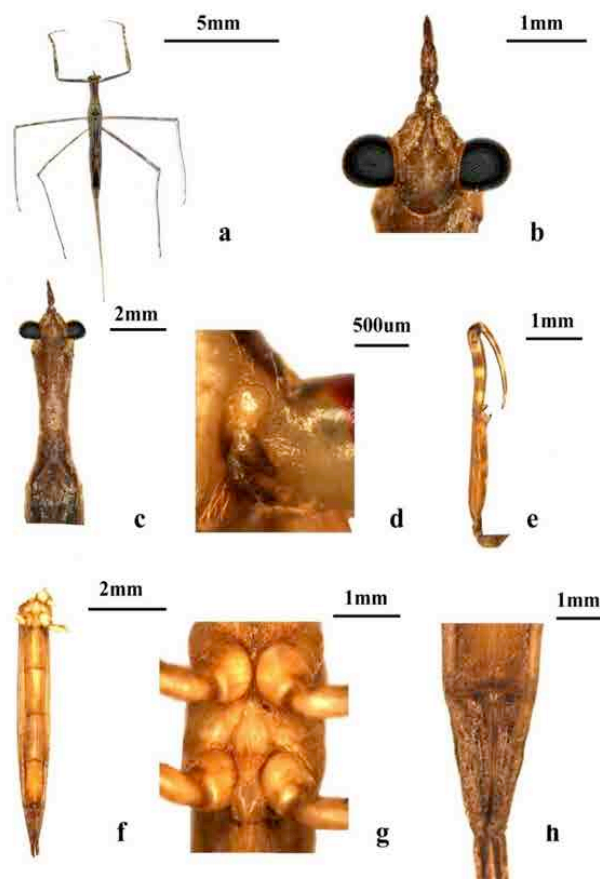


Image 23. a–h. *Ranatra varipes atrophpha* Montandon, 1903. a. Dorsal view of female; b. Head, dorsal view; c. Pronotum; d. Antennae; e. Fore femur of female; f. Abdominal sternites of female; g. Metasternal keel; h. Female genital segment

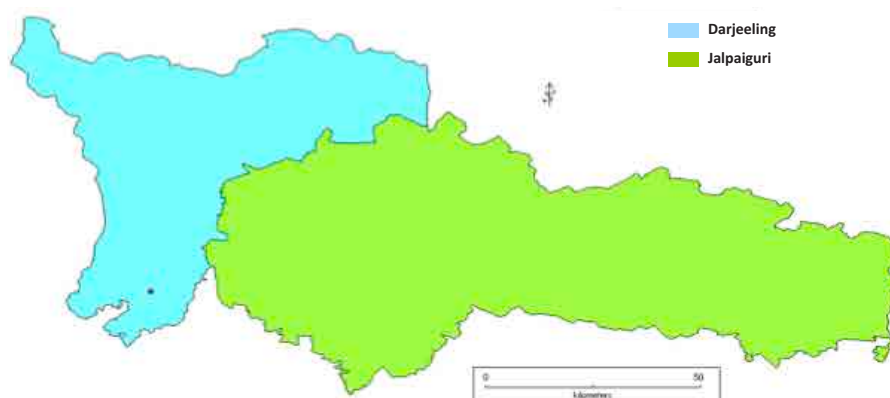


Figure 20. Distribution of *R. varipes atrophpha* Montandon in the study area

wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Adults may attain a length of about 18.5–23 mm. Respiratory siphon always shorter than body, length ranging between 14–18 mm.

**Description:** Brownish in colour. Eyes globular, red. Head length 1.45mm and width 0.83mm. Eyes 0.61mm in length and 0.68mm in width. Rostrum

1.82mm in length. Total length of antennal segment 0.49mm, second and third segment of antenna with a few scarcely distributed stout spines. Anterior lobe of pronotum about twice as long as posterior lobe, which is slightly curved dorsoventrally. Prosternum with a prominent keel ventrally. Mesosternum with a conspicuous median keel. Metasternum with a keel as

in Image 23g. Fore femora (Image 23e) broad with a distinct tooth. Hind femora in both sexes reaching upto the posterior margin of sixth sternite.

**Genital segment:** Sixth sternite of female expanded distally distinctly. Operculum almost as long as connexivum. Female ovipositor 1.8mm in length.

**Global distribution:** Java, Myanmar, and Thailand.

**Distribution in India:** West Bengal, Assam, Bihar, Karnataka, Madhya Pradesh, Pondicherry, and Tamil Nadu.

**Habitat:** Fish ponds, lakes with floating vegetation at edges.

**Remarks:** Montandon (1903) described this species without mentioning the type locality. Lansbury (1972) in his 'Review of the Oriental Species of *Ranatra* Fabricius' mentioned the type localities of examined materials in Madras and Pondicherry of South India and Titilagarh of Bihar, Eastern India. This species is also predaceous in nature.

***Ranatra digitata* Hafiz and Pradhan, 1947: Image 24. a–h**

**Material examined:** Regn.no.4764/H15, 1female, 17.iii.2012, Murti River, Medla camp, Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1male, 2females, 17.iii.2012, pond near Rhino camp, Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male attains a length of 28–31mm, length of respiratory siphon 26.5–29.2 mm. Body length of female ranges from 28.5–33mm and length of respiratory siphon 27–29mm.

**Description:** Head length 1.30mm, vertex evenly rounded between eyes. Eyes globular, much greater than the interocular region, length of eye 0.98mm and width 1.11mm. Antennae with several stout spines. Anterior

lobe much darker and slightly less than twice as long as posterior lobe, length of anterior lobe of pronotum 3.55mm and anterior width 1.68mm. Humeral width 2.43mm. Prothorax anteriorly tricarinate, central keel sharply carinated. Mesosternum rounded and shining, anterior margin emerginated, mesosternum with a 'V' shaped cleft between mid coxae. Metasternum flat, basally triangular, lateral margins concave as in Image

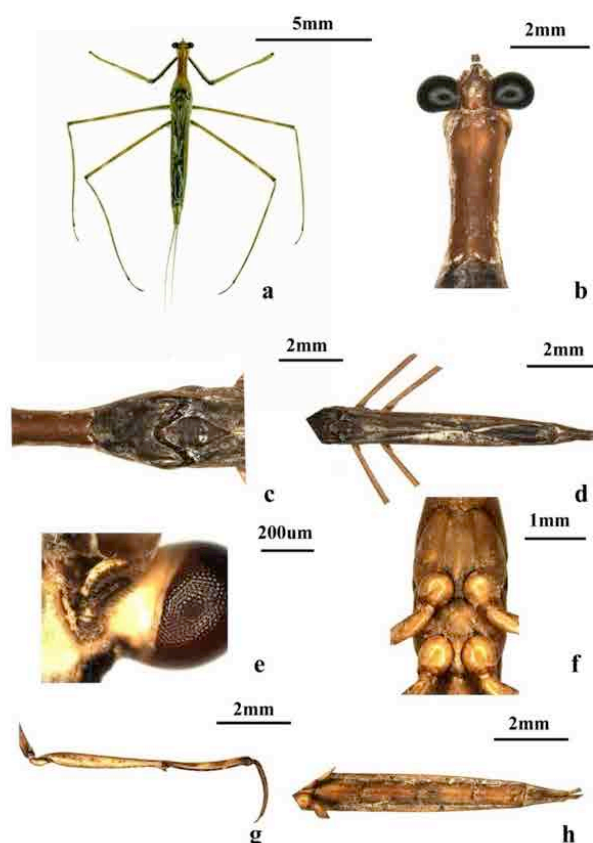


Image 24. a–h. *Ranatra digitata* Hafiz & Pradhan, 1947. a. Dorsal view of female; b. Head and pronotum; c. Scutellum; d. Abdomen, dorsal view; e. Antennae; f. Metasternal keel; g. Fore femur of female; h. Abdominal sternites, ventral view

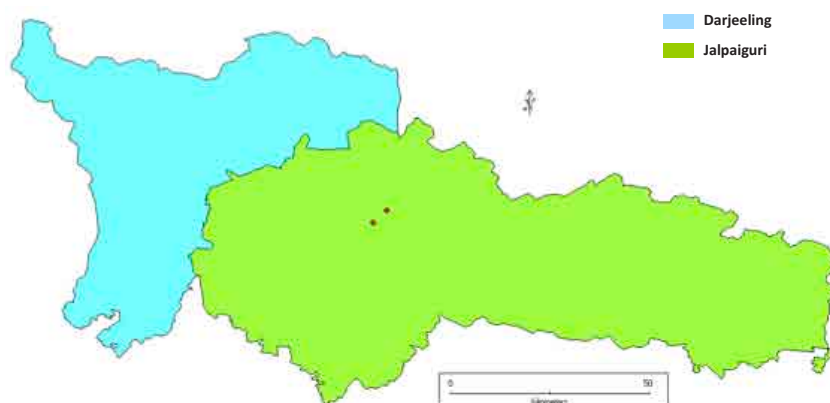


Figure 21. Distribution of *R. digitata* Hafiz & Pradhan in the study area



24f. Length of scutellum 2.47mm, width 1.13mm. Length of abdomen 2.63mm and width 2.43mm. Fore femora as in Image 24g. Mid femur and tibiae slightly shorter than hind femora and tibiae. Hind femora in both sexes reaching about half way along operculum.

Genitalia: Male genital capsule not distally invaginated, flagellum very long. Female genital segment 2.63mm in length and 1.41mm in width. Ovipositor projecting outward of the genital segment.

**Global distribution:** Myanmar and India.

**Distribution in India:** Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, and West Bengal.

**Habitat:** Water tanks, ponds, rock pools, and ditches.

**Remarks:** This species is widespread in stagnant ecosystems of West Bengal and is prevalent in ponds, where pisciculture practice is going on. This species is closely related to *R. flagellata* Lansbury.

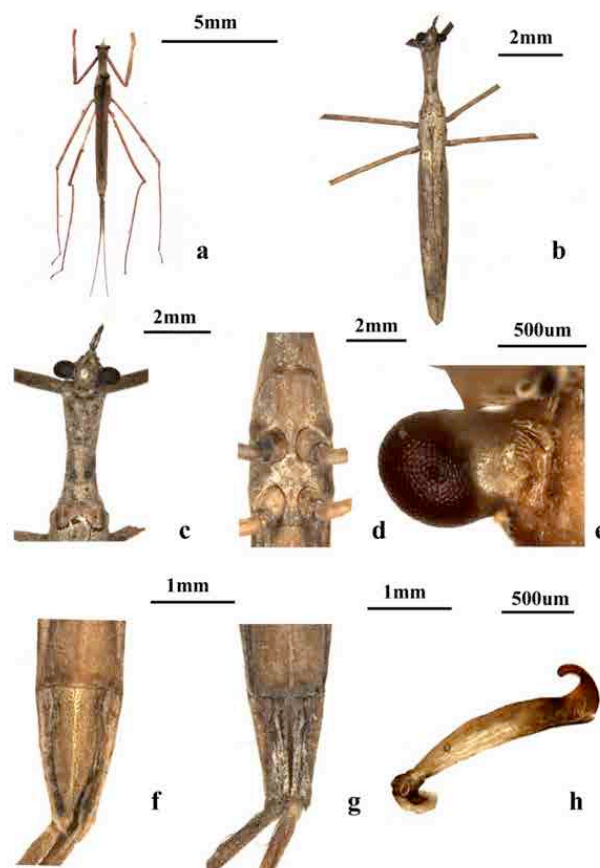
***Ranatra filiformis* Fabricius, 1790: Image 25. a–h**

**Material examined:** Regn.no.4756/H15, 1male, 2females, 8.xi.2013, Murti River, in front of Murti Banani Bungalow, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1male, 2females, 3.x.2013, pond at Binnaguri, Jalpaiguri District, West Bengal, coll. S. Basu; 1female, 17.iii.2012, pond near Rhino Camp, Gorumara National Park, Jalpaiguri District, West Bengal, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

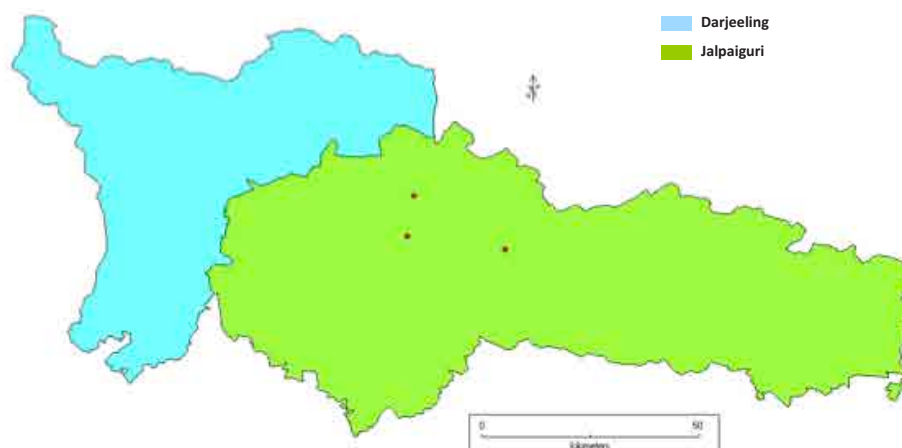
**Morphology:** Size: Male body length 22–25.5 mm, respiratory siphon length 21.5–23 mm. Female body length 20.6–28mm, length of respiratory siphon 13–23mm.

**Description:** Head length 1.35mm and width in front of eyes 0.89mm, vertex slightly raised between eyes, occasionally developed into a vestigial tubercle. Length of eye 0.65mm and width 0.61mm. Rostrum 0.87mm in length. Interocular width 0.76mm. Second and

third segments of antennae mostly black with long, stout spines. Length of anterior lobe of pronotum 3.66mm and width 1.18mm. Length of posterior lobe of pronotum 1.25mm and width 1.77mm. Anterior lobe slightly darker than posterior lobe with an obtuse



**Image 25. a–h. *Ranatra filiformis* Fabricius, 1790. a. Dorsal view of male; b. Full body of male; c. Head and pronotum; d. Metasternal keel; e. Antennae; f. Male genital segment, ventral view; g. Female genital segment, ventral view; h. Male paramere**



**Figure 22. Distribution of *R. filiformis* Fabricius in the study area**

carina extending to transverse groove, posterior lobe punctuate along hind margins. Prothorax ventrally with a prominent keel. Mesosternum rounded and shining. Length of scutellum 1.6mm and width 1.1mm. Metasternal process as in Image 25d, broadest basally with slightly rose at centre. Mid and hind coxae equidistant from each other. Fore femora 7.53mm in length, with a prominent tooth. Femora and tibiae of mid and hind legs sometimes annulated with light and dark brown rings. Length of abdomen 13.9mm and width 1.85mm.

**Genitalia:** Length of male genital segment 2.21mm and width 1.33mm. Male operculum broad, sharply carinate. Parameres (Image 25h) distally hooked with several stout spines on inner margins. Female operculum long and narrow, reaching ends of connexivum.

**Global distribution:** India, Myanmar, Nepal, Pakistan, Philippines, and Sri Lanka.

**Distribution in India:** Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Meghalaya, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.

**Habitat:** Ponds, slow-flowing streams, ditches, and puddles.

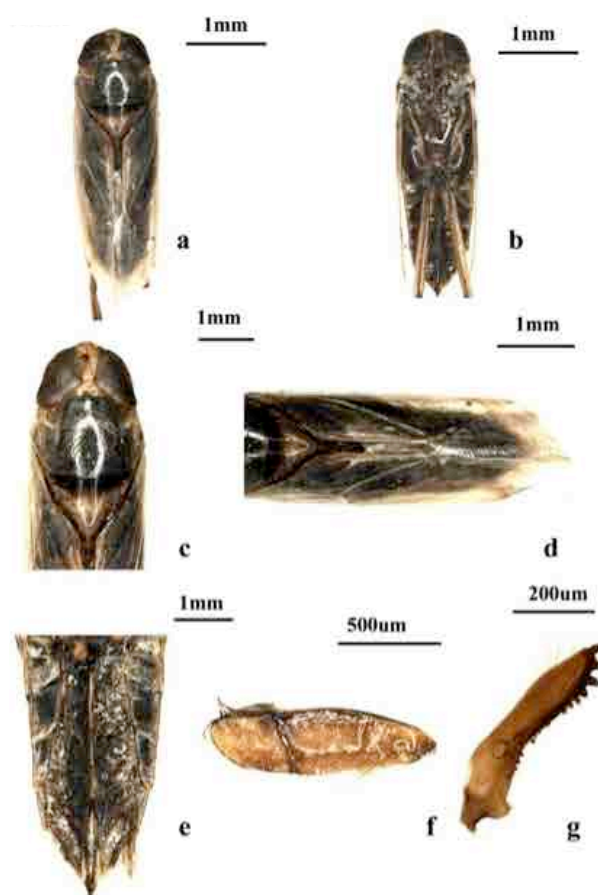
**Remarks:** This is one of the smaller species. This is widespread in India and commonly found species.

#### Family Notonectidae Latreille, 1802

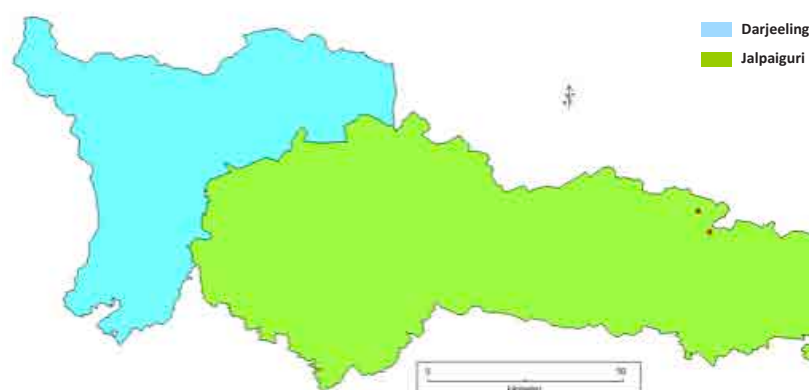
They are truly aquatic forms which differ from all other aquatic bugs (except Pleidae and Helotrephidae) in the habit of swimming on their backs. The notonectids are small, medium-sized (15–20mm), oblong bugs, characterised by four segmented antennae, three to four segmented rostrum, absence of ocelli, non-raptorial legs, and flattened hind legs devoid of claws.

#### Genus *Anisops* Spinola, 1840

**Diagnosis:** Body usually small, slender, but some species are large and attain a length of about 12 mm. Eyes large, may or may not be holoptic. The interocular region with a median longitudinal depression anteriorly. Anterior end of hemelytral commissure with a definite hair-lined pit. The hemelytra not coriaceous. Ventrally,



**Image 26.** a–g. *Anisops paranigrolineatus* Brooks, 1951. a. Dorsal view of female; b. Ventral view of female; c. Head and pronotum; d. Scutellum and abdomen, dorsal view; e. Female genital segment, ventral view; f. Fore femur of female; g. Female ovipositor



**Figure 23.** Distribution of *A. paranigrolineatus* Brooks in the study area

body longitudinally convex with deeper thoracic region. Abdominal sternites with a median longitudinal keel marked laterally with long hairs. The inner margin of connexivum with long hairs. Mid and hind tarsae two-segmented, except the fore tarsae one-segmented. Stridulatory apparatus, i.e., tibial comb present in males. Male genital segment modified. Parameres are asymmetrical, the right one being large and the left one hook-shaped at apex and small.

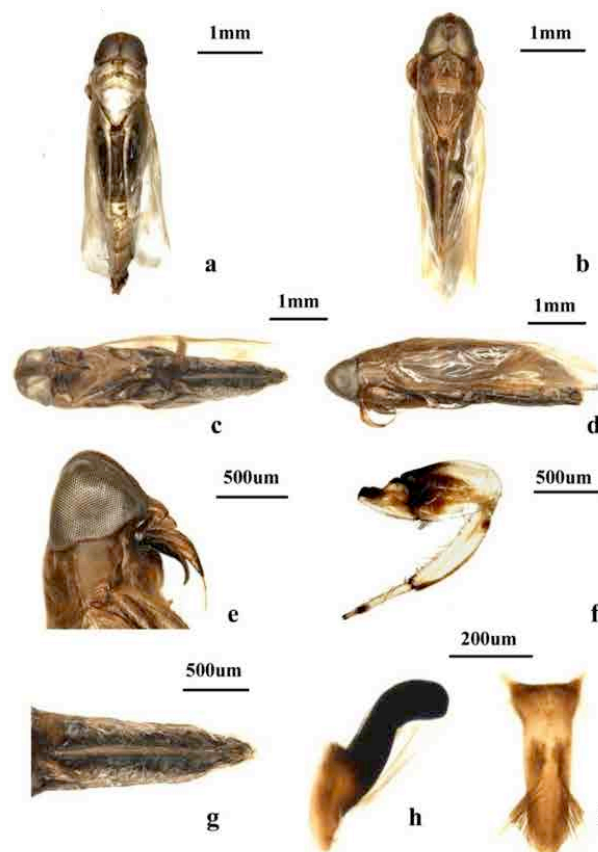
**Anisops paranigrolineatus Brooks, 1951: Image 26. a–g** 1951. *Anisops paranigrolineata* Brooks. *Kansas University science bulletin*, 34: 407.

**Material examined:** Regn.no. 4616/H15, 1 female, 6.iii.2011, Jayanti Forest Bungalow, Alipurduar District, West Bengal, India, coll. S. Basu; 1 female, 6.iii.2011, Jayanti River, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

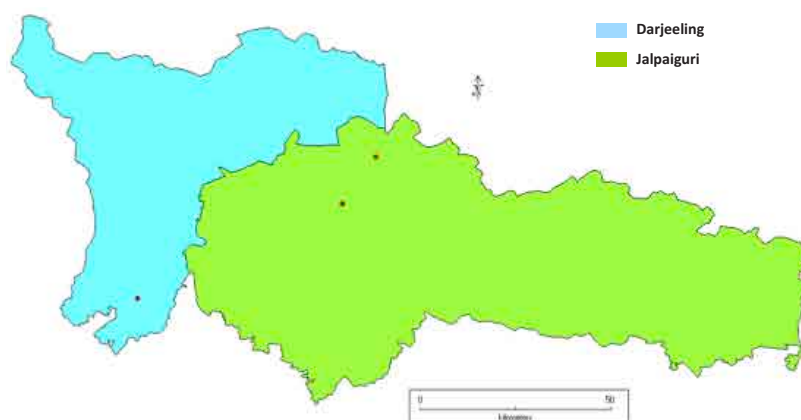
**Morphology:** Size: Adult males attain a size of 5.9–6.0 mm, maximum body width 1.4mm. Body length of females range from 6.2–6.4 mm, maximum body width 1.6–1.8 mm.

**Description:** Fusiform, brown coloured species. Generally head pale yellowish brown. Eyes dark brown, legs pale yellow and venter black with prominent keel and segmental margins of the connexivum stramineous. Length of head 0.48mm and width (infront of eyes) 0.33mm. Eye width 0.58mm, 2.0 times wider than the interocular width (0.28mm), but a little wider than the anterior width of pronotum (0.52mm). Dorsally, the outline of the head is rounded. Hemelytra hyaline and appearing black as it overlies the black dorsal body surface. Scutellum length 0.687mm and width 0.93mm. Pronotum wider than long, length of pronotum 1.19mm and width 1.6mm. Anterior margin of vertex not extended beyond eyes. Synthipsis wide. Posterior

margin of pronotum convex, dorsally with a faint median ridge. Ventrally, labrum greatly reduced in length. Rostrum 0.77mm in length, rostral prong shorter than the third rostral segment. Fore femur greatly enlarged at base with pointed apex in male. In female, fore femur broad with numerous setae as in Image 26f.



**Image 27. a–i. *Anisops breddini* Kirkaldy, 1901. a. Dorsal view of male; b. Dorsal view of female; c. Ventral view of male; d. Lateral view of male; e. Rostral prong of male; f. Male fore leg; g. Male genital segment, ventral view; h. Male paramere; i. Dissected male genital segment**



**Figure 24. Distribution of *A. breddini* Kirkaldy in the study area**

Genitalia: The male paramere is little excavate and the female ovipositor with numerous denticles as in Imaeg 26g. The length of ovipositor 0.72mm.

**Global distribution:** India.

**Distribution in India:** Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Freshwater ecosystems such as rocky streams, rivers, ponds, etc.

**Remarks:** The species description is written based on the female as male specimens are not collected. The male descriptions are based on the literature of Brooks (1951) and Thirumalai (1994).

***Anisops breddini* Kirkaldy, 1901: Image 27. a–i**

1964. *Anisops kempii* Brooks: Lansbury, *Annales Zoologici Warszawa*, 22: 215.

**Material examined:** Regn.no.4755/H15, 1female, 16.ix.2011, canal within Gava Ganga and Kamala Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 4males, 7females, 10 nymphs, 17.ix.2011, pond near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4males, 4females, 1 nymph, 17.iii.2012, wetland within Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male 5.7–6.6 mm, maximum body width of male 1.2–1.6 mm. Body length of female 5.4–6.8 mm, maximum body width of female 1.2–1.7 mm.

Description: Body pale in colour dorsally with the elytra pale-greyish. Abdominal sternum dark brown in colour with the keel reddish brown for the greater part and brownish black at the terminal end. Eyes holoptic posteriorly, dorsally lateral margins of eyes slightly convex giving the head an almost conical appearance; head as wide as pronotum. Eye length 0.76mm and width 1.10mm. Lateral margins of pronotum parallel. Hemelytra with reduced membranes. Rostral prong in males slightly longer than the third rostral segment. Fore femora of male strongly swollen. Fore tibia slightly more than one-and-half times as long as tarsus. Stridulatory comb on fore tibia consists of a few irregular teeth in male. Fore femora and tibia 0.87mm and 1.1mm in length, respectively. Mid tibia with a long claw, as long as the third tarsal segment. Abdomen 2.3mm in length and 0.80mm in width.

**Genital segments:** Male genital segments modified and little elongated. Male paramere as in Imaeg 27h. Female genital segments symmetrical and not modified.

**Global distribution:** Sri Lanka, Indochina, Java,

Sulawesi, Kedah, Melaka, Johor, and Singapore (Fernando & Leong 1976), and India.

**Distribution in India:** Andhra Pradesh, Assam, Bihar, Delhi, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.

**Habitat:** Ponds, pools, agricultural fields, and small streams with vegetation.

**Remarks:** A widespread species in India. *Anisops kempii* described by Brooks (1951) from India and Thailand are considered as the macropterous form of *Anisops breddini* and hence synonymised.

***Anisops sardeus sardeus* Herrich-Shaffer, 1850: Image 28. a–i**

1850. *Anisops sardeus* Herrich-Shaffer, *Die wanzenartigen Insekten*, 9: 41.

**Material examined:** Regn.no.4604/H15, 1 male, 1 female, 23.ix.2012, pond near Domohoni, Jalpaiguri District, West Bengal, India, coll. M. Chakrabarty, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 7.5–8.4mm, maximum body width 1.8–1.9mm, female body length 7.3–7.5mm, maximum body width 1.9–2.1mm.

Description: Dorsally stramineous in colour. Eyes brown. Hemelytra hyaline and appear darker due to dark brown body surface. Abdominal venter dark brown or black with keel. In male, the interocular space produced into a prominent cephalic horn with acuminate apex anteriorly as viewed from the above, lateral margins of head rounded. Synthipsis narrow. Labrum short, apex acuminate, each basal angle bearing a tuft of erected hairs whose tips are curved medianly and form a loop with each other. Head is wider than pronotum. Pronotum with its humeral width more or less twice the median length, posterior margin of pronotum convex, emarginated medially. Rostral prong slightly shorter than the third rostral segment. Stridulatory comb of approximately 18 teeth. Mid tarsal claws strongly curved inward at base.

Genitalia: Male genital segment with tuft of a pair of setae laterally on both sides. Male left and right paramere as in Image 27h & i, respectively. Left paramere broad and right paramere apically curved.

**Global distribution:** India, Turkey, Syria, Albania, Africa, Corfu, Canary Islands, Afghanistan, and Myanmar.

**Distribution in India:** Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Chandigarh, Delhi, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.

**Habitat:** Ponds, water tanks, and lakes.



**Remarks:** This species is a close relative of *A. bouvieri* Kirkaldy by the shape of the male cephalic horn. It can be differentiated by the presence of marginal row of prominent setae on the inner surface of fore tibia of male.

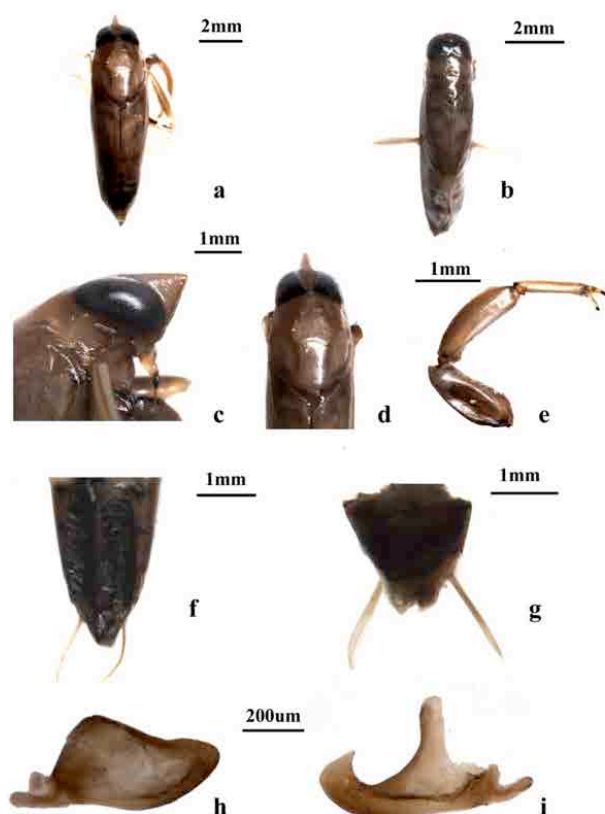


Image 28. a–i. *Anisops sardeus sardeus* Herrich-Shaffer, 1850. a. Dorsal view of male; b. Dorsal view of female; c. Cephalic horn of male; d. Head and pronotum of male; e. Fore leg of male; f. Male genital segment, ventral view; g. Dissected male genital segment; h. Male left paramere; i. Male right paramere

#### *Anisops nasutus* Fieber, 1851: Image 29. a–f

1851. *Anisops nasuta* Fieber, *Abhandlungen der Königlichen Böhmisches Gesellschaft der Wissenschaften*, 7: 484–485.

1906. *Anisops fieberi* Kirkaldy: Distant, *Fauna of British India*, 3: 46.

**Material examined:** Regn.no.3147/H15, 14males, 6females, 12.iii.2011, wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 6.0–7.5 mm, maximum width of body 1.5–1.8mm. Female attains a length of 6.0–7.0mm, maximum body width 1.4–1.9mm.

**Description:** Slightly fusiform species. Dorsally pearlaceous or stramineous. Eyes brown. Scutellum tinged with pale orange. Abdominal venter black with keel. The head rounded anteriorly with the vertex extending beyond the anterior margins of eyes. Synthipsis narrow. Pronotum with its humeral width twice the median length, posterior margin convex, medianly emerginate. Frons produced anteriorly into a cephalic horn, apex of which with a median depression. Labrum short and broad, basal portion provided with a few long hairs. Stridulatory comb consists of approximately 14teeth.

**Global distribution:** India, Australia, Celebes, New Guinea, and Guam.

**Distribution in India:** Assam, Andhra Pradesh, Madhya Pradesh, Odisha, and West Bengal.

**Habitat:** Ponds, lakes, and water tanks.

**Remarks:** This species is similar to *A. batillifrons* Lundblad. They are abundant in ponds with aquatic vegetation.

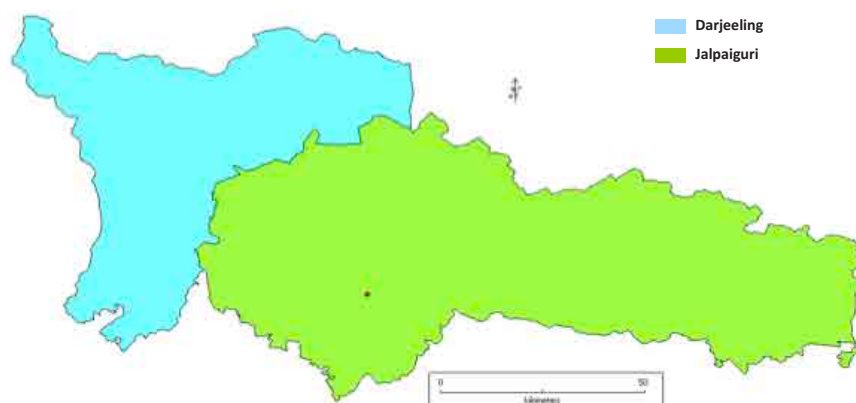


Figure 25. Distribution of *A.sardeus sardeus* Herrich-Shaffer in the study area

### Genus *Nychia* Stal, 1860

**Diagnosis:** Body elongate, oval, whitish dorsally, mostly found in brachypterous forms. Head not as broad as pronotum. Eyes very large, inner margins converging dorsally and meeting each other in posterior third. Antennae three-segmented. Pronotum broader than long with antero-lateral margins distinctly foveate. Claval commissure of hemelytra continuous. Mid femur with a pair of stout bristles ventrally in basal half. Fore and mid tarsi two segmented in males and one segmented in female. Male parameres asymmetrical,

small. Female with short gonapophyses.

### *Nychia sappho* Kirkaldy, 1901: Image 30. a–k

1901b. *Nychia marshalli sappho* Kirkaldy, *Annali di Museo Civico di Storia Naturale di Genova*, 20: 809.

1910a. *Nychia marshalli* (Scott, 1872): Distant, *Fauna of British India*, 5: 334.

1933. *Nychia malayana* Lundblad, *Archiv für Hydrobiologie, Supplement*, 12: 148.

2001. *Nychia proxmarshalli* (Scott): Thirumalai, *Fauna of Conservation area*, 11: 116.

**Material examined:** Regn.no.4611/H15, 1 female, 16.ix.2011, Ghoshpukur Dighi, Kamala Bagan, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 5 females, 17.iv.2013, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Males attain a length of 3.6–5.2 mm and females may attain a length of 4.6–5.8 mm. Maximum body width of male (across middle) 1.27mm and of female 1.43mm.

**Description:** Dorsally entirely white with dark reddish eyes. Females are wider than male. Males are slender in appearance. Head length 0.612mm, head with vertex a little raised. Antenna three-segmented, hidden inside a groove ventrally. Eyes holoptic, united basally, length of eye 0.71mm and width 0.59mm. Interocular region narrow, width 0.18mm. Rostrum 1.03mm in length, dark brown in colour. Males are with rostral prong in the second rostral segment. Pronotum 1.56 times wider than length ( $W/L=1.24/0.79$ ), short and trasverse with concave angles. Hemelytra translucent. Scutellum small, 0.87mm in length and 0.59mm in width, hemelytra without clavus and sutures. In females, hemelytra fully covered the body, while in males, body remains uncovered. Length of abdomen 2.21mm, width 0.69mm. Ventral abdominal keel not extending upto the

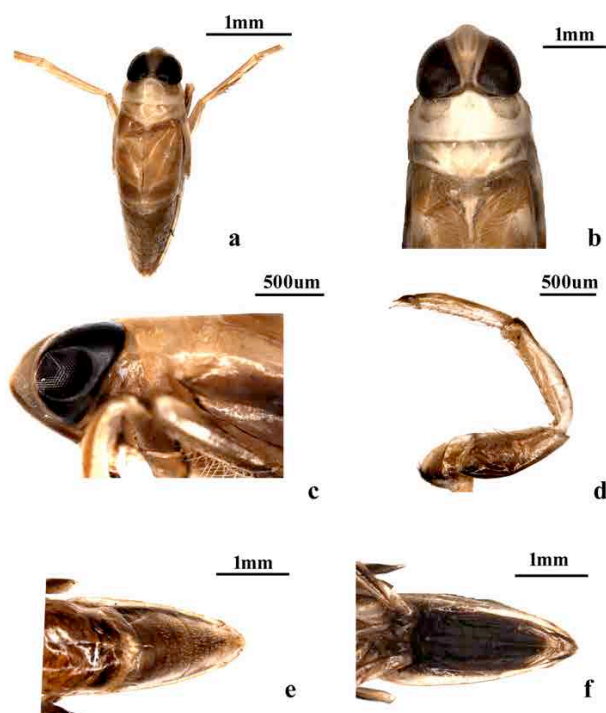


Image 29. a–f. *Anisops nasutus* Fieber, 1851. a. Dorsal view of female; b. Head and pronotum; c. Lateral view of head; d. Fore leg of female; e. Abdomen, dorsal view; f. Genital segment, ventral view

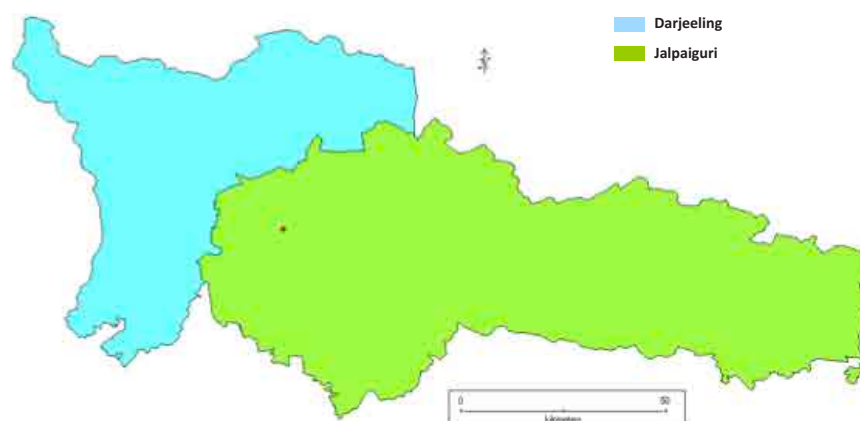


Figure 26. Distribution of *A. nasutus* Fieber in the study area

last abdominal segment, abdominal sternites fringed with long dark hairs. Fore femur 1.48mm in length, 0.64mm in width, with seven spines arranged medio-ventrally. Fore tarsae two-segmented, 0.66mm and 0.25mm in length, respectively.

Genitalia: Male genital segments dark black, hairy

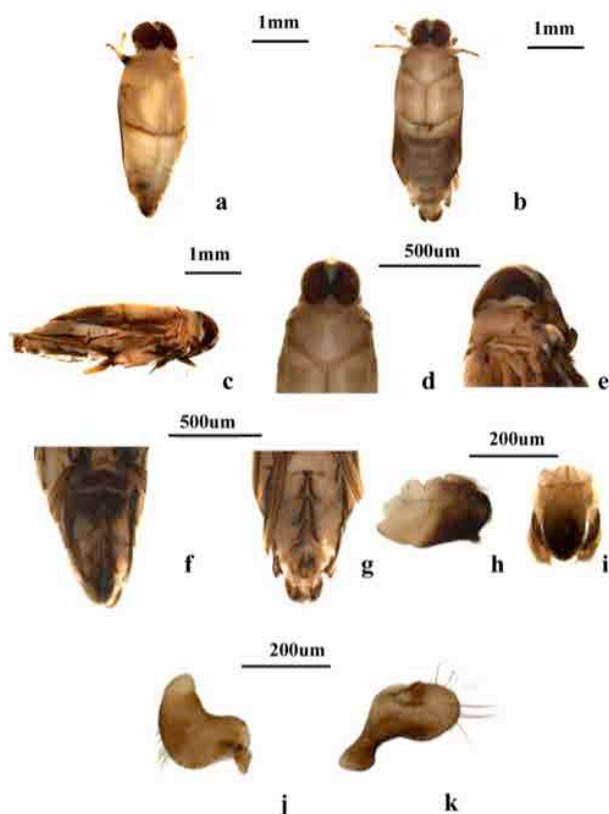


Image 30. a–k. *Nychia sappho* Kirkaldy, 1901. a. Dorsal view of male; b. Dorsal view of female; c. Lateral view of female; d. Head and pronotum; e. Rostral prong; f. Male genital segment, ventral view; g. Female genital segment, ventral view; h. Lateral view of genital segment; i. Dorsal view of genital segment dissected; j. Right paramere of male; k. Left paramere of male

medially and laterally. Male left and right paramere as in Image 30j & k, stout, black in colour, more or less sigmoid-shaped, with a few long setae basally. Female genital segment as in Image 30f.

**Global distribution:** India, Australia, Indonesia, Malaysia, New Guinea, Sri Lanka, Africa, Taiwan, and Philippines.

**Distribution in India:** Tamil Nadu, Pondicherry, and West Bengal.

**Habitat:** Freshwater ecosystems such as fishing ponds, lakes, rivers, etc.

**Remarks:** This genus is with only a few poorly known species in India. It can be easily identified by the structure of its eyes, which are joined basally.

#### Genus *Enithares* Spinola, 1837

**Diagnosis:** Body medium-sized, convex dorsally. Head narrow. Eyes large, distinct, dorsally occupying about two-third of head. Antenna four-segmented. Ocelli absent. Rostrum four-segmented. Pronotum broader than head, lateral margins diverging. Pronotal fovea present near antero-lateral margin. Nodal furrow present in the corium, directed inwards from lateral margins. Wing membrane bilobed. Fore and mid tarsae three-segmented. Hind tarsi two-segmented. A pair of sharp tarsal claws in all legs. Mid femur modified, with a pointed spur-like protuberance. Abdominal keel fringed with hairs along lateral margins. Genital capsule (segment IX) cleft medianly into an anterior and posterior lobe. Parameres symmetrical. Female genital segment (segment VI) produced towards end.

#### *Enithares mandalayensis* Distant, 1910: Image 31. a–h

**Material examined:** Regn.no.4772/H15, 1 female, 18.iii.2012, jhora in front of Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll.

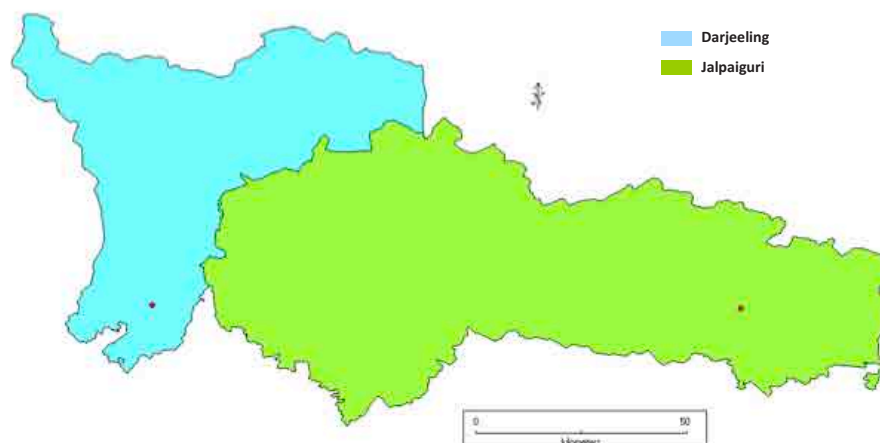


Figure 27. Distribution of *N. sappho* Kirkaldy in the study area

S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length ranges between 6.7–6.8 mm, maximum body width 2.75mm. In female, the body length reaches upto 6.5–8mm, maximum body width 2.2–2.75 mm.

**Description:** Small, robust species, more or less dark species. Eyes reddish brown, vertex yellowish brown in

colour. Pronotum medially with a pale transverse band, posteriorly hyaline appearing brown to black. Scutellum yellowish brown. Head dorsally rounded, 0.67mm in length and width in front of eyes is 0.48mm. Anterior width of vertex slightly produced. Synthlipsis just less than half the anterior width of vertex. Length of eye 0.97mm and width 0.84mm. Interocular width 0.58mm, less wide than eye width. Pronotum 0.66mm in length. Humeral width 2.21mm, lateral margins of pronotum diverging, posterior margin almost straight. Rostrum 1.54mm in length. Both sexes have a slight depression on anterior surface of hind femur near to trochanter. Hind femur with a nodule distally. Mesotrochanter as in Image 31g. Ventrally, metaxyphus as in Image 31e. Abdomen 2.58mm in length, 1.58mm in width, tapering towards the end.

**Genitalia:** Male paramere pear-shaped, concave along outer margin. Female ovipositor long, stout, and sometimes reaching little beyond the end of abdomen.

**Global distribution:** India, Myanmar, Thailand, Malaysia, and Vietnam.

**Distribution in India:** Assam, Manipur, and West Bengal.

**Habitat:** Small streams within forests, stagnant temporary pools, etc.

**Remarks:** This species is a new record to the State of West Bengal.

#### *Enithares unicata* Lundblad, 1933: Image 32. a–g

**Material examined:** Regn.no.4758/H15, 2 females, 17.iii.2012, wetland within Chapramari Wildlife Sanctuary, Jalpaiguri district, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Female body length ranges from 6.7–7.5 mm. Male attains a length between 7.5–8.0 mm. In both sexes, maximum width ranges within 2.3–

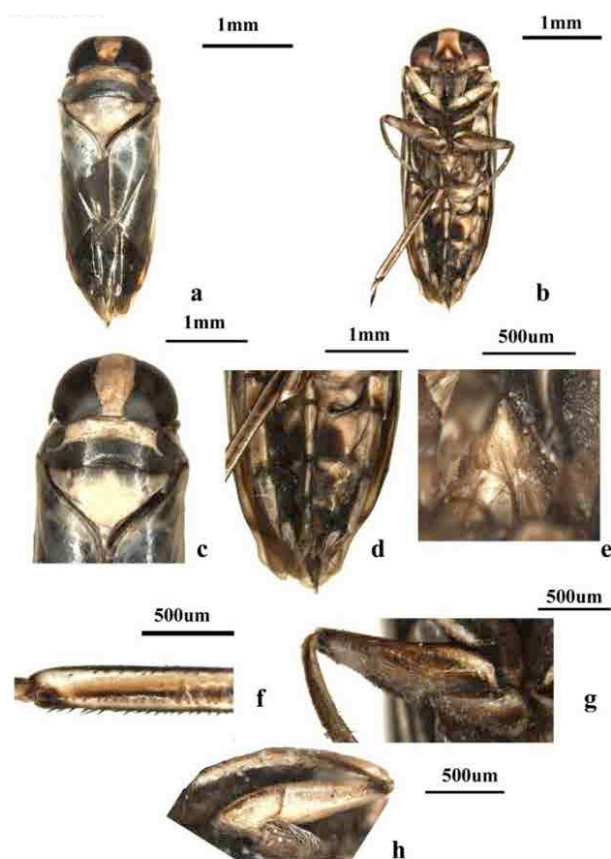


Image 31. a–h. *Enithares mandalayensis* Distant, 1910. a. Dorsal view of female; b. Ventral view of female; c. Head and pronotum; d. Genital segment, ventral view; e. Metaxyphus; f. Hind femur; g. Mid femur; h. Fore femur

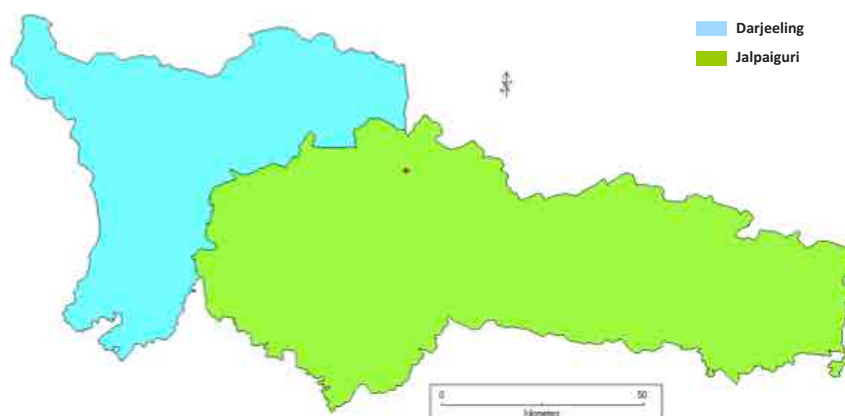


Figure 28. Distribution of *E. mandalayensis* Distant in the study area



2.75 mm.

**Description:** Small pale species. Eyes pale reddish brown. Vertex with a black stripe along inner margins. Anterior part of pronotum yellowish brown, posteriorly appearing dark brown to black. Scutellum yellowish

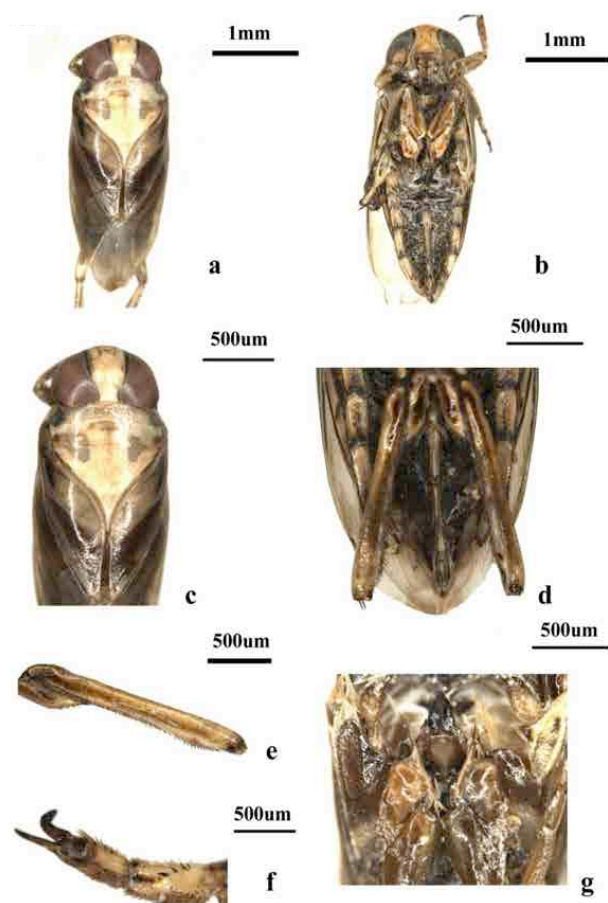


Image 32. a–g. *Enithares unicata* Lundblad, 1933. a. Dorsal view of female; b. Ventral view of female; c. Head and pronotum; d. Genital segment of female, ventral view; e. Hind femur; f. Claws of mid leg; g. Metaxyphus

brown. Abdomen ventrally black. In dorsal view, head rounded. Anterior width of vertex slightly produced. Head length 1.1mm and width 0.81mm (in front of eyes). Pronotum 0.90mm in length. Humeral width 2.54mm. Scutellum 1.56mm in length, 1.67mm in width. Interocular width 0.72mm. Eyes 1.2mm in length, 0.83mm in width. Pronotal posterior margin convex, centrally emerginated. Hind femur (2.41mm) longer than the mid femur (1.43mm). Hind femur distally with two spines as in Image 32d. Mesotrochanter rounded. Claw of mid leg is curved, stout. Length of abdomen 2.85mm and width 1.94mm, ventrally hairy, and with a prominent keel. Metaxyphus as in Image 32g, elongated, apically convergent.

Genitalia: Male parameres short and triangular. Female ovipositor prominent and elongated.

**Global distribution:** Sumatra, Java, India

**Distribution in India:** West Bengal

**Habitat:** Small pools with rich vegetation and muddy bottom, and stagnant pools within forests.

**Remarks:** This species is a new record in India. It is almost distinguishable from *Enithares mandalayensis*, by the male chaetotaxy of mid leg, metaxyphus of both sexes, and male genitalia. It is quite possible that *Enithares unicata* is only a geographic race of *E. mandalayensis*.

#### Family Pleidae Fieber, 1851

Body minute (size 1.5–3mm), compact, with strongly condensed body, swimming upside-down, somewhat resembling miniature notonectids, having the head and thorax not fused. Because of their small size, they may escape notice of collectors. The head relatively large, directed ventro-caudad; rostrum short and three-segmented. The abdomen has a distinct midventral carina.

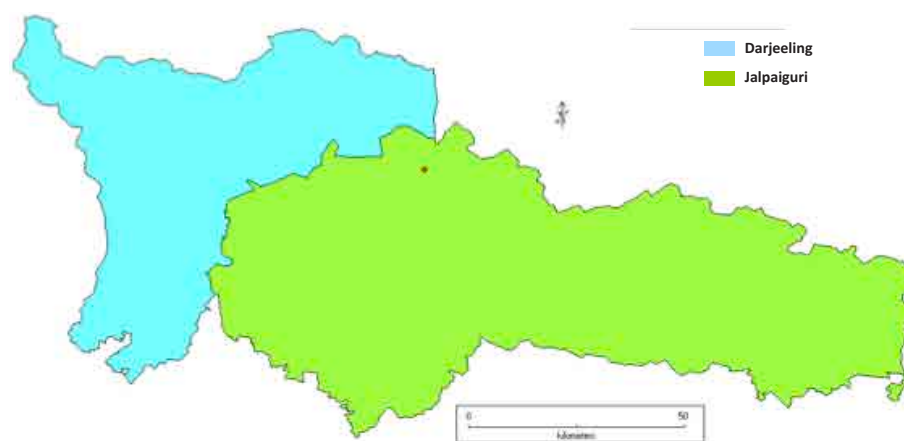


Figure 29. Distribution of *E. unicata* Lundblad in the study area

### Genus *Paraplea* Esaki & China, 1928

**Diagnosis:** Small, yellowish to light brownish, oval shaped body. Body length upto 2.5mm. Eyes large, globular and dark red in color. Antennae three-segmented, hidden beneath the head. Ocelli absent. Rostrum four-segmented. Pronotum large, quadrate, and either reticulate or punctuate. Hind legs with swimming hairs and with two claws in tarsae. Fore and

hind tarsi with two segments. Sternites 2–6 with keel.

#### *Paraplea frontalis* (Fieber, 1844): Image 33. a–h

1844. *Ploa frontalis* Fieber, *Entomologische Monographien Leipzig*, 18.

1906. *Plea frontalis* (Fieber): Distant, *Fauna of British India*, 3: 48.

1934. *Plea (Paraplea) frontalis* (Fieber): Lundblad, *Archiv für Hydrobiologie Supplement*, 12:138.

1947. *Plea (Paraplea) frontalis* (Fieber): Hafiz & Pradhan, *Rec. Indian Mus.*, 45: 349.

**Material examined:** Regn.no.2711/H15, 2 males, 3 females, 17.ix.2011, pond near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length ranges from 2.0–2.2mm and female attains a length of 2.1–2.5 mm, relatively larger species.

**Description:** General body color yellowish brown to dark brown. Eyes reddish brown. Scutellum yellowish white. On the vertex two pale brown oval spots present. Head pattern consists of two pairs of dots dorsally of the median stripe. The head marking pattern, however, may be vague or absent except for the median stripe. Frons and vertex finely punctuate. Interocular width almost twice the width of an eye. Pronotum wider than long, lacking the characteristic well-defined dots at humeral angles and posterior margin. Hemelytra with very fine hairs, coarsely reticulately punctuate. Metasternal keel with a more or less irregular anterior margin and a shallow depression at middle. Abdominal sterna with three distinct backwardly directed keel.

**Genitalia:** Male genital segments modified. Seventh male sternite obtuse or with a small notch. Male parameres as in Image 33h, with several setae. Seventh female sternite with small acute tip. Female ovipositor (Image 33g) with numerous spines, the number ranges from 14–17 in right ovipositor and in left ovipositor, the

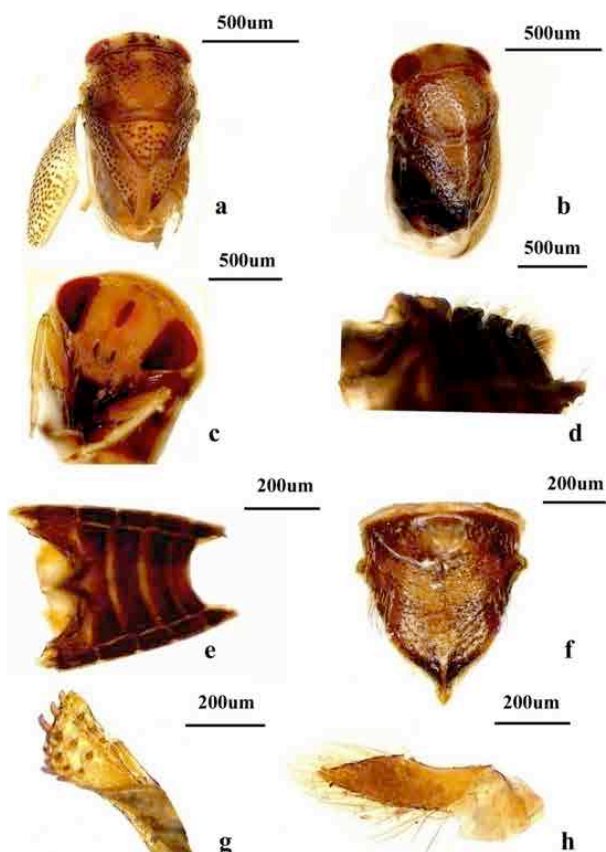


Image 33. a–h. *Paraplea frontalis* (Fieber, 1844). a. Dorsal view of male; b. Dorsal view of female; c. Marking pattern of head; d. Lateral view of abdominal keel; e. Abdominal tergites of male; f. Female genital segment; g. Female ovipositor; h. Male paramere

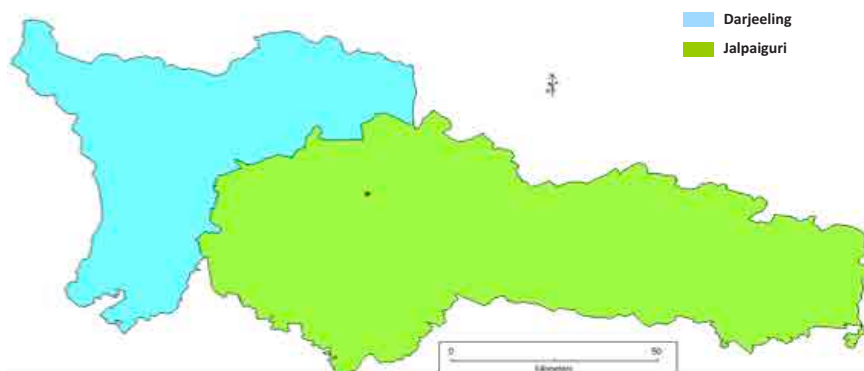


Figure 30. Distribution of *P. frontalis* (Fieber) in the study area

spines are 16–20.

**Global distribution:** Myanmar, Sumatra, Java, Sri Lanka, Southeast Asia, Taiwan, Singapore, Thailand, West Malaysia, and India.

**Distribution in India:** Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Bihar, Chandigarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Punjab, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Freshwater ecosystems like ponds, lakes with plenty of aquatic vegetation, and swamps.

**Remarks:** This species has a wide range of distribution. They are predators, and feed on mosquito larvae, small crustaceans, water fleas, etc.

#### Infraorder Gerromorpha Popov, 1971

##### Family Gerridae Leach, 1815

Body elongate or oval with sub-apical claws, hind femora reaching beyond the apex of abdomen and the middle legs, usually distinctly longer than the hind legs. The body is covered with a velvety hydrofuge, hair-pile and the colour varies from black or grey to brown, the dorsum being marked with light grey or yellow lines or spots. Macropterous, brachypterous, micropterous and apterous forms are frequently encountered. The size ranges from 2–40mm.

##### Genus *Ptilomera* Amyot and Serville, 1843

**Diagnosis:** Large, robust, stout water striders. Body colouration dark brown to yellowish brown or dark green, with areas of black markings covered by silvery pubescence, ventrally pale yellow to white. Head anteriorly widened in front of eyes with antennal tubercles divergent anteriorly. Eyes large, reddish brown or black, broadly rounded. First antennal segment longer than the combined length of II–IV. Rostrum short with two long sensory setae on posterior margin of segment III, not reaching beyond the prosternum. Pronotum in apterous forms sub-quadrangular in shape, wider than long, posterior margin of pronotum straight to weakly concave. Metanotum shorter than mesonotum, with median longitudinal depressed black midline. In macropterous forms, pronotum is greatly enlarged. Fore wing with distinct venation. Forelegs enlarged with femur straight, weakly incrassate, longer than tibiae, fore tibiae slender, with spur on inner margin at apex, fore femur and tibia with a few small black tubercles along inner margin. Male mid femur bearing a fringe of stiff black setae, which is absent in females. Male abdominal tergite VIII greatly enlarged and conspicuous. Proctiger expanded, often with lateral

wings. Pygophore elongated. Parameres large, curved, bearing fringe of long setae. Female genital segments with well-developed connexival spines.

##### *Ptilomera (Proptilomera) himalayensis* Hungerford and Matsuda: Image 34. a–f and Image 35. g–m

**Material examined:** Regn.no.3171/H15, 1 male, 1 female, 19.iv.2013, Buxa Jhora, near Buxa Fort, Buxa Tiger Reserve Forest, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 1.x.2013, Gourjan Jhora, near Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4 males, 4 females, 7 nymphs, 15.iii.2012, Teesta River, near Rabijhora, Darjeeling District, West Bengal, India, coll. S. Basu; 1 female, 22.iii.2013, Teesta River, near Chitre Bridge, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of macropterous male 14.2–15.0mm. Body length of macropterous female 12.2–14.5 mm. Apterous males arise a length of 10.7–11.2 mm and apterous females attain 11.9–12.3 mm in length.

**Description:** Length of head 1.16mm, width across eyes 1.52mm, interocular width (0.75mm) 1.66 times wider than the eye width (0.45mm). Eyes 1.7 times as long as width ( $L/W=0.78/0.45$ ), head in front of eyes little swollen, with a few trichobothrial setae. Vertex with a pair of backward angling dark spots on either sides of midline, interocular region with a pair of vertical dark band parallel to the margin of eyes, and with a few silvery setae. Antenna dark brown with silvery pubescence, first antennal segment longer than the length of rests together, length of antennomeres, 1–4: 5.29mm, 1.16mm, 2.01mm, and 1.32mm. Rostrum 1.55mm in length, extending up to the margin of fore coxa, third segment of rostrum covered with short recumbent silver setae. Pronotum 1.1mm in length and 1.7 times wider than length (width 1.91mm), with a cavity-like dark patch present medially, a shallow transverse sulcus starting from posterior margin of pronotum reaching up to the margin of humeri. Humeral width 2.76mm, posterior margin narrowly flattened, evenly curving, demarcated by a shallow curving sulcus. Wings uniformly pale brown with prominent dark venation, extending beyond the posterior tip of abdomen. Abdominal tergites 2.8 times longer than the width ( $L/W=4.36/1.53$ ), tergites II–VII dark brown with small silvery setae and a median yellowish patch. Connexiva prominent, dark brown, about one fourth as wide as abdominal tergites. Fore trochanter with four prominent setae, fore leg 6.01mm in length and

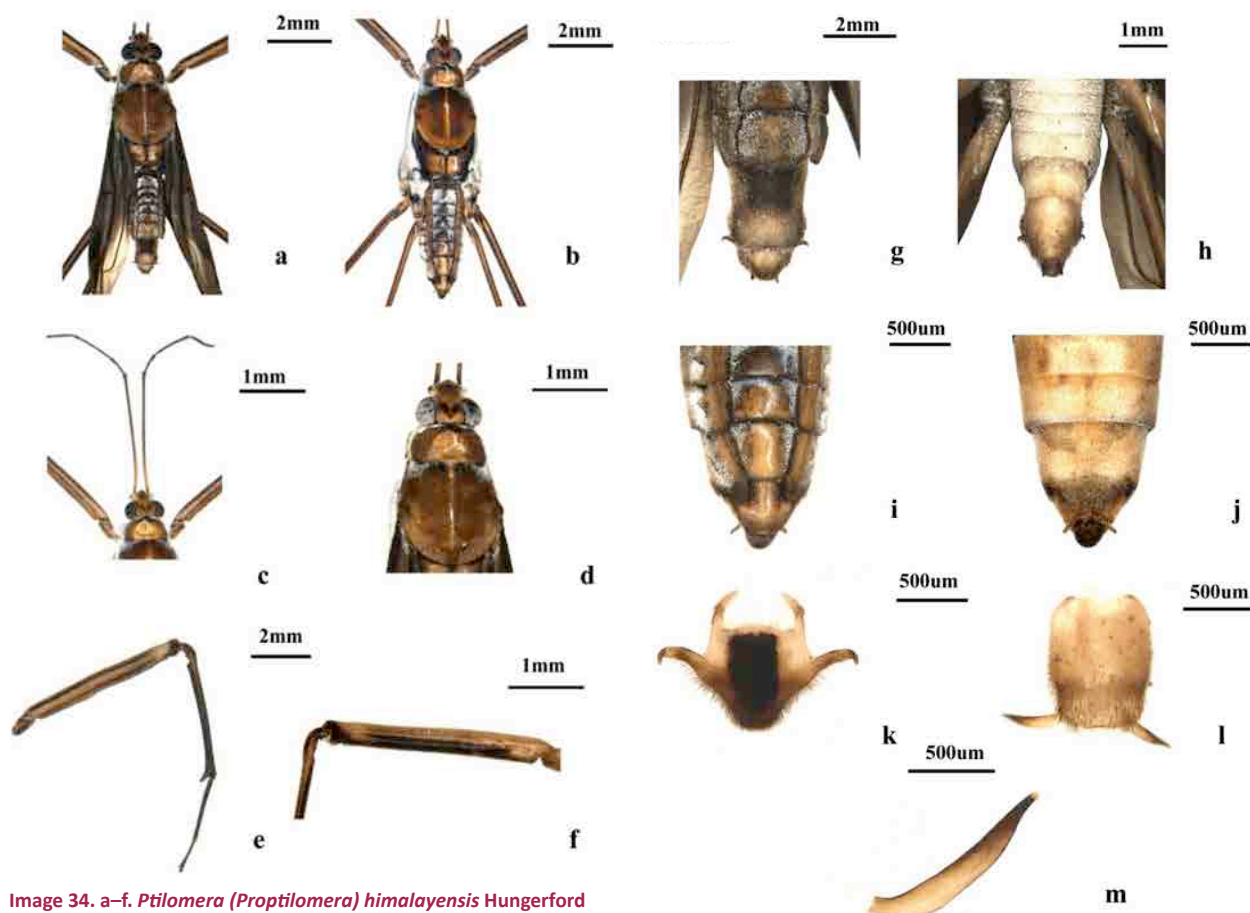


Image 34. a–f. *Ptilomera (Proptilomera) himalayensis* Hungerford & Matsuda, 1958. a. Dorsal view of male; b. Dorsal view of female; c. Head and antennae; d. Male head and pronotum; e. Fore leg of male; f. Fore femur, enlarged view

Image 35. g–m. *Ptilomera (Proptilomera) himalayensis* Hungerford & Matsuda, 1958. g. Genital segment of male, dorsal view; h. Genital segment of male, ventral view; i. Genital segment of female, dorsal view; j. Genital segment of female, ventral view; k. Proctiger of male; l. Pygophore of male; m. Male paramere

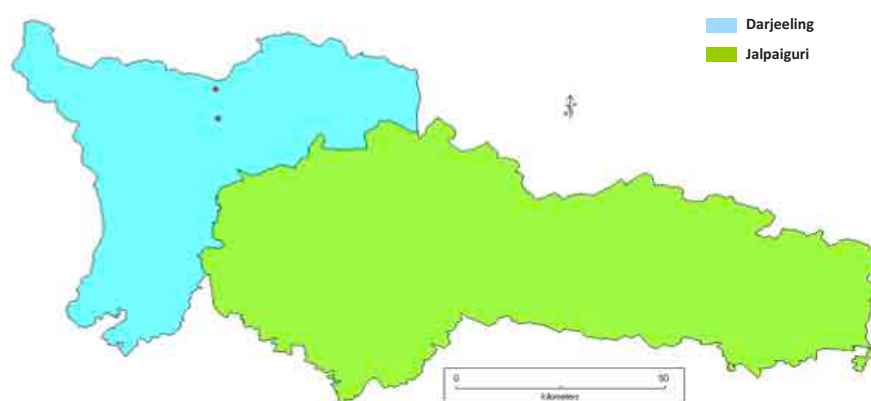


Figure 31. Distribution of *P. himalayensis* Hungerford & Matsuda in the study area

0.71mm in width, with a dense hairy black patches towards its inner margin basally and with a few setae distally, two small tooth present near tibial margin. Fore tibia with two small tooth followed by a small curvature,

marked with another small tooth towards its anterior margin; outer and inner margin with rows of hairs. Fore tarsae two-segmented, hairy with a pair of sharp, curved claws. Mid and hind legs with thick upright black



setae throughout, mid femur with swimming hair fringe posteriorly. Metacoxal spine absent.

**Genitalia:** Abdominal sternite VIII broadly elongated, clothed with short black recumbent setae dorsally, length 1.65mm and width 0.95mm. Seventh abdominal segment of male short. Pygophore (Image 35l) small, simple and broad, the lateral lobes of pygophore slender and hidden inside except their tips, without dorsolateral projections. Male proctiger as in Image 35k. Paramere as in Image 35m, apex sharp, but ends bluntly. In female, seventh abdominal segment simple, without prominent connexival spines.

**Global distribution:** India.

**Distribution in India:** Arunachal Pradesh, Sikkim, Uttar Pradesh, and West Bengal.

**Habitat:** Hill streams, mountainous rivers, and waterfalls.

**Remarks:** They are mostly found in the streams with high water currents. The members of this species can be easily distinguishable from other *Ptilomera* species by the absence of metacoxal spine.

***Ptilomera (Ptilomera) laticaudata (Hardwicke, 1823):***  
**Image 36. a–i and Image 37: j–p**

1823. *Gerris laticaudata* Hardwicke, *Transactions of the Linnean Society of London*, **14**:134

**Material examined:** Regn.no.3682/H15, 1 female, 23.iii.2013, Rishi River, Site 2, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 1 females, 2 nymphs, 4.x.2013, Bagdogra, Sanyasithan Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 3 nymphs, 19.iv.2013, Bajekhola, Jayanti Forest, Buxa Tiger Reserve, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 19.iii.2013, Buri Torsha riverside, South Khairabari Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 males, 3 females, 1.x.2013, Chel River, Gorubathan, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 3 females, 19.iii.2012, Chel River, near Ranichera Tea Garden, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 2 nymphs, 11.ix.2011, jhora near Bagrakote Tea Garden, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 26.ix.2012, jhora near Kalimpong, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 18.iv.2013, jhora near Chilapata Forest, Mendabari Beat, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 21.iii.2013, Jorkhola, Bukulung, near Mirik, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 2 nymphs, 17.iii.2013, Kalikhola, between Gorumara and Chapramari Wildlife Sanctuary, Jalpaiguri

District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 11.ix.2011, Mal River, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 3 males, 1 females, 3 nymphs, 17.iii.2013, Murti River, near Murti Rail Bridge, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 1 female, 8 nymphs, 9.xi.2013, Murti River, Samsing, Jalpaiguri District, West Bengal, India, coll. M. Chakrabarty; 1 male, 1 female, 1 nymph, 17.iii.2013, Neora River, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 3 females, 4 nymphs, 20.iv.2013, Raimatang River, Raimatang, Buxa Tiger Reserve Range, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 1 female, 4 nymphs, 15.iii.2012, Relly Khola, Teesta Bazar, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 23.iii.2013, Rishi River, Site 2, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 19.iv.2013, Bajekhola, Jayanti Forest, Buxa Tiger Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 females, 4 nymphs, 1.x.2013, Chel River, Gorubathan, Darjeeling District, West Bengal, India, coll. S. Basu; 3 females, 1 nymph, 20.iii.2012, falls near Bunkulung, near Mirik, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 3 nymphs, 18.iv.2013, jhora near Chilapata Forest, Mendabari Beat, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 1 nymph, 10.iii.2011, jhora in front of Chapramari Rail Gate, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 17.iii.2013, Murti River, near Murti Rail Bridge, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 6 females, 24.ix.2012, Murti River, on the way to Chalsa, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 female, 13.ix.2011, Teesta River, Rabijhora, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 3 nymphs, 15.iii.2012, Rellykhola, near Teesta Bazar, Darjeeling District, West Bengal, India, 23.iii.2013, coll. S. Basu; 3 females, Rishi River, Site 1, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 1 nymph, 11.ix.2011, Sukhajhora, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of apterous male ranges between 11.8–14mm; macropterous male may attain a length of 13.9–15.4mm; body length of apterous female varies from 13.0–15.4mm.

**Description:** Body colour metallic brown. Female has four black dots on vertex. Maximum body width across mesoacetabula 2.58mm in male and 3.15mm in female. Head 1.6 times as long as width ( $L/W=1.26/0.8$ ). First antennal segment longer than the rest. The length

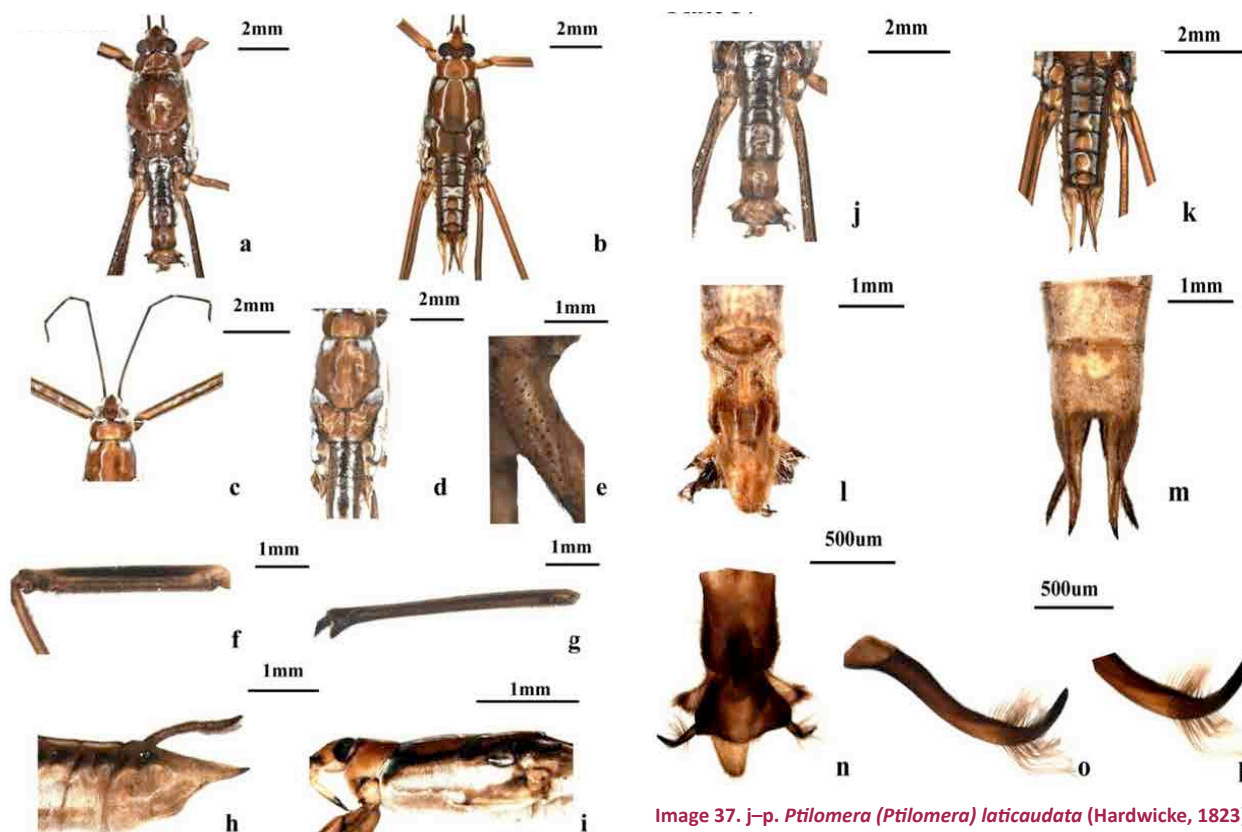


Image 36. a–i. *Ptilomera (Ptilomera) laticaudata* (Hardwicke, 1823). a. Dorsal view of male; b. Dorsal view of female; c. Head and antennae; d. Pronotum, mesonotum and metanotum; e. Mesotrochanter; f. Male fore femur; g. Male fore tibia; h. Female abdomen, lateral view; i. Lateral view, pro and meso pleura

Image 37. j–p. *Ptilomera (Ptilomera) laticaudata* (Hardwicke, 1823). j. Male genital segment, dorsal view; k. Female genital segment, dorsal view; l. Male genital segment, ventral view; m. Female genital segment, ventral view; n. Male genitalia dissected; o. Male paramere; p. Paramere, enlarged view

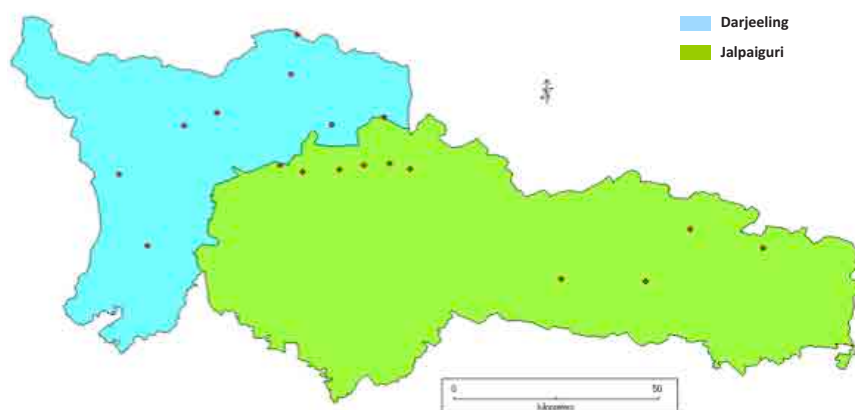


Figure 32. Distribution of *P. laticaudata* Hardwicke in the study area

of antennal segments 1–4: 5.07mm, 0.87mm, 1.65mm, 1.05mm. Interocular width almost as wide as head width, i.e., 0.76mm. Pronotum 1.96 times as wide as the length ( $W/L=1.98/1.01$ ). Abdomen 1.3 times as long as meso and metanotum together, width of abdomen 1.42mm.

Genitalia: Length of male genital segment 1.21mm

and width 2.74mm. Pygophore with median lobe very broad, but short, not as long as the distal width of lateral wing, sometimes surpassing the later caudally. Pygophore (Image 37n) relatively short, its tip bluntly pointed. Front and rear margin of wings not parallel. Paramere (Image 37o & p) in dorsal view sigmoid with the tip hairy; seventh abdominal tergite (Image 37m)

of female with rear margin not broadly rounded. Base of connexival spine arising from beneath the dorsal edge of seventh connexivum, the transverse base of connexival spines overlapping the rear margin of seventh abdominal segment on either side. Connexival spines long, their tips attaining the tips of dorsolateral lobe.

**Global distribution:** Nepal and India.

**Distribution in India:** Sikkim, West Bengal, Assam, and Himachal Pradesh.

**Habitat:** Hill streams, rivers, and waterfalls.

**Remarks:** During monsoon in North Bengal, this species is found abundantly in hilly areas.

### Genus *Heterobates* Bianchi

**Diagnosis:** Dorsally dark black, clothed with short silvery pubescence. Head with a median black spot and marginal yellowish area. Pronotum with or without median longitudinal yellow stripe. Antenna about as long as body length in male, but shorter than body in female, first segment longer than the rests together. Rostrum stout and densely clothed with hairs. Mesonotum has distinct median longitudinal sulcus. Fore femur sparsely clothed with long hairs on inner margin, fore tibia with a conspicuous process at inner apical angle. Mid tibia with fringed hairs basally, first mid tarsal segment longer than the second, without claws. Hind tibia strongly curved apically, with inconspicuous fringe of hairs on entire inner margin. Male genital segment VIII with dorsal apical margin rounded. Pygophore well-exposed, narrowly rounded on apical margin. Connexivum slanting towards middle basally in female, each abdominal tergites in female becoming progressively larger posteriorly. Seventh segment of female broadly rounded on dorsal apical margin.

### *Heterobates rihandi* (Pradhan, 1950): Image 38. a–h and Image 39. i–n

1950a. *Teratobates rihandi* Pradhan, *Records of the Indian Museum*, 48: 103.

**Material examined:** Regn.no.4060/H15, 5 males, 4 females, 17.iii.2012, Dhupjhora, Gachbari, Murti River, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 3 females, 1 nymph, 17.iii.2012, Dhupjhora, Murti River, within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4 males, 5 females, 3 nymphs, 17.iii.2013, Jaldhaka River, Nagrakata, Jalpaiguri District, West Bengal, India, coll. S. Basu; 10 males, 2 females, 21 nymphs, 20.iii.2012, Mahananda River, within Mahananda Wildlife Sanctuary, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males,

11.ix.2011, Mal River, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4 males, 5 females, 3 nymphs, 9.iii.2011, Murti River, Chalsa, Jalpaiguri District, West Bengal, India, coll. S. Basu; 3 males, 3 females, 10.iii.2011, Murti River, in front of Murti Banani Bungalow, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4 females, 17.iii.2012, Murti River, Medla Camp, Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 11.ix.2011, Sukhajhora near Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 14.iii.2011, Teesta River near Sevoke Coronation Bridge, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male ranges from 6.8–7.1 mm and females may attain a length of 7.0–7.4mm.

**Description:** Body black dorsally. Head pale brown with a central longitudinal spot extending from its anterior end to the vertex, the central spot at its posterior margin deeply emerginate. Antennal tubercles tipped with black. First antennal segment much longer than the other three segments together. Head 1.9 times as long as wide ( $L/W=0.85/0.45$ ). Eyes large, prominent and castaneous. Length of eyes 0.46mm, width 0.22mm. Rostrum 1.47mm in length, four-segmented, not passing beyond anterior coxae, third segment longest than others. Pronotum shining black with an inverted 'T'-shaped pale yellowish brown markings touching the posterior margin. Length of pronotum 0.58mm and width 1.02mm. Meso and metaotum shining black with silvery grey pubescence, provided with a central longitudinal yellowish brown marking at middle. Abdomen three times longer than wide ( $L/W=2.75/0.9$ ). In male, abdomen black with yellowish brown genital segment. Fore femora pale yellowish brown, distinctly longer than tibia. Fore tibiae with a distinct apical spine-like protuberance. Mid tibiae fringed with long swimming hairs inwardly.

**Genitalia:** Male genital segment 0.62mm in length and 0.46mm in width and bluntly acuminate towards apex. Male paramere as in Image 39n. Male proctiger broad, lateral margin little pointed outward (Image 39k). Female genital segment elongated, more or less W-shaped. Sixth abdominal tergite widest, terminal segment pale ochraceous, short, with a few short fine bristles at its posterior margin. Female connexival spines long and pointed.

**Global distribution:** India.

**Distribution in India:** Uttar Pradesh, Arunachal Pradesh, Himachal Pradesh, and West Bengal.

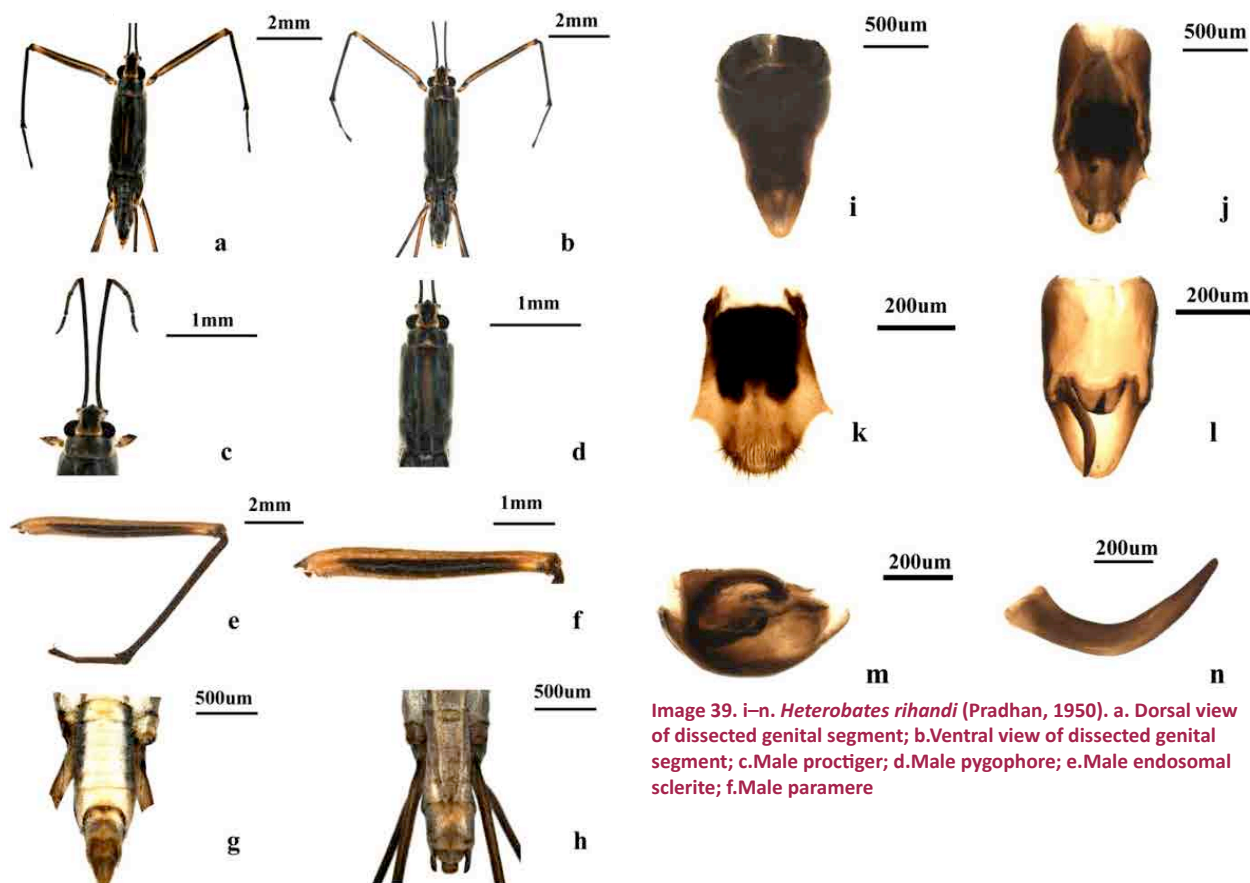


Image 38. a–h. *Heterobates rihandi* (Pradhan, 1950). a. Dorsal view of male; b. Dorsal view of female; c. Head and antennae; d. Marking pattern of pro and mesonotum; e. Male fore leg; f. Fore femur of male; g. Male genital segment, ventral view; h. Female genital segment, ventral view

Image 39. i–n. *Heterobates rihandi* (Pradhan, 1950). a. Dorsal view of dissected genital segment; b. Ventral view of dissected genital segment; c. Male proctiger; d. Male pygophore; e. Male endosomal sclerite; f. Male paramere



Figure 33. Distribution of *H. rihandi* (Pradhan) in the study area

**Habitat:** River, streams, and riffles.

**Remarks:** This species is a new record to West Bengal. They are mostly found hiding between cobbles. They possess a distinctly demarcated flattened body ventrally, which helps them in adhering to the stones or

in beds of fast-flowing hill streams.

#### Genus *Pleciobates* Esaki, 1930

**Diagnosis:** Body long, cylindrical, dark black dorsally, ventrally grey in colour, pilose. Occur in



both apterous and macropterous forms. Head wider than long, protruding beyond eyes. Antennae long, slender, first antennal segment longest, third segment longer than second and fourth. Rostrum short, not extending beyond prosternum. In apterous forms, the pronotum short, transverse, wider than long with

anterior central marking. Mesonotum longer than pronotum. Metanotum shorter than mesonotum, equal or longer than pronotum. Fore leg simple, without any modifications. Mid leg longest. Abdominal connexival spines well-developed in females, absent in male.

***Pleciobates bengalensis* Jehamalar, Basu & Zettel, 2014: Image 40. a–j**

**Material examined:** Regn.no. 3444/H15, 15 males, 1 female, 19.iv.2013, Raidhak River, Alipurduar District, West Bengal, India, coll. S. Basu; 2 females, 17.iv.2013, Dima River, Buxa Tiger Reserve, Damanpur Forest, West Bengal, India, coll. S.Basu; 4 males, 1 female, 17.iv.2013, Sikhiajhora Stream, Alipurduar District, West Bengal, India, coll. S.Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male varies from 6.07–6.90 mm; body width (across mesoacetabula) 1.80–1.76 mm. Body length of female ranges from 6.43–7.10 mm, width at mesoacetabula 2.13–2.50 mm.

Description: Dorsally dark brown to black except yellowish brown head (with a crown-shaped black mark in front of eyes), pronotum with yellow median oblong mark. Venter pale yellowish brown. Dorsally body clothed with minute silvery white hairs, prominent on meso and metanotal sulcations and on abdominal tergites. Head length 0.85mm, maximum head width across eyes 1.14mm, eye length 0.54mm, eye width 0.33mm. Dorsum of head with rows of few setae from base of antennal tubercle along inner eye margins to base of head. Lengths of antennal segments 1–4: 3mm, 0.81mm, 0.80mm, 0.76mm. Pronotum with anterior margin almost straight and posterior margin straight to concave. Meso and metanota with median longitudinal sulcus and clothed with minute silvery white hairs, combined length of meso and metanota 2.52mm. Fore trochanter with 4–6 long setae on ventral region.

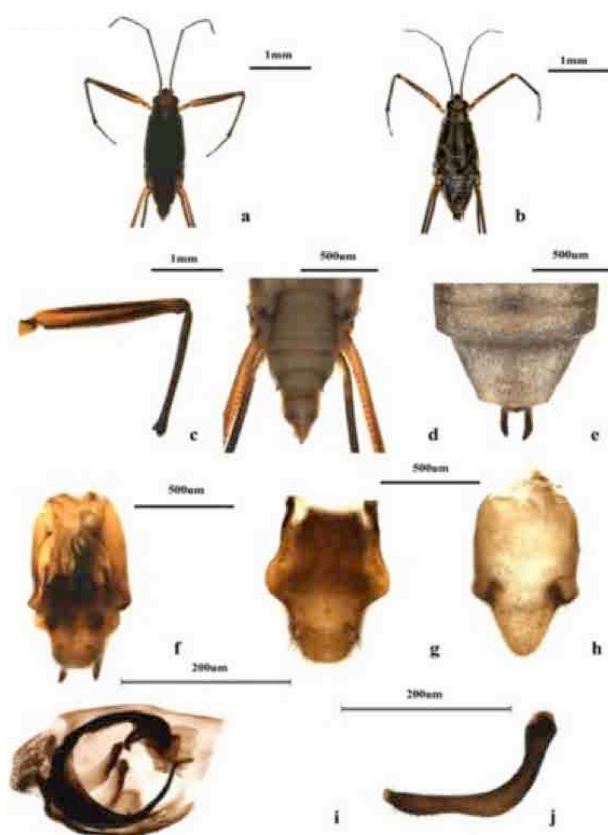


Image 40. a–j. *Pleciobates bengalensis* Jehamalar, Basu & Zettel, 2014. a. Dorsal view of male; b. Dorsal view of female; c. Male fore femur and tibia; d. Male genital segment, ventral view; e. Female genital segment, ventral view; f. Male genital segment dissected; g. Proctiger of male; h. Pygophore of male; i. Male endosomal sclerite; j. Male paramere

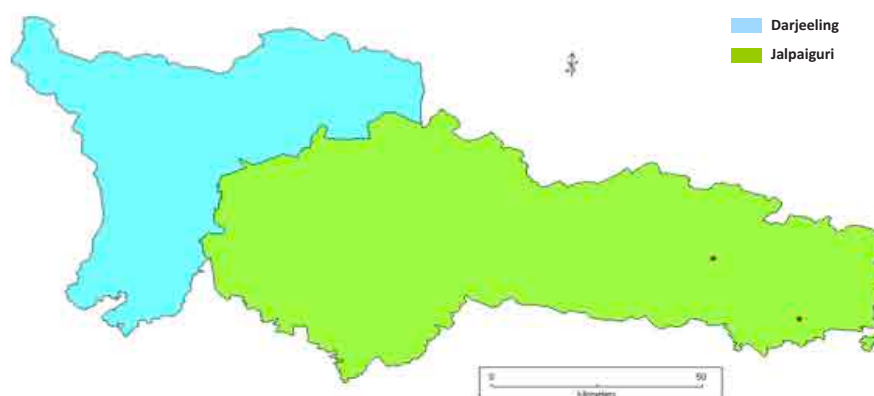


Figure 34. Distribution of *P. bengalensis* Jehamalar et al. in the study area

Fore femur dorsally with two broad black stripes, one on anterior margin and another about one-fifth from posterior margin, both confluent near apex (Image 40c), ventrally without prominent stripe, apically margined with piceous hue. Flexor side of femur with 9–11 setose spines, apex with three minute spines in addition to fringe of setae. Ventral region of mid trochanter with 2–5 denticles. Fore claws absent. Hind trochanter at posteroventral region with one to three thin short brown spines, femur at base of inner margin with three thin erect hairs, apex of femur with few stout spines. Dorsal length of abdomen of male 2.28mm, abdominal venter densely clothed with silvery white hairs. Anterior margin of tergite I distinctly convex and posterior margin distinctly concave (Image 40e), anterior region of sternum VIII with transverse depression.

Genitalia: Proctiger very broad at base, suddenly narrowed beyond midlength, clothed with dense hairs (Image 40j). Pygophore with W-shaped median notch at base, its apical part produced into tongue-like lobe, clothed with minute hairs, posterolateral region of basal part blunt in lateral view (Image 40g). Paramere basally stout, curved before middle, outer margin beyond middle curved, apical part with pilosity, tip blunt and slightly bent to middle (Image 40h), visible externally at abdominal tip. Dorsal sclerite of endosoma deeply split anteriorly and basally (Image 40i). Connexival segment VI with long, tubular, yellowish brown process clothed with numerous short hairs, first gonapophysis (G-I) with several long setae basoventrally on both sides and with numerous medium-sized setae dispersed throughout ventral region; apically with a thorn-like blunt process, length of process I (GP-I).

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** This species is found in the shady areas of slow-flowing rivers or streams.

**Remarks:** The males of *Pleciobates bengalensis* Jehamalar, Basu & Zettel, 2014 can be easily distinguished from the most closely related species, *P. expositus*, by a prominent silvery white fascia on each side of the sublateral region of the mesonotum, the straight posterior margin of abdominal tergite VII, the concave posterior margin of tergite VIII, and the structure of endosomal sclerites.

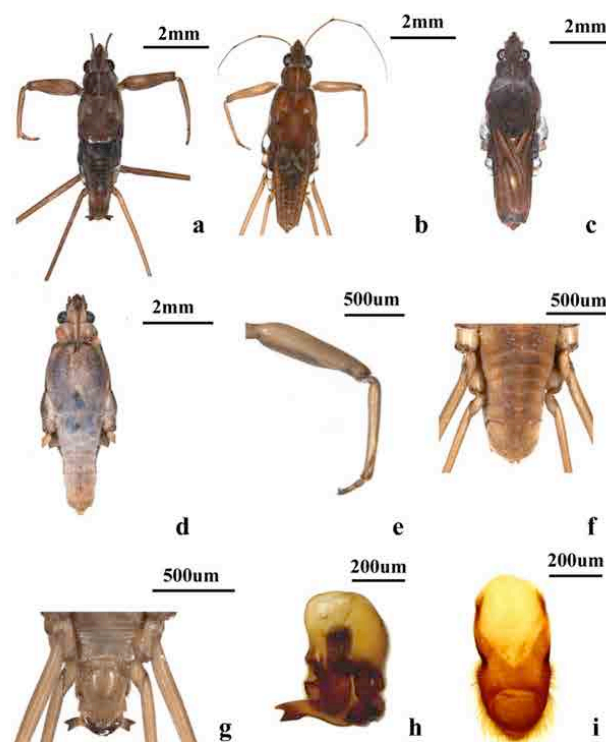


Image 41. a–i. *Chimarrhometra orientalis* (Distant, 1879). a. Dorsal view of apterous male; b. Dorsal view of female; c. Dorsal view of macropterous male; d. Ventral view of female; e. Fore leg of male; f. Female genital segment, ventral view; g. Male genital segment, ventral view; h. Male genital capsule with paramere; i. Pygophore of male

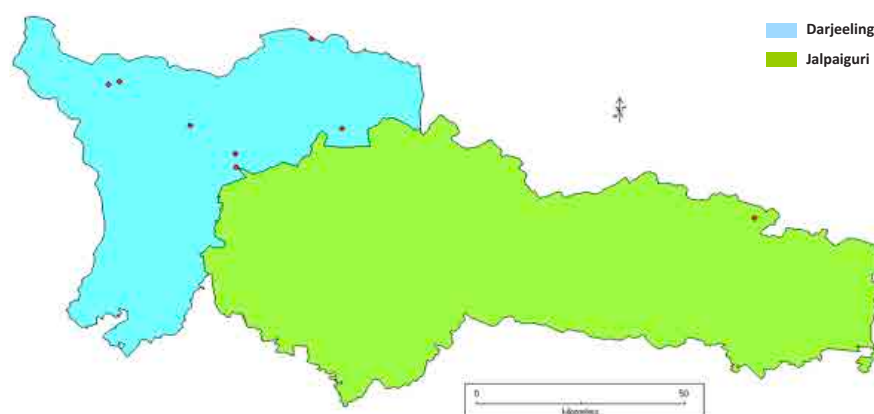


Figure 35. Distribution of *C. orientalis* (Distant) in the study area

**Genus *Chimarrhometra* Bianchi, 1896**

**Diagnosis:** Body elongated, dorsally yellowish to reddish brown with black or brown markings. Venter pale in color. Head directed forward with small distinctly visible antenniferous tubercles. Eyes large, globular. Antennae slender, shorter than the body, first antennal segment distinctly longer than the other segments, without spine-like hairs. Rostrum stout, reaching hind margin of prosternum. Pronotal lobe completely reduced in apterous forms. Fore femora incrassate in male. Hind legs much shorter than the mid leg. Hind tarsae shorter than mid tarsae, claws long, hook-shaped. Males with relatively short pregenital abdomen. Male parameres very long and falciform with short hairs. Female sternum VII sub-equal in length of preceding two sterna together.

***Chimarrhometra orientalis* Distant: Image 41. a–i**

1879. *Halobates* (?) *orientalis* Distant, *Transactions of the Royal Entomological Society of London*: 126.

1908. *Rheumatotrechus himalayanus* Kirkaldy, *Canadian Entomologist*, 40: 452.

1910b. *Gerris monticola* Distant, *Annals and Magazine of Natural History*, 5(8):141.

**Material examined:** Regn.no. 3181/H15, 2 males, 5 females, 29.ix.2013, Bijanbari Bazar, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 3 females, from Buxa Jhora, 19.iv.2013, Buxa Fort, Buxa Tiger Reserve, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 3 females, 1 nymph, 12.ix.2011, Dhobijhora, Mongpu, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 1.x.2013, jhora near Gorubathan, Darjeeling District, West Bengal, India, coll. S. Basu; 3 males, 1 female, 14.iii.2011, Kalijhora, near Teesta Coronation Bridge, Darjeeling District, West Bengal, India, coll. S. Basu; 5 males, 4 females, 23.iii.2013, stagnant pool beside Rishi River, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 30.ix.2013, stream near Pulbazar, Darjeeling District, West Bengal, India, coll. S. Basu; 6 females, 4 nymphs, 14.iii.2011, Teesta River near Sevoke Coronation Bridge, Darjeeling, West Bengal, India, coll. S. Basu; 4 nymphs, 20.iii.2013, falls near Bunkulung, Mirik, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Males may attain a length of about 8.0mm. Length of female insects vary from 8–9.2mm.

**Description:** Body yellowish brown to reddish brown dorsally. Head with a broad median band and narrow

lateral stripes. Antennae and legs mainly brownish yellow. Fore wings brownish. Head with semi-globular, large eyes, width of head across head 1.2–1.4mm. Length of antennal segments 1–4: 1.7mm, 1.3mm, 1.1mm, 1.2mm. Pronotum truncated anteriorly with mid-longitudinal pale line and mesonotum with paired oblique depression near the anterior margin. Fore femora distinctly incrassate, length 2.5mm and width 1.1mm. Mid femur sub-equal in length to body, but little longer than the hind femur. Wings reaching apex of abdomen.

**Genitalia:** Male genital segment (Image 41h) more or less depressed posteriorly, sternite VII a little longer than preceding two sterna together. Male pygophore (Image 41i) large, sub-ovate, forked into into a pair of prominent, vertically raised, antler shaped process. Parameres (Image 41h) falciform, large, with apices crossing beneath pygophore. In females, genital segments protruding from abdominal end (Image 41f). Proctiger small and cone-shaped.

**Global distribution:** Pakistan and India.

**Distribution in India:** Arunachal Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Meghalaya, Sikkim, Uttar Pradesh, and West Bengal.

**Habitat:** Hill streams, waterfalls, cascades, and rivers.

**Remarks:** They are mostly found in the shallow edges of streams or between rocks in streams. They can be easily identified by their modified male genital segment.

**Genus *Amemboa* Esaki (1925)**

**Diagnosis:** Body elongate and oval. Head slightly projected in front of eyes. Dorsally, body yellow to orange yellow with black or brown markings. Head with lyre-shaped markings or sometimes with two sub-lateral stripes. Antennal tubercles small but distinctly visible from above. Eyes large, globular. First, second, and third antennal segments sub-equal in length, fourth segment longer than the third. First antennomere with short dark scattered spines. Pronotum wider than interocular width. Fore femora incrassate in some species and with modification like patches of black hairs or with spines. Hind tibia shorter than mid tibia. First segment of mid tarsus longer than the second segment. Male pygophore usually modified apically, proctiger with or without lateral arms. Parameres always rudimentary often large. Female abdominal sternum VII longer than all preceding sterna. Female proctiger rounded posteriorly.

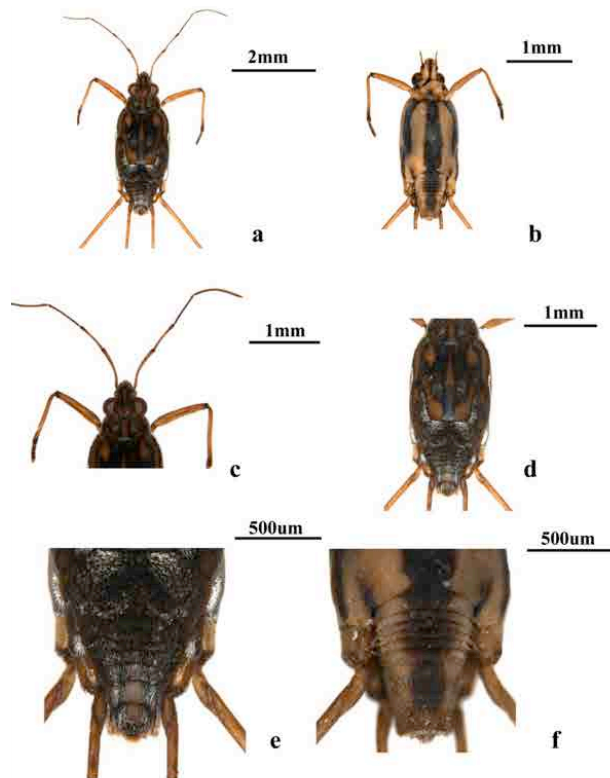


Image 42. a–f. *Amemboa kumari* (Distant, 1910). a. Dorsal view of female; b. Ventral view of female; c. Head and antennae; d. Markings of meso and metanotum; e. Female genital segment, dorsal view; f. Female genital segment, ventral view

8.iii.2011, Sikhiakhora, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male 3.12–3.3 mm and body length of female 3.46–3.52 mm. Max body width of male 0.95mm and of female 1.24mm.

**Description:** Body dark black with distinct yellowish orange markings. Length of head 0.61mm and width 0.39mm, head directed forward, with median lyre-shaped markings and two sub-lateral streaks. Antennal tubercle small, but visible from above. Length of antennal segments 1–4: 0.68mm, 0.56mm, 0.63mm, 0.72mm. Interocular width 0.39mm. Eye length 0.32mm and width 0.18mm, eyes large and globular, red in colour. Length of pronotum 0.39mm and width 0.83mm, pronotum anteriorly with two median and two sublateral longitudinal stripes. Metanotum and abdomen dorsally dark, marked with yellow markings. Mesopleura with longitudinal dark stripe, venter pale yellow, marked with one median and two sublateral dark markings. Metasternal process is sub-triangular and centrally longitudinally sulcate. Male fore femur relatively slender, with two separate hair tufts beyond middle. Mid femur relatively long. Length of abdomen 1.11mm and width 0.69mm.

**Genitalia:** Length of female genital segment 0.58mm

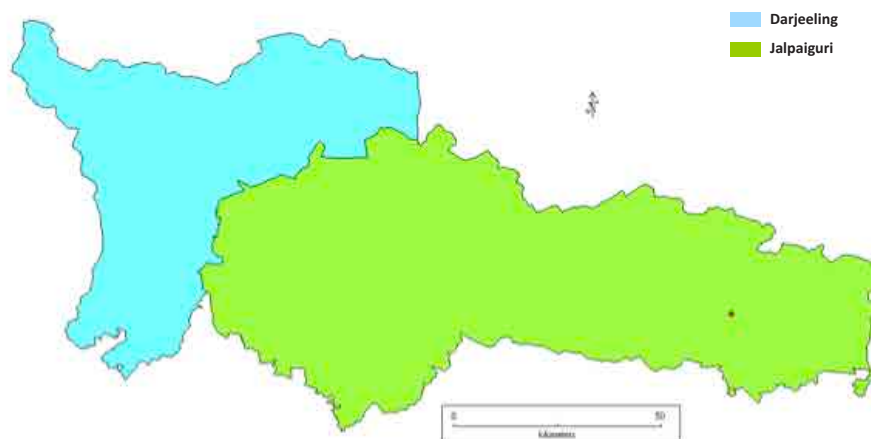


Figure 36. Distribution of *A. kumari* (Distant) in the study area

***Amemboa kumari* (Distant, 1910): Image 42. a–f**

1910b. *Onychotrechus kumari* Distant, *Annals and Magazine of Natural History*, 5 (8):145.

1984. *Amemboa* (*Amemboa*) *kumari* (Distant): Polhemus and Andersen, *Steenstrupia*, 10 (3): 85.

1950b. *Amemboa pervati* Pradhan, *Records of the Indian Museum*, 48 (3 & 4): 12.

**Material examined:** Regn.no.3506/H15, 2 females,

and width 0.52mm. Female genitalia as in Image 42e & f.

**Global distribution:** India.

**Distribution in India:** Karnataka, Kerala, Tamil Nadu, Odisha, and West Bengal.

**Habitat:** Jungle streams, pools, puddles near river banks or stream beds.

**Remarks:** This species is a new record to West



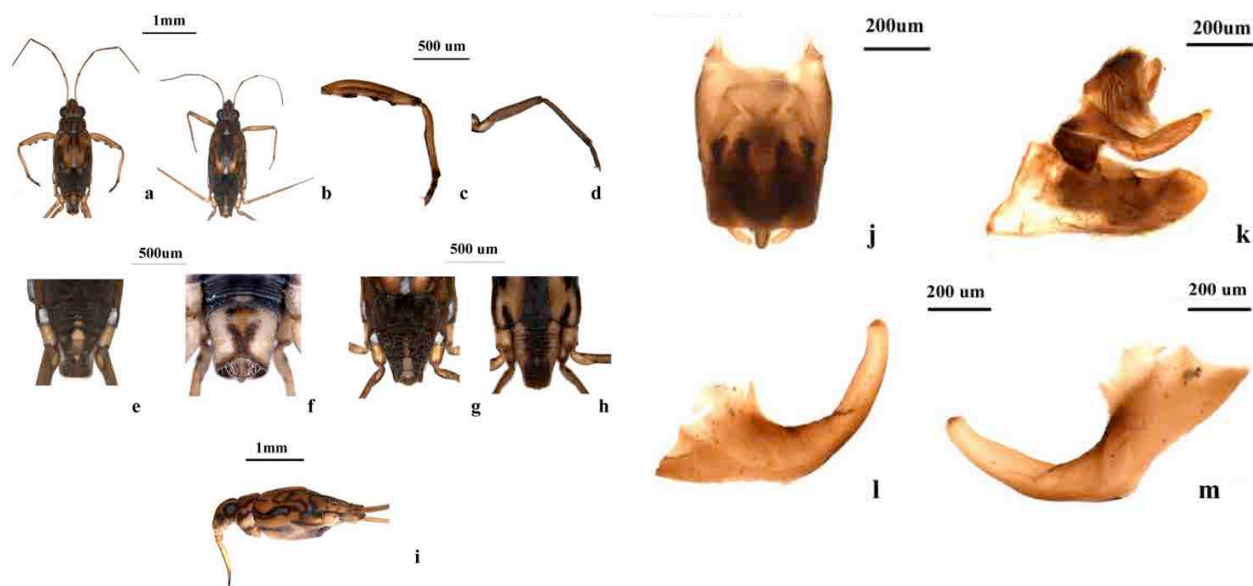


Image 43. a–i. *Amemboa mahananda* Basu, Subramanian & Polhemus, 2014. a. Dorsal view of apterous male; b. Dorsal view of apterous female; c. Fore leg of male, dorsal view; d. Fore leg of female, dorsal view; e. Male genital segment, dorsal view; f. Male genital segment, ventral view; g. Female abdominal tergites, dorsal view; h. Female abdominal tergites, ventral view; i. Lateral view showing pleural marking pattern

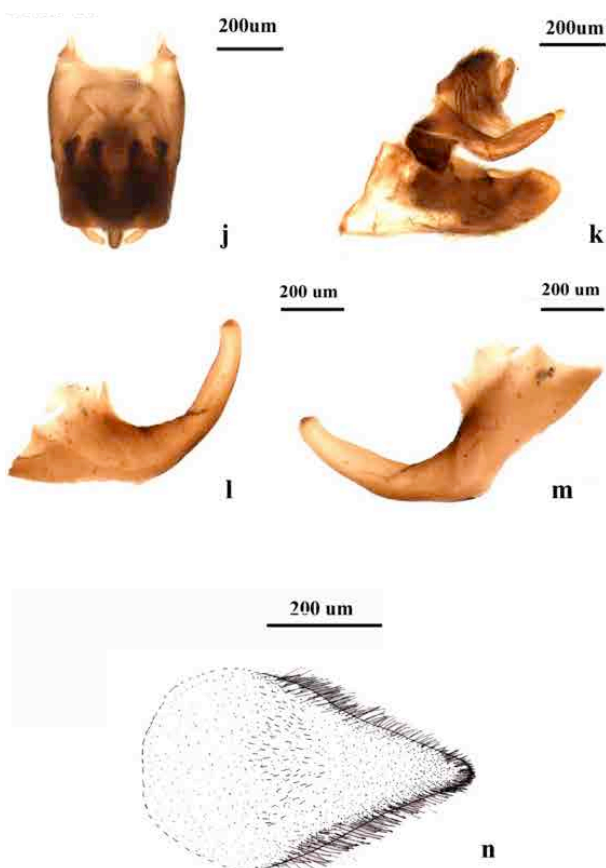


Image 44. j–n. *Amemboa mahananda* Basu, Subramanian & Polhemus, 2014. j. Dorsal view of dissected genital segment; k. Pygophore and proctiger, lateral view; l–m. Male lateral arms of proctiger (two opposite views); n. Proctiger, after dissection

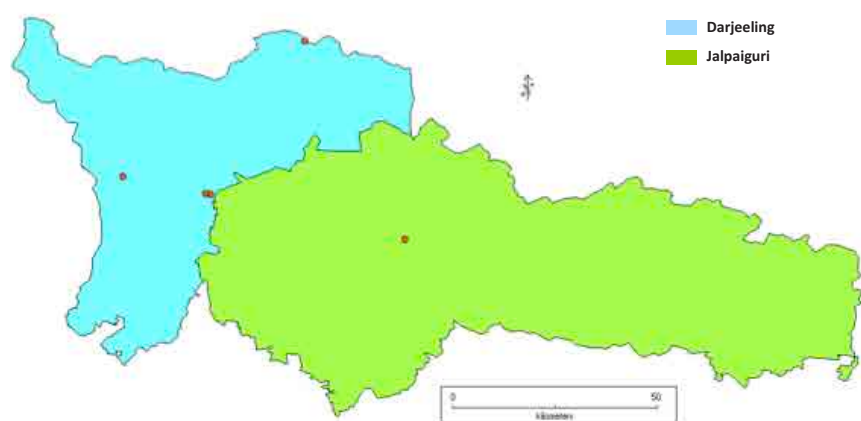


Figure 37. Distribution of *A. mahananda* Basu et al. in the study area

Bengal. The females are difficult to identify without associated males.

***Amemboa mahananda* Basu, Subramanian & Polhemus, 2014: Image 43. a–i, Image 44. j–o**

**Material examined:** Regn.no.4597/H15, 9 males, 3

females, 20.iii.2012, stagnant pool, Mahananda Wildlife Sanctuary, Darjeeling District, West Bengal, India, coll. S. Basu; 5 males, 3 females, 2 nymphs, 20.iii.2012, Panchanoi River, Mahananda Wildlife Sanctuary, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male 3.24–3.48 mm (3.36mm), maximum width across mesoacetabula 1.10–1.20 mm (1.13mm). Body length of female 3.42–3.69 mm, maximum width across mesoacetabula 1.30–1.36 mm.

Description: Black with prominent yellowish orange markings and silvery dots dorsally. Head little broader than long, yellowish with a roughly V-shaped black mark medially, a pair of black elongated spots near the inner margin of eyes. Interocular region 2.4 times longer than eye width (interocular width/eye width=0.44/0.18). Antennal segments spiny, antennomere 1–3 almost equal in length, length of antennal segment 1–4: 0.78mm, 0.74mm, 0.75mm, 0.86mm. Rostrum 1.40mm in length, surpassing the fore trochanter. Pronotum with a roughly W-shaped yellow mark, laterally connected to the propleural stripes. Mesonotum and metanotum also with a prominent broad W-shaped yellow mark, wider than head. Certain individuals with middle arm of this 'W' disconnected from remainder of the two arms. Genital segments (tergite VIII) black with three triangular, small yellowish markings anteriorly. Mesonotum and metanotum 2.9 times longer than pronotum. Fore femur with three hairy black patches located almost equidistantly, followed by a shallow curvature distally. In some specimens, the last two black hairy patches connected with a median hairy zone distally, where as some lack this continuation. Fore leg of female relatively simple, without any markings (Image 43c). Middle femur 2.5 times as long as fore femur and 1.1 times longer than hind femur. Fore tibia hairy, basally with an indentation. Tarsus with a pair of prominent curved claws. Abdomen including genital segment 1.3 times longer than the width (length/width=0.91/0.72).

Genitalia: Sternite VIII of male, 1.3 times longer than width (length/width=0.96/0.7), almost rectangular with its curved lateral arm of proctiger projecting outward in some individuals, however, in others, this is hidden within the genital segment. Pygophore widened basally on ventral view, but tapering distally, with scattered long hairs medially and densely arranged hairs along its margin. Proctiger shaped as roughly arrow-shaped, outer margin curving inward. The lateral arms of proctiger long, slender curved at middle, distally almost straight, weakly narrowed towards truncated apex (Image 44l & m). Female genital segment bucket shaped, much wider anteriorly (Image 43g & h).

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** Stagnant pools covered with algae and

steep, shaded banks of streams.

**Remarks:** *Amemboa mahananda* Basu, Subramanian & Polhemus, 2014 is a close relative of *Amemboa speciosa* Polhemus and Andersen, 1984 from southern Vietnam.

***Amemboa bifurcata* Basu, Subramanian and Polhemus, 2014: Image 45. a–j, Image 46.k–p**

**Material examined:** Regn.no. 3134/H15, 2 males, 19.iv.2013, Bania River, Chilapata Forest, Alipurduar District, coll. S. Basu; 4 males, 10 females, 4 nymphs, 17.iii.2013, Kalikhola, stream flowing between Chapramari Wildlife Sanctuary and Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male 3.23–3.62 mm, maximum width across mesoacetabula 1.04–1.13 mm. Body length of female 4.14–4.28 mm, maximum width across mesoacetabula 1.33–1.36mm.

Description: Brownish black with yellow markings dorsally. Head yellowish with black markings, 1.2 times wider than long, length of head 0.57mm, width of head across eyes 0.71mm. Interocular width 0.42mm. Eye reddish brown. Antennae shorter than body-length, length of antennomeres 1–4: 0.76mm, 0.74mm, 0.78mm, 0.86mm. Pronotum 1.8 times wider than length (W/L=0.87/0.48), black with yellow marking as typical for the genus. Metanotum almost black, with silvery pubescence, posterior margin sinuate. Male fore femur (Image 45d & e) moderately incrassate, ratio of length and width 4.1 (0.99/0.24), with three black tuft of hairs, basal part with elongated patch of stiff sub-erect hairs, followed by one thin almost pointed patch of hairs and distally with one elongated patch of black, short hairs. Fore tibia modified with outer margin concave and inner margin with a prominent ridge near middle, covered with short dense pilosity. Fore tarsus with first segment shorter than second segment; claws sharply bent, curved. Fore leg (Image 45f) of female relatively slender, dorsally with a black stripe, ratio of length and width 5.9 (1.18/0.20), inner margin of fore femora with densely arranged black hairs and with golden hairs distributed throughout. Mid leg longer than the hind leg. Mid and hind femur, tibia, tarsus with scattered spines. Abdominal tergite II–IV entirely black, V–VIII black with a median yellow spot. Meso- and metaacetabula with silverish, shining, frosted areas, sterna II–VI combined; sternite VII little wider and longer than the rest.

Genitalia: Abdominal sternum VIII 1.4 times as long as wide (L/W=0.69/0.48), elongated, with silvery

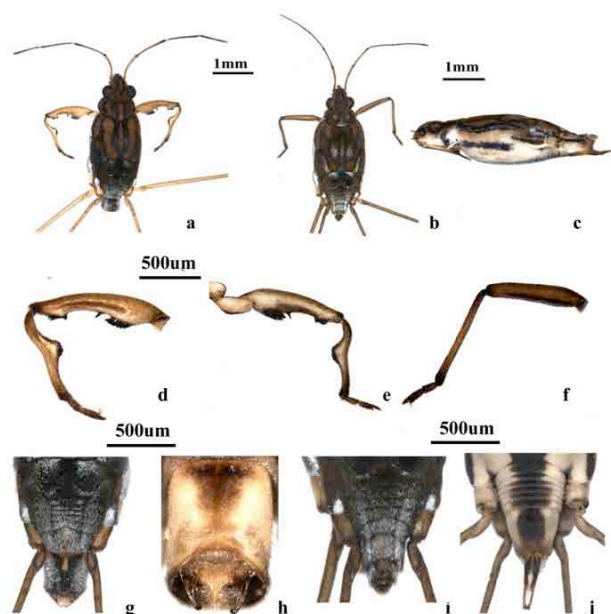


Image 45. a–j. *Amemboa bifurcata* Basu, Subramanian & Polhemus, 2014. a. Apterous male, dorsal view; b. Apterous female, dorsal view; c. Lateral view showing pleural marking pattern; d. Male fore leg, dorsal view; e. Male fore leg, ventral view; f. Female fore leg, dorsal view; g. Abdominal tergites of male; h. Abdominal sternites of male; i. Abdominal tergites of female; j. Abdominal sternites of female

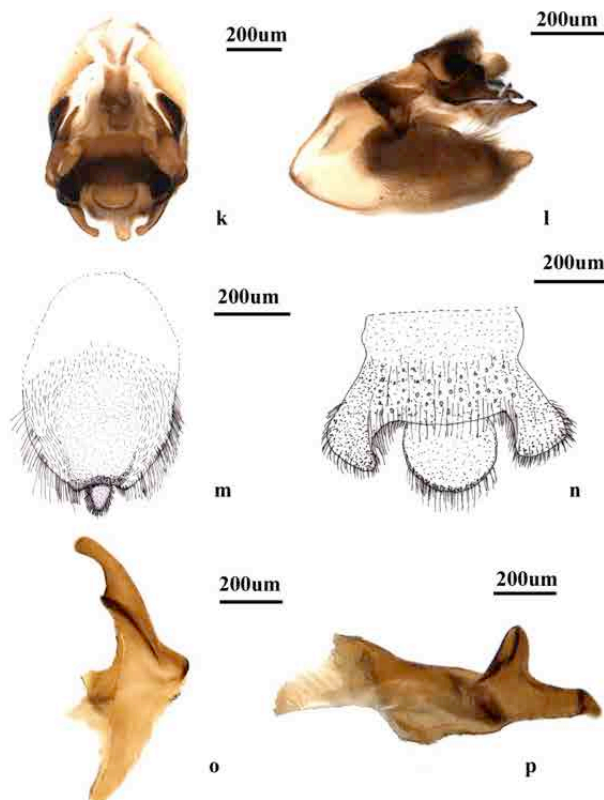


Image 46. k–p. *Amemboa bifurcata* Basu, Subramanian & Polhemus, 2014. k. Genital segment of male, ventral view; l. Pygophore and proctiger, lateral view; m. Pygophore of male; n. Proctiger of male; o–p. Male lateral arms of proctiger (two opposite views)

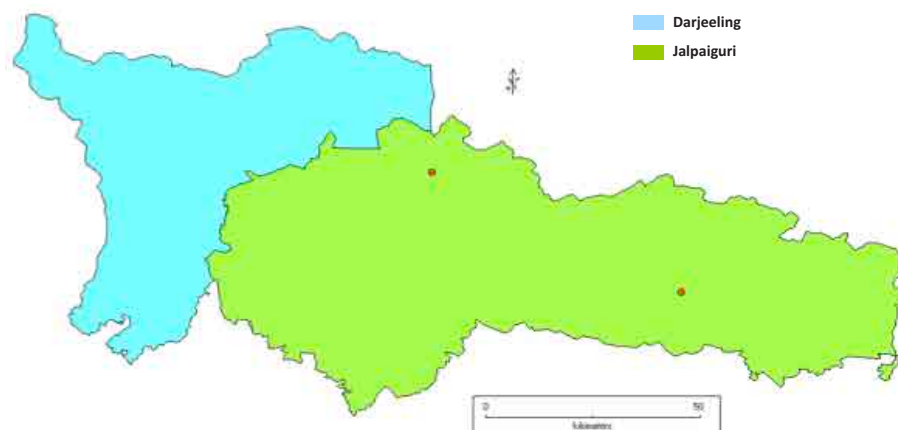


Figure 38. Distribution of *A. bifurcata* Basu et al. in the study area

pubescence. Pygophore and proctiger as in Image 46m & n. Pygophore oval-shaped, basally more widened, with densely arranged long hairs and modified distally into an elongated narrow process. Proctiger semi-circular in shape, hairy below. The lateral arms of proctiger bifurcated at middle forming two slender arms, tip of these two bifurcations end bluntly. In dorsal view, it

is widened anteriorly, and then gradually narrowed towards its posterior end (Image 46o & p). Female sternum VII 1.28 times as long as wide ( $L/W=0.73/0.57$ ), basally broad, trapezoid, hairy below. Ovipositors (Image 45j) are long with densely arranged spines on it. Proctiger of female round shaped, ends bluntly.

**Global distribution:** India.

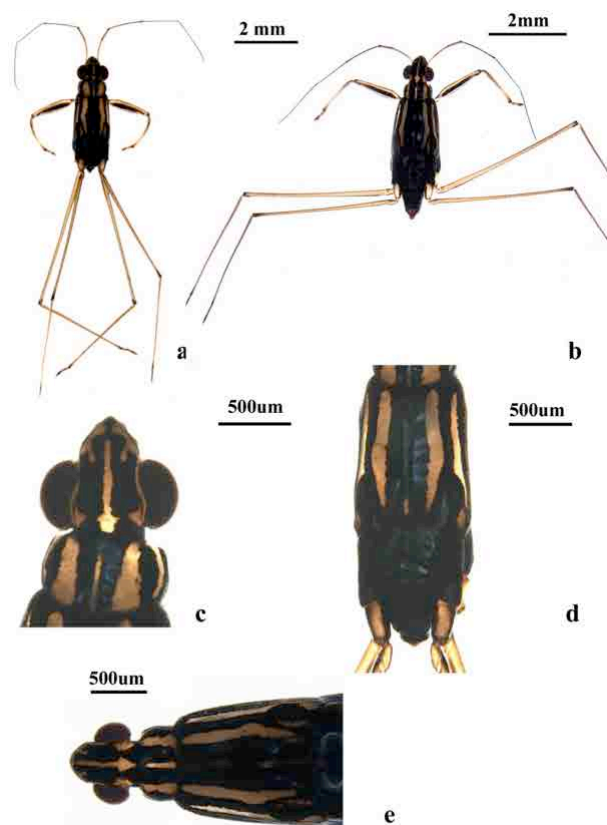


Image 47. a–e. *Onychotrechus dooarsicus* Subramanian, Basu & Zettel, 2014. a. Dorsal view of apterous male; b. Dorsal view of apterous female; c. Head and pronotal marking pattern in male; d. Meso- and metanotal marking pattern in male; e. Marking pattern in female

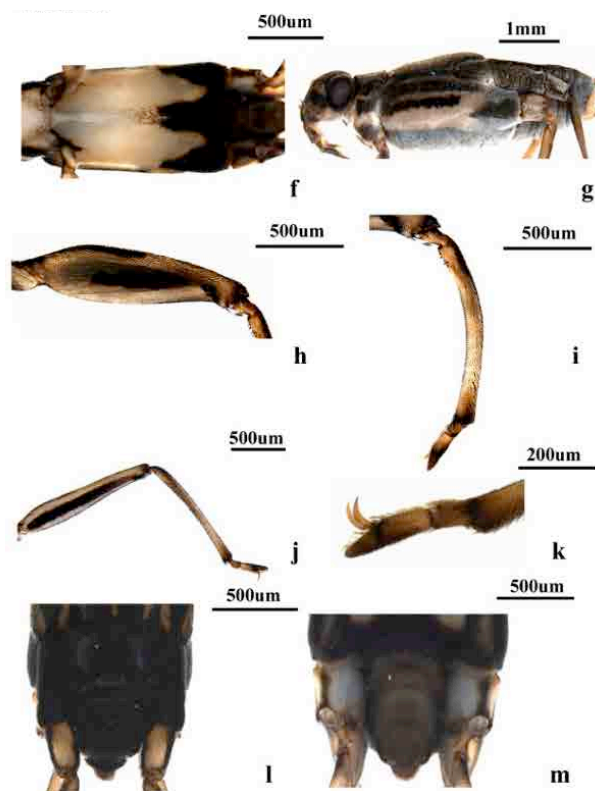


Image 48. f–m. *Onychotrechus dooarsicus* Subramanian, Basu & Zettel, 2014. f. Mesosternum of male, ventral view; g. Lateral view of female; h. Forefemur of male; i. Foretibia and tarsi of male; j. Foreleg of female; k. Foreleg claws in male; l. Abdominal tergites of male; m. Abdominal sternites with genital segments in male

**Distribution in India:** West Bengal.

**Habitat:** Stagnant pools covered with algae and stream, river.

**Remarks:** *Amemboa bifurcata* Basu, Subramanian and Polhemus, 2014 is closely related to *A. dentata* Polhemus and Andersen, 1984, first described from Dehradun, Uttarakhand.

#### Genus *Onychotrechus* Kirkaldy, 1903

**Diagnosis:** Body small, elongated. Head typically with amedian, longitudinal yellowish brown stripe. Pronotum black with a median and two sub-lateral stripes. Venter pale yellowish. Head projected forwards with prominent antenniferous tubercles. Eyes large, globular. Antennae longer than body, first segment of antenna longer than the second with two closely set dark spine-like hairs in apical third and usually another two spine-like hairs beyond that. Pronotal lobe reduced in apterous forms, but macropterous forms having distinct humeri. Fore femora usually slender, may or may not be modified apically in male. Mid and hind

legs sub-equal in length. First tarsal segment shorter than the second, with ventral row of spine-like hairs. Males with abdominal venter about one-fifth of body length and more or less distinctly grooved medially. Male genital segments small. Claspers relatively small, club-shaped with short setae. Endosomal sclerite well-developed with long lateral sclerite. Female sternum VII partly exposed ventrally.

***Onychotrechus dooarsicus* Subramanian, Basu and Zettel, 2014:** Image 47. a–e, Image 48. f–m and Image 49. n–s

**Material examined:** Regn.no.3131/H15, 2 males, 1 female, 19.iv.2013, Buxa Jhora near Buxa Fort, Buxa Tiger Reserve, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length (from head tip to the tip of proctiger) of apterous male 3.27–3.30mm, maximum width of body across mesoacetabula 1.12–1.07mm. Body length of apterous female 4.4mm,

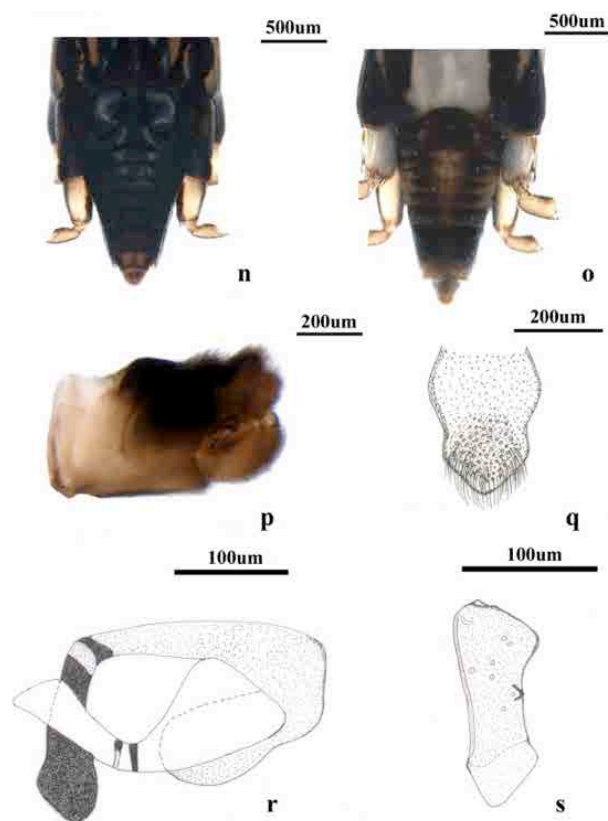


maximum body width across mesoacetabula 1.38mm.

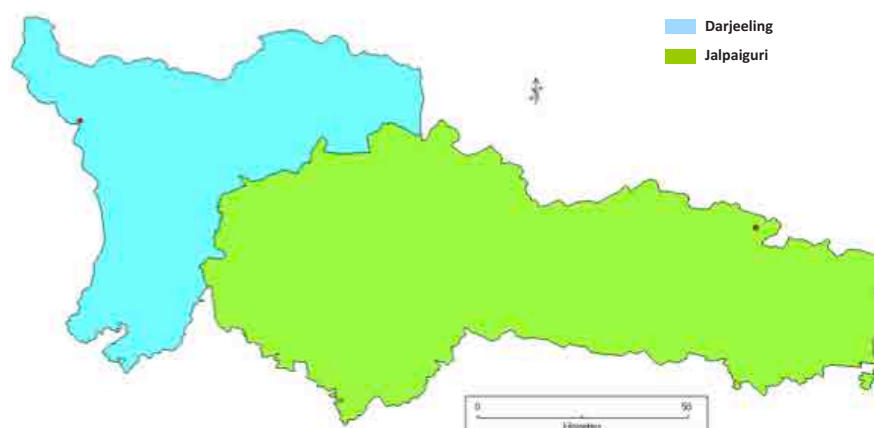
**Description:** Body dorsally black with yellow markings. Head with a median yellow longitudinal stripe, which ends in a blunt arrow head (Image 47c), head length 0.64mm, width 0.41mm. Interocular width two times as large as eye width (0.45:0.22). Eye length 0.44mm. Length of antennal segments 1–4: 0.96mm,

0.94mm, 0.89mm, 1.38mm, first antennomere with three spines distally, of which two spines are long, third one small and arising near base of first spine. Pronotum with two broad yellow sub-lateral stripes, a thin median yellow stripe, and two yellow curved lateral stripes. Pronotum length 0.53mm, width 0.79mm. Meso and metanotum with two thin lateral stripes, two broad sub-lateral stripes and an indistinct short yellow median line. Mesosternum (Image 48f) modified, with narrow median groove slightly widened posteriorly, depression with black, scattered setae directed to its centre. Forefemur (Image 48h) slender, widened basally, but almost evenly tapering apically, length of forefemur 1.17mm, width 0.25, apically with a few setae and with short dark stiff hairs distributed throughout, yellow with one broad dark band on dorsal side and one very slender dark brown band on extensor side. Foretibia (Image 48i) strongly curved, basally with patch of few short hairs on flexor side, a soft spinous structure protruded outwards from base of curvature; apical region with two prominent black spines that diverge from almost touching bases (forming a 'V'), and with four black spines and a row of short hairs towards extensor side. Mid and hind femora slender, both with distinct rows of short spines arranged equidistantly. Fore claws (Image 48k) sharply bent and slightly longer than mid and hind claws. Abdominal tergites completely black (Image 47d and Image 48l). Abdomen (Image 48l & m) short, only about one-third of body length. Length of abdominal sternites 1.01mm, width 0.90mm. Sterna II–VI visible as very narrow curved strips, sternum VII (Image 49p) much longer.

**Genitalia:** Pygophore sub-oval, little elongated, widened basally. Proctiger (Image 49r) short, widened distally, gradually tapering towards basal part, with long setae and medially with numerous punctures.



**Image 49.** n–s. *Onychotrechus dooarsicus* Subramanian, Basu & Zettel, 2014. n. Abdominal tergites of female; o. Abdominal sternites of female; p. Dissected genital segments of male; q. Proctiger of male; r. Endosoma, lateral view; s. Left paramere, lateral view



**Figure 39.** Distribution of *O. dooarsicus* Subramanian et al. in the study area

Endosomal sclerites as in Image 49s. Paramere (Image 49t) short, simple and with a distinct median notch. Abdominal tergites of female (Image 49o) elongated, hairy. Abdominal sterna II–VI with median groove, sternum VII (Image 49p) broad, trapezoid, concave

towards end, partly concealing genitalia. Proctiger acuminate.

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** Shallow zones between rocks, splashed by slow-flowing streams.

**Remarks:** *Onychotrechus dooarsicus* Subramanian, Basu & Zettel, 2014 is a close relative to *Onychotrechus jaechi* recently described from Bhutan. They share some common characteristics such as males of both species have almost identical pro-, meso- and metasternal markings, basally incrassate fore femora, similar mesosternal modifications and short abdominal segments.

#### Genus *Gerris* Fabricius, 1794

**Diagnosis:** Body small or medium in size, length varies from 5.0–15mm. Wing dimorphic species. Head elongated with prominent markings. Antennae are short and shorter than half of body-length, first antennal segment without spinous hairs, distinctly shorter than the second and third segment together. Fore femora usually pale and with longitudinal dark stripes, thickened. Metasternal scent orifice slit-shaped and tuberculated. Hind femora sub-equal or shorter than mid tibia. Posterior corners of abdominal connexiva triangular and pointed, but not spinous, except in a few females. Phallosome of male well-sclerotised ventrally.

#### *Gerris (Gerris) nepalensis* Distant, 1910: Image 50. a–i

**Material examined:** Regn.no. 3186/H15, 1 male, 2 females, 4 nymphs, 17.iii.2012, Kalipur wetland, within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 17.iv.2013, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

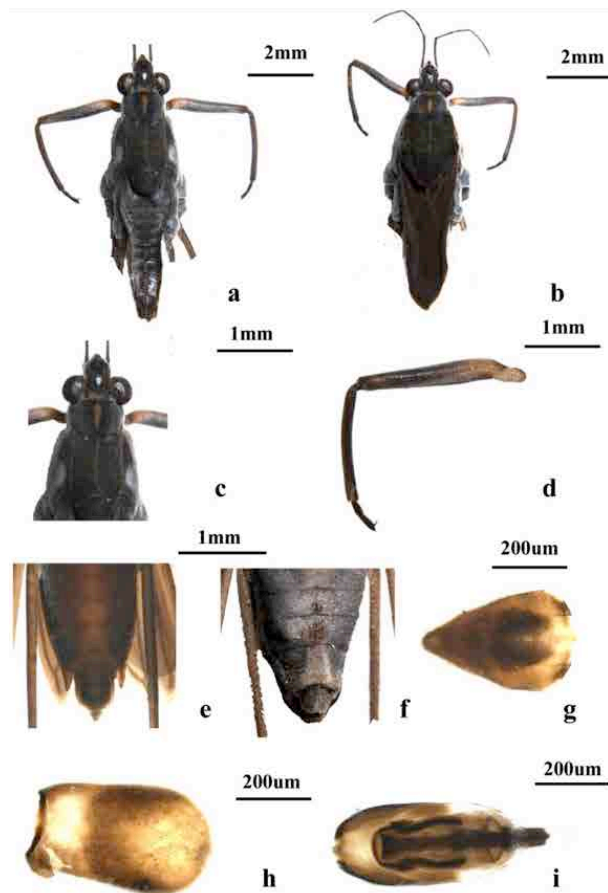


Image 50. a–i. *Gerris (Gerris) nepalensis* Distant, 1910. a. Dorsal view of apterous male; b. Dorsal view of macropterous male; c. Head and pronotum; d. Male fore leg; e. Male genital segment; f. Female genital segment; g. Proctiger of male; h. Pygophore of male; i. Dorsal view of endosomal sclerite

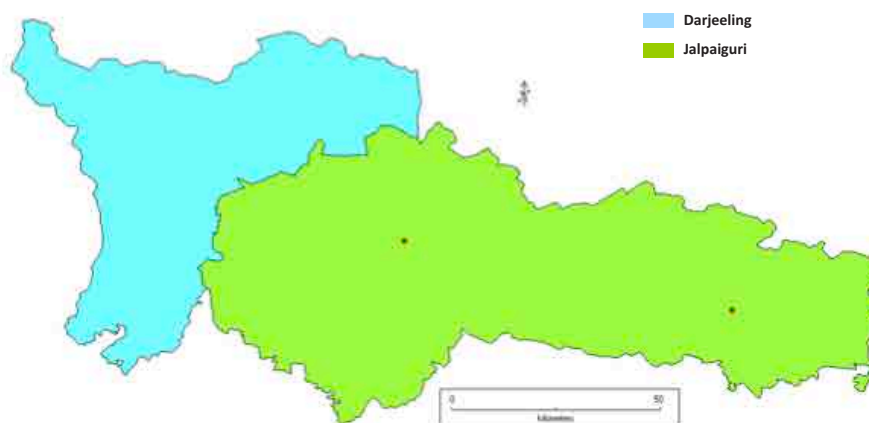


Figure 40. Distribution of *G. nepalensis* Distant in the study area

**Morphology:** Size: Apterous males 7.0–7.8mm. Macropterous males 8.0–8.5mm. Apterous females 8.6–9.0mm. Macropterous females 9.3–10.0mm (Andersen and Chen 1993).

**Description:** Dorsally generally black. Head black with a curved yellow marking towards its posterior

margin. Head length 1.02mm and width 0.56mm. Interocular width 1.9 times wider than eye width ( $I.W./E.W.=0.68/0.35$ ). Head length 1.8 times as long as eye length ( $H.L./E.L.=1.02/0.57$ ). Antennae black. First antennal segment longer than the second, third, and fourth segment. The length of antennal segment, 1–4: 1.25mm, 0.67mm, 0.64mm, 0.92mm. Rostrum 1.91mm in length. Pronotum blackish with sublateral spots of silverfish pubescence, anterior part of pronotum without sub-marginal pale stripes. Pronotum 1.5 times longer than wide ( $L/W=1.13/0.75$ ). Abdominal tergites length 3.8mm and width 1.27mm. Fore femora 2.01mm in length, stout. Mid and hind femora with several spines. Mid tibia longer than fore and hind tibia. Connexival spines of males distinctly pointed, but, short mainly in apterous forms.

**Genitalia:** Abdominal segment VIII 1.7 times as long as wide ( $L/W=0.98/0.55$ ). Ventrally, segment VIII with a pair of impression, furnished with silvery hairs. Endosomal sclerites in dorsal view as in Image 50i.

**Global distribution:** Nepal, China, Japan, Korea (Miyamoto and Lee, 1963), and East of Russia (Kanyukova, 1982).

**Distribution in India:** Arunachal Pradesh, Jammu and Kashmir, Sikkim, Uttar Pradesh, and West Bengal.

**Habitat:** Slow-flowing streams, stagnant water bodies with good vegetation.

**Remarks:** This species is most frequently encountered in apterous forms.

***Gerris (Macrogerris) gracilicornis* (Horvath, 1879):** Image 51. a–i

1879. *Limnotrechus gracilicornis* Horvath, *Termesztudományi Füzetek*, III: CIX.

1903. *Gerris selma* Kirkaldy, *Entomologist*, 36: 181.

1910b. *Gerris lepcha* Distant, *Annals and Magazine of Natural History*, 5 (8): 140.

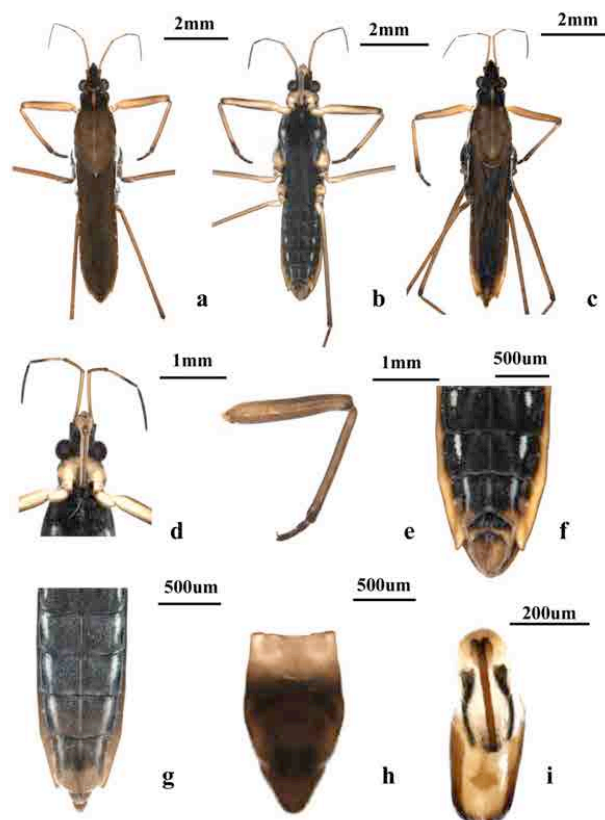


Image 51. a–i. *Gerris (Macrogerris) gracilicornis* (Horvath, 1879). a. Dorsal view of macropterous male; b. Ventral view of male; c. Dorsal view of macropterous female; d. Ventral view of head with antennae; e. Male fore leg; f. Abdominal tergite of male; g. Abdominal tergite of female; h. Dissected genital segment; i. Dorsal view of endosomal sclerite

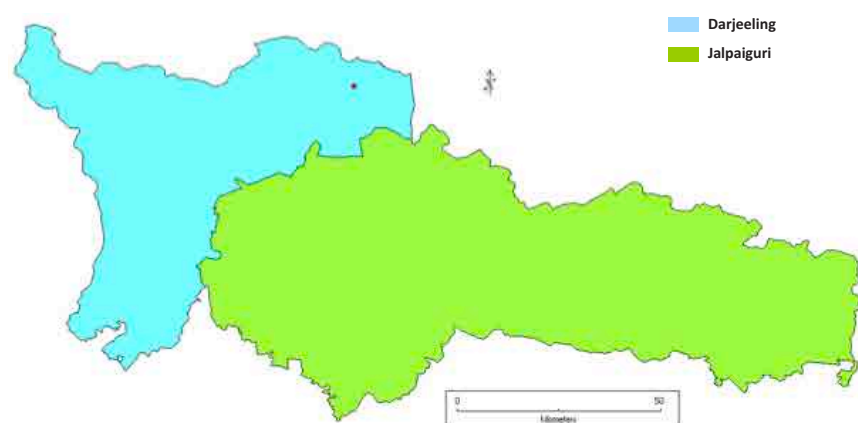


Figure 41. Distribution of *G. gracilicornis* Horvath in the study area

1975. *Gerris (Gerriselloides) gracilicornis* (Horvath): Andersen, *Entomologica Scandinavica Supplements*, 7: 22.

**Material examined:** Regn.no. 3148/H15, 2males, 2females, 4 nymphs, 3.x.2012, jhora within Neora Valley National Park, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Macropterous male attains a length of 13mm and brachypterous males attain a length of 12.5–12.7 mm. Macropterous females body length 11.7mm and in brachypterous female, body length 11.5mm.

**Description:** First antennal segment nearly half in length than the remaining three segments. Small brownish yellow spots in front of each eye. Anterior lobe of pronotum distinct, a mid longitudinal carina present on pronotum, anterior margin of pronotum with a pair of prominences. Mesothorax with short, erect pubescence laterally. Abdominal sterna of male usually with a distinct longitudinal keel.

**Genitalia:** Abdominal segment VIII with paired, oval impressions usually furnished with silvery hairs ventrally. Dorsal plate of endosomal sclerite with sub-parallel sides, almost slightly prolonged beyond the dorsal sclerites (Image 51i). Hind margin rounded. Distal recurved part of dorsal sclerite shovel-shaped and widened. Ventral sclerites paired small, almost rudimentary. In female (Image 51g), connexival spines distinctly pointed, almost reaching posterior margin of last abdominal segment.

**Global distribution:** China, Japan, East of Russia, Korea, Bhutan, and Taiwan.

**Distribution in India:** Sikkim, Uttar Pradesh, West Bengal, Arunachal Pradesh, and Assam.

**Habitat:** High altitudinal hill streams or stagnant pools within high mountainous forests.

**Remarks:** This species is mostly found in the high altitudinal area of northern India. They encountered mostly in macropterous forms.

#### Genus *Aquarius* Schellenberg, 1800

**Diagnosis:** Body large in size, ranges from 10.4–26.5mm. Pronotum usually dark with median pale stripe anteriorly. First antennal segment long, sub-equal to or longer than second and third antennal segment together. Fore femora uniformly dark. Well-developed connexival spines at abdominal end. Hind tibia being more than four times as long as first hind tarsal segment. Male genital segment long. Pygophore large, sub-ovate. Proctiger tapering with more or less pointed

apex. Parameres small, setose.

#### *Aquarius adelaidae* (Dohrn): Image 52. a–f and Image 53. g–l

1903. *Gerris spinolae* (Leth. and Serv.): Distant, *Fauna of British India*, 2: 180.

**Material examined:** Regn.no.3179/H15, 1 male, 2 females, 17.iv.2013, Dima River, Damanpur Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 8 males, 1 nymph, 16.ix.2011, Ghoshpukur Dighi, Kamala bagan, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 3 nymphs, 17.iii.2012, pond near Rhino Camp, Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 5 males, 7 females, 17.iv.2013, Sikkiahjhora, Alipurduar District, West Bengal, India, coll. S. Basu; 3 females, 1 nymph, 17.iii.2012, small jhora within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: In macropterous male, body length ranges from 11–12.5 mm, maximum body width (across mesoacetabula) 2.5–3.0 mm. Body length of macropterous female 11.9–12.2 mm and maximum body width 2.8–4.0 mm. Brachypterous male attains a length of 10.5–10.7 mm, maximum body width 2.5–2.6 mm.

**Description:** Dark brownish dorsally. Pronotal lobe with entire margin brownish yellow. Body elongated with distinctly visible connexival spines. Antennae 6.25mm in length, third segment much shorter than the second and a little shorter than the fourth segment, first antennal segment nearly as long as remaining three segments together. Pronotum with a distinct black carina on posterior lobe of pronotum. Rostrum reaching the posterior margin of prosternum. Fore femora almost straight and slightly constricted before apex, terminated by two distinct spines. Mid femur ventrally with pilosity and numerous spines. Hind femora distinctly longer than the body length. Metasternum slightly depressed posteriorly, with slit-shaped scent orifice. Abdomen moderately slender.

**Genital segment:** In male, connexival spines stout and long, almost reaching abdominal end. However, in female, the connexival spines are stout and surpass the abdominal end. Second abdominal sternum long, whereas 3–7 sterna sub-equal in length, slightly depressed. Posterior margin of seventh sternum deeply emarginated with a broad, triangular impression in middle. Genital segment VIII sub-cylindrical with prominent triangular tubercle ventrally. Pygophore large, paramere with setae and conate. Dorsal plate of



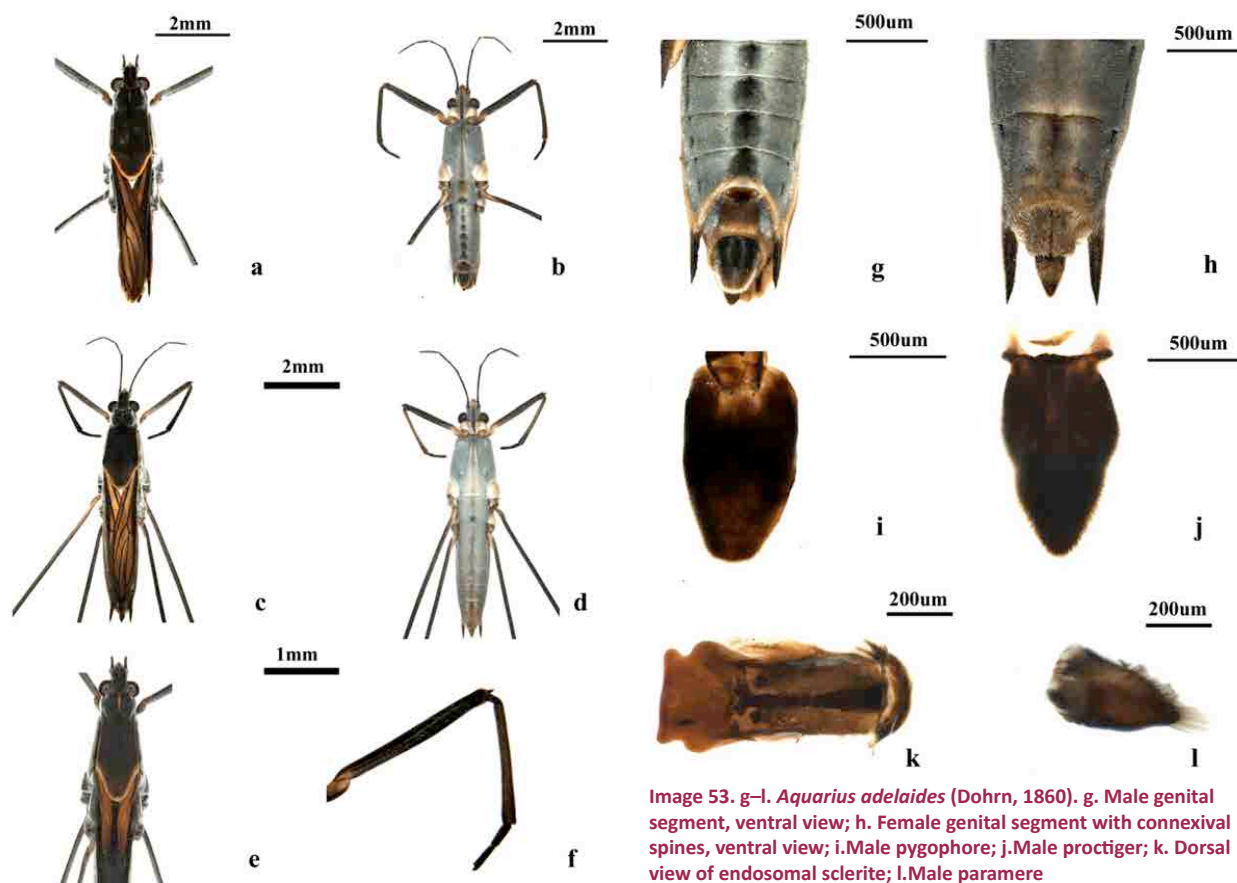


Image 52. a–f. *Aquarius adelaides* (Dohrn, 1860). a. Dorsal view of macropterous male; b. Ventral view of macropterous male; c. Dorsal view of macropterous female; d. Ventral view of macropterous female; e. Head and pronotum; f. Male fore leg

Image 53. g–l. *Aquarius adelaides* (Dohrn, 1860). g. Male genital segment, ventral view; h. Female genital segment with connexival spines, ventral view; i. Male pygophore; j. Male proctiger; k. Dorsal view of endosomal sclerite; l. Male paramere

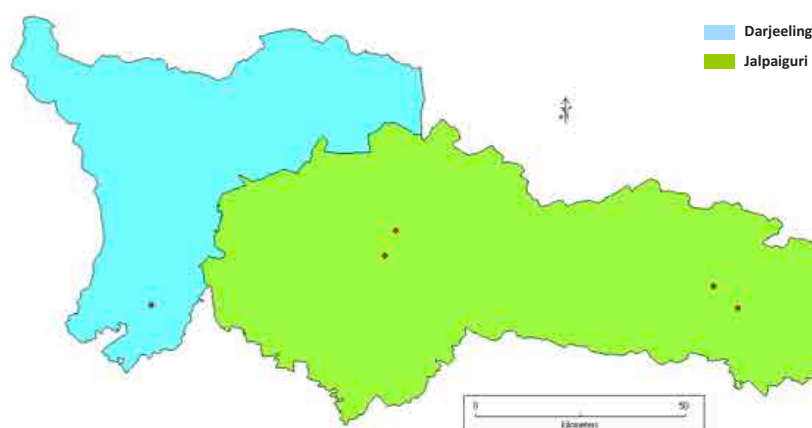


Figure 42. Distribution of *A. adelaides* (Dohrn) in the study area

male endosomal sclerite (Image 53k) distinctly widened, basal furcation of dorsal sclerite robust, lateral sclerite long and slender. Ventral sclerite 'V'-shaped. One 'Y'-shaped long and two shorter rod-like accessory sclerites present. Female genital segment VII (Image 53h) long, ends acutely pointed. Female proctiger small, cone-

shaped with pointed apex.

**Global distribution:** Australia, Myanmar, China, Java, Malacca, Philippines, Sumatra, Thailand, and India.

**Distribution in India:** Andhra Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Odisha, Rajasthan,

Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Fresh water habitats like fish ponds, lakes, temporary pools, and flooded paddy fields.

**Remarks:** This species is widely distributed. They can be collected from larger stagnant waterbodies. This species is closely related to *Aquarius paludum*, but can be distinguished by male genital segment with a very prominent triangular tubercle on ventral surface and

the structure of endosomal sclerite.

#### Genus *Neogerris* Matsumura

**Diagnosis:** Body elongated. Dorsally dark black, venter pale. Head typical with U-shaped yellow band. Pronotum with yellow oval or round spot anteriorly, pronotal lobe dark with yellow margins. Head directed forward. Eyes large, globular with two short trichobothria. Antennae short and robust, first segment shorter than or sub-equal to the second and third segment together, fourth little longer than the third. In macropterous forms, pronotal lobe wider than long. Forewings with two closed cells apically, without any distinct vein. Fore femur with diversified ventral pubescence comprising of short, dense hairs and with long bristles. Fore pretarsal claws well-developed, mid and hind claws totally reduced. Abdomen moderately shortened in most species. Connexivum not terminating in spine. Male genital segment slightly elongated than in female. Male pygophore simple, sub-rectangular. Proctiger narrow. Claspers very small, symmetrical, devoid of hairs. Female sternum VII with produced hind margin in middle.

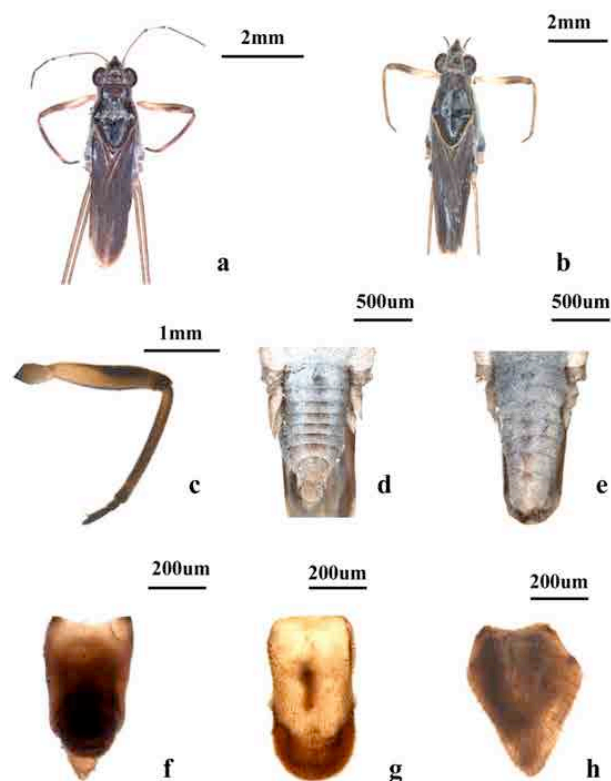


Image 54. a–h. *Neogerris parvulus* (Stal, 1859). a. Dorsal view of macropterous male; b. Dorsal view of macropterous female; c. Male fore leg; d. Male genital segment, ventral view; e. Female genital segment, ventral view; f. Male genitalia dissected; g. Male pygophore; h. Male proctiger

#### *Neogerris parvulus* (Stal, 1859): Image 54. a–h

1859. *Gerris parvula* Stal, *Zoology*, 4: 265.

1934. *Limnogonus parvulus* (Stal): Lundblad, *Archiv für Hydrobiologie - Supplement*, 12: 384.

1959. L. (*Limnogonellus*) *parvulus* (Stal): Hugerford and Matsuda, *Journal of the Kansas Entomological Society*, 32(1): 41.

1899. *Gerris tristan* Kirkaldy, *Revue d'Entomologie*, 18: 88.

**Material examined:** Regn.no. 3163/H15, 1 male, 16.ix.2011, Bhimbhar Dighi near Sayedabad Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 4 males, 5 females, 19.iv.2013, Bania River,

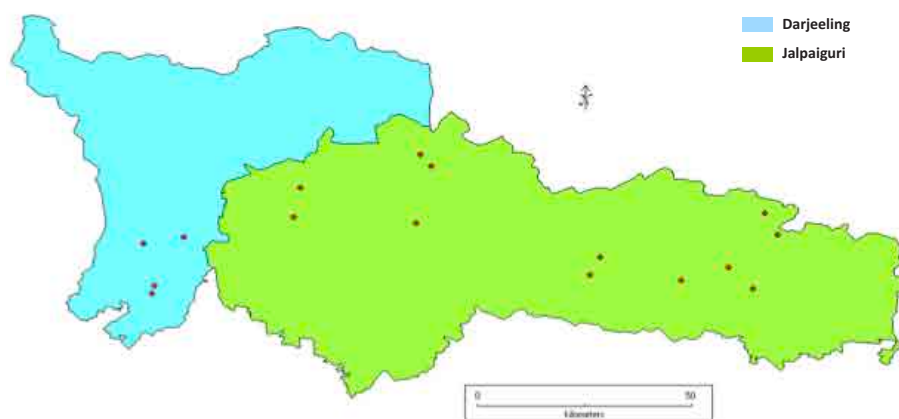


Figure 43. Distribution of *N. parvulus* (Stal) in the study area

Chilapata Forest, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 2 females, 19.iii.2013, Buri Torsha River, Bish Khutia, between South Khairabari and North Khairabari Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 2 females, 19.iii.2013, Buri Torsha Riverside, South Khairabari Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 2 nymphs, 17.iv.2013, Dima River, Damanpur Forest, Buxa Tiger Reserve, Alipurduar District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 16.ix.2011, Ghoshpukur Dighi, Kamala Bagan, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 6.iii.2011, Jayanti Forest Bungalow, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 6.iii.2011, Jayanti River, Alipurduar District, West Bengal, coll. S. Basu; 1 male, 2 females, 4.x.2013, jhora near Kiranchandra Tea Garden, Darjeeling District, West Bengal, coll. S. Basu; 5 males, 6 females, 17.iii.2013, Kalikhola, between Gorumara and Chapramari Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 8 males, 5 females, 17.iii.2012, Kalipur Wetland within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 6 males, 8 females, 4.x.2013, Shivmandir, Siliguri, Darjeeling District, West Bengal, coll. S. Basu; 10 males, 14 females, 17.iv.2013, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu; 5 males, 4 females, 5 nymphs, 19.iii.2012, Teesta Canal, near Odlabari, Jalpaiguri District, West Bengal, coll. S. Basu; 3 males, 2 females, 12.iii.2011, wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 3 nymphs, 17.iii.2012, wetland within Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Macropterous male body length 4.4–5.06 mm. Apterous males attain a length 3.6–4.6 mm. Macropterous female attains a length of 5.4–7.5 mm and apterous female attains a length of 4.3–5.04 mm.

**Description:** Body black dorsally. Head with a U-shaped brownish yellow band. Pronotum anteriorly with large, roundish or rectangular brownish yellow spot. Head length 0.67mm and width (excluding eyes) 0.49mm. Length of antennal segment 1–4: 0.98mm, 0.45mm, 0.53mm, 0.57mm. Eye length 0.45mm and width 0.27mm. Interocular width 0.56mm. Pronotal lobe in apterous forms, usually covering most of the mesonotum, length of pronotum 0.47mm and width 0.84mm. Fore femora stout, 1.34mm in length and with greatest width, 0.25mm about middle. Male mid

and hind femora with several short spines distributed throughout. Thoracic venter dilated anteriorly in lateral view. Abdomen length 1.94mm and width 0.79mm. Abdominal sternum VII equal to or little shorter than sternum V and VI together. Abdominal segments apically prolonged.

**Genitalia:** Male genital segment 0.71mm in length and 0.35mm in width, posterior margin broadly concave. Pygophore more or less rectangular in shape (Image 54g). Proctiger (Image 54h) hairy below. Dorsal sclerites usually with hook-shaped apices. Female genital segment VII a little longer than sternum V and VI, posterior margin distinctly produced.

**Global distribution:** India, Myanmar, Oman, Muscat, Iran, Thailand, Vietnam, Malay Peninsula, China, Taiwan, Amoy, Java, Ryukyu Island, Philippines, Solomon Island, and New Guinea.

**Distribution in India:** Arunachal Pradesh, Assam, Kerala, Odisha, Pondicherry, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Slow-flowing streams, river beds, pools, ponds, and lakes.

**Remarks:** This is a widespread species. This species is sometimes attracted to light and can be caught easily by light traps.

#### Genus *Limnogonus* Stal

**Diagnosis:** Adults usually dimorphic with apterous and macropterous forms. Dorsally dark black, pronotal lobe with pale, median, longitudinal stripe throughout and pale sub-marginal stripes that continue anteriorly. Head typically with a pair of yellow sub-lateral stripes. Eyes large, globular with two short trichobothria. Antenna long and slender, distinctly shorter than body length, first antennal segment longest, distinctly shorter than the rests together. Pronotum fully prolonged covering mesonotum in apterous forms. Prosternum with distinct median pit. Forewings with two closed cells apically and without venation. Fore femora of male moderately thickened, uniform ventral pubescence with setae. Fore tarsus much shorter than the second segment. In macropterous forms, fore wings surpassing abdominal end in both sexes. Male abdomen moderately shortened; the connexival end usually obtuse. Male genital segment simple, posterior margin of eighth segment concave in middle. Female abdomen relatively longer than in male. Posterior margin of female seventh segment straight or produced in middle.

***Limnogonus (Limnogonus) fossarum fossarum* (Fabricius, 1775): Image 55. a–i**

1775. *Cimex fossarum* Fabricius, *Systema Entomologiae*, 727.

1794. *Gerris fossarum* Fabricius, *Entomologia*

*systematica emendatan et aucta*, IV: 188.

1868. *Limnogonus fossarum* Stal, *Kongliga Svenska vetenskaps-akademiens handlingar*, 7: 133.

**Material examined:** Regn.no.3188/H15, 5 males, 5 females, 1 nymph, 17.iv.2013, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 19.iii.2011, Buri Torsha River, Bish Khutia, border between South Khairabari and North Khairabari Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 female, 16.ix.2011, Ghoshpukur Dighi, Kamala Bagan, Darjeeling District, West Bengal, coll. S. Basu; 5 males, 3 females, 14 nymphs, 17.iii.2012, Kalipur Wetland within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 23.ix.2012, pond near Domohoni, Jalpaiguri District, West Bengal, India, coll. M. Chakrabarty; 1 female, 19.iv.2013, Poro River, Poro Beat, Chilapata Forest Range, Alipurduar District, West Bengal, India, coll. S. Basu; 1 female, 19.iii.2012, Teesta Canal, near Odlabari, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4 males, 13 nymphs, 13.iii.2011, wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Apterous male body length 7.5–8.5mm, macropterous males may attain a length of 8.0–10.3mm. Apterous females reach a length upto 7.9–9.2 mm and body length of macropterous females range from 8.0–11.0 mm.

Description: Dorsally black in colour with yellowish markings. Submarginal stripe of pronotal lobe usually separated from the lateral stripes on the anterior pronotum, reaching upto the metanotum. Mesopleural stripe slender and sinuate. Mesosternum of male with a large, elongate patch of short, golden hairs posteriorly. Head 1.6–1.7 mm in width across eyes. Fourth antennal

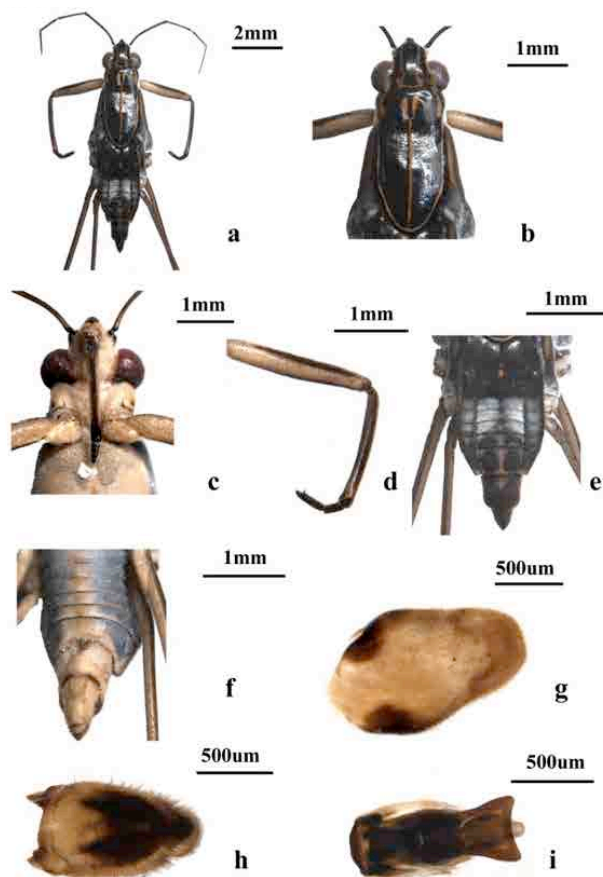


Image 55. a–i. *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius, 1775). a. Dorsal view of apterous male; b. Head and pronotum; c. Rostrum; d. Male fore leg; e. Dorsal view of male genital segment; f. Ventral view of male genital segment; g. Pygophore of male; h. Proctiger of male; i. Dorsal view of endosomal sclerite

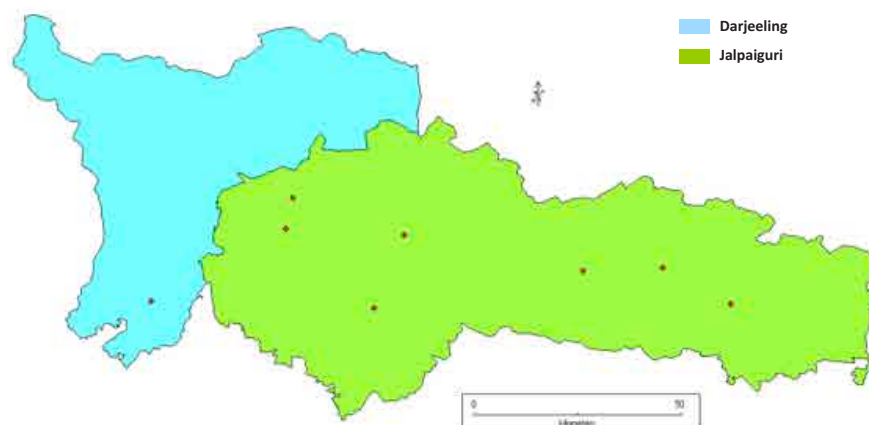


Figure 44. Distribution of *L. fossarum fossarum* Fabricius in the study area



segment longer than third. Fore femora with two dark stripes dorsally, slender, with greatest width across middle. Mid femur with scattered hairs ventrally. Abdominal venter a little more than one-fourth of body length, laterally moderately dilated. Abdominal sternites

apically moderately prolonged. In female, conexivum more or less obliquely raised.

Genitalia: Abdominal segment VIII in male with ventral posterior margin broadly concaves and more or less sinuates at middle. Pygophore broad (Image 55g). Female sternum VII subequal to sternum V and VI.

**Global distribution:** Myanmar, India, Thailand, Laos, Vietnam, China, Macao, Hong Kong, Hainan, Amoy, Singapore, Sumatra, Philippines, Taiwan, and Borneo.

**Distribution in India:** Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu, and West Bengal.

**Habitat:** Lakes, ponds, water tanks, paddy fields, ditches, hot-springs, brackish water pools.

**Remarks:** This species is widespread. They are predatory in nature and are found to predate on leaf hoppers, plant hoppers, and moths in paddy fields.

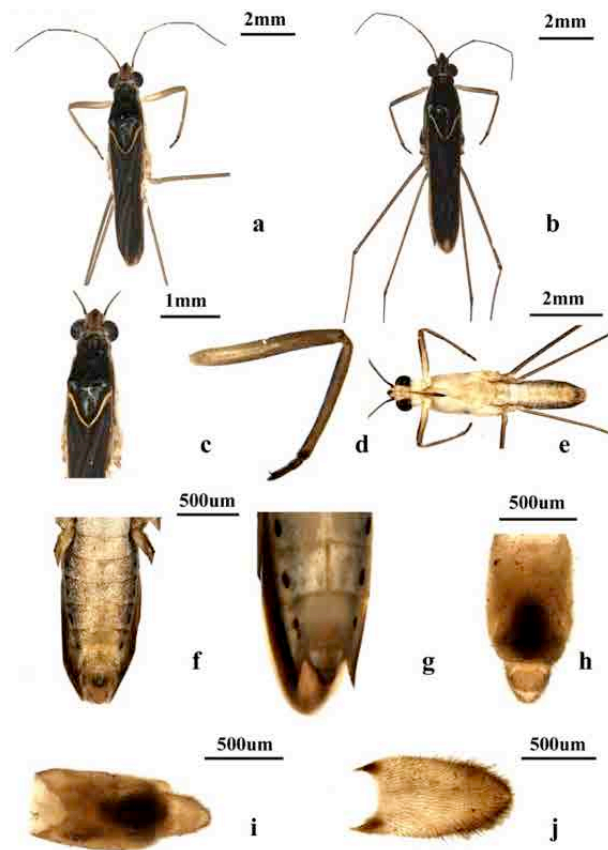


Image 56. a–j. *Limnogonus (Limnogonus) nitidus* (Mayr, 1865). a. Dorsal view of macropterous male; b. Dorsal view of macropterous female; c. Male head and pronotum; d. Male fore leg; e. Ventral view of male; f. Male genital segment, ventral view; g. Female genital segment, ventral view; h. Dissected male genitalia, ventral view; i. Dissected male genitalia, dorsal view; j. Male pygophore

***Limnogonus (Limnogonus) nitidus* (Mayr): Image 56.A–j**

1865. *Hydrometra nitida* Mayr, Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien, 15: 443.

1903. *Gerris nitida* (Mayr): Distant, *Fauna of British India*, 2: 178.

**Material examined:** Regn.no. 4714/H15, 2 males, 4.x.2013, jhora beside Kiranchandra Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 13.ix.2011, Rabijhora, Teesta River, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 5.5–6.2 mm and females attain a length of 6.0–6.5mm.

**Description:** Maximum body width of male across mesoacetabula 1.2mm. Head length 0.65mm, head

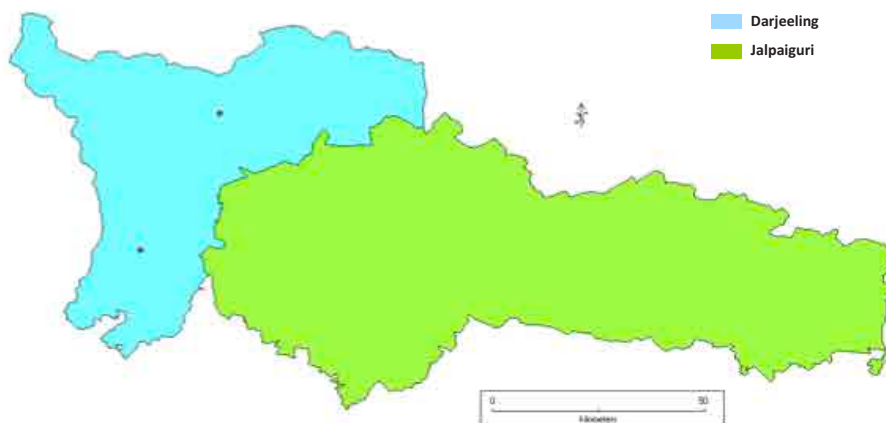


Figure 45. Distribution of *L. nitidus* (Mayr) in the study area

width 0.53mm. Eye length 0.49mm and width 0.24mm. Interocular width (0.705mm) is 1.3 times longer than the head width. Pronotum 2.3 times wider than long ( $W/L=0.826/0.356$ ). Anterior pronotal lobe with two

small yellow markings. In macropterous male, humeral width 1.14mm, first antennal segment is longer than second, fourth antennal segment is longest than rest. Length of antennomeres 1–4: 1.08mm, 0.76mm, 0.87mm, 1.24mm. Length of abdomen 2.32mm and width 0.83mm. Fore femur not modified, fore tarsae two-segmented, length of fore femur 1.47mm and width 0.23mm. Connexival spines are prominent in females than in males.

**Genitalia:** Length of male genital segment 0.534mm and width 0.46mm. Genital segment is elongated. Endosomal sclerites are well-sclerotised. Pygophore is broad, oval as in Image 56J.

**Global distribution:** Indonesia, Malaysia, Maldives, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, India and Vietnam.

**Distribution in India:** Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Delhi, Karnataka, Kerala, Odisha, Rajasthan, Tamil Nadu, Tripura, West Bengal, Uttar Pradesh, Uttarakhand, Himachal Pradesh, Maharashtra, and Sikkim.

**Habitat:** Temporary pools, paddy fields, ponds, and streams.

**Remarks:** They are mostly found as winged individuals and are reported as the predators of the brown plant hopper and serves as bio-control agents.

#### Genus *Rhagadotarsus* Breddin

**Diagnosis:** Body black dorsally. Head along eyes reddish. Pronotum yellow to orange yellow at middle. Head with an obscure median longitudinal sulcus or sometimes without it; posterior margin of head concave. Antennae slender, first segment much longer than second, second shorter than the third, and fourth segment about as long as third or longer. Pronotum very short, basal margin concave laterally rounded. Metasternum slightly depressed anteriorly, posterior

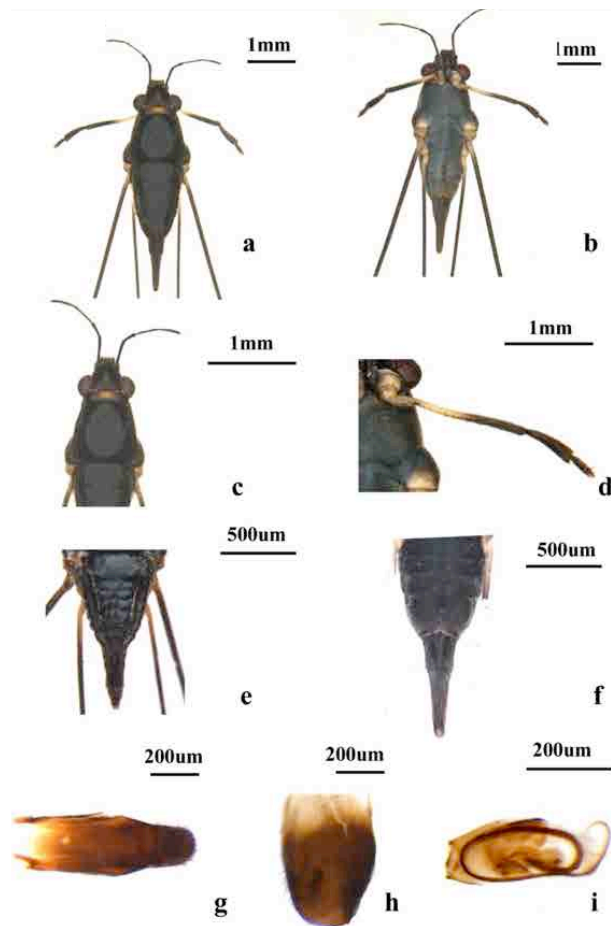


Image 57. a–i. *Rhagadotarsus (Rhagadotarsus) kraepelini* Breddin, 1905. a. Dorsal view of male; b. Ventral view of male; c. Head, pronotum and mesonotum; d. Male fore leg; e. Dorsal view of male genital segment; f. Ventral view of female genital segment; g. Male genitalia dissected; h. Male pygophore; i. Male endosomal sclerite

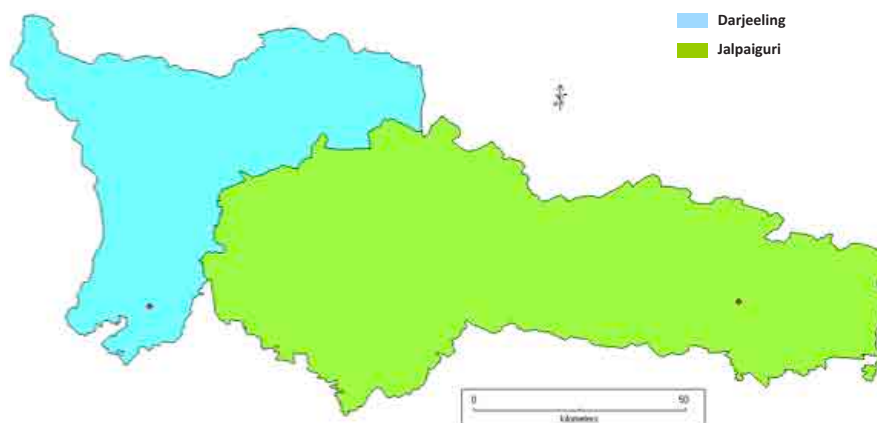


Figure 46. Distribution of *R. kraepelini* Breddin in the study area

margin concave. Fore femur slender, without any modification in both sexes, apically slightly thickened. Abdomen long, nearly straightly narrowed posteriorly. Connexivum strongly reflexed. Male seventh sternite longer than sixth sternite, with a deep depression.

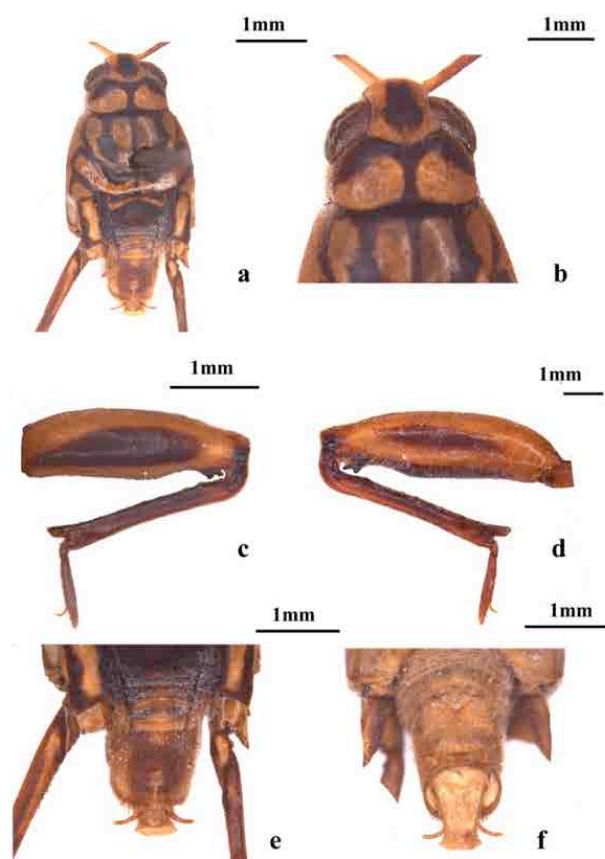


Image 58. a–f. *Metrocoris anderseni* Chen & Nieser, 1993. a. Dorsal view of male; b. Head and pronotum; c. Male fore leg, dorsal view; d. Male fore leg, ventral view; e. Male genital segment, dorsal view; f. Male genital segment, ventral view

Eighth segment cylindrical, strongly longitudinally depressed ventrally. Pygophore with apical margin rounded. Female genital segment cylindrical.

***Rhagadotarsus (Rhagadotarsus) kraepelini* Breddin 1905: Image 57. a–i**

**Material examined:** Regn.no. 3175/H15, 1 male, 3 females, 16.ix.2011, canal within Gava Ganga and Kamala Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 17.iv.2013, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: In apterous male body length varies from 3.5–4.2mm and in female body length ranges from 3.94–4.31mm. Maximum body width (across meso-acetabula) of male 1.19mm and in female 1.22mm.

**Description:** Body colour mainly black, heavily marked pruinose silvery grey. Coxa, trochanter of all legs yellowish brown. Head length 0.49mm and width (including eyes) 0.86mm. First antennal segment is long, the length of the segments 1–4: 0.45mm, 0.22mm, 0.35mm, 0.37mm, antennal segments clothed with short recumbent setae. Rostrum reaching upto the fore coxa. Interocular width (0.52mm) 2.82 times wider than eye width (0.18mm). Eyes dark brown, length 0.32mm. Pronotum 6 times wider than length. Length of mesonotum 0.94mm and width 1.02mm. Metanotum fused with first abdominal tergite. Abdominal tergites becoming narrow posteriorly, length 2.38mm, width 0.82mm. Fore femur with two parallel rows of ventrally directed setae. Claws sharp and long. Mid femur (3.41mm) 1.2 times longer than the hind femur (2.85mm).

**Genitalia:** Male genital segment elongated,

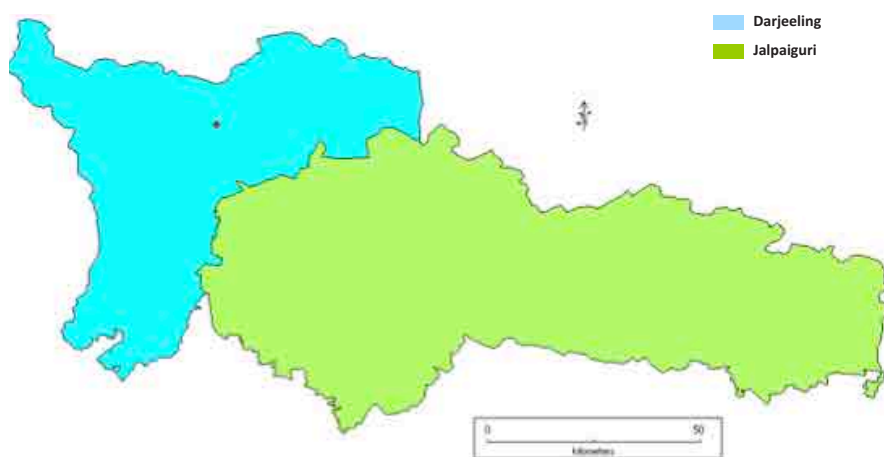


Figure 47. Distribution of *M. anderseni* Chen & Nieser in the study area

modified; deeply excavate basally, depression deeper and hair free medially. Connexiva broad. Endosoma as in Image 57i. Proctiger (Image 57g) narrow and elongated. Pygophore as in Image 57h. Female genital segment with a median ridge, with a serrated ovipositor in seventh segment (Image 57f).

**Global distribution:** Malaysia, Singapore, Java, Indonesia, Sri Lanka, Thailand, Vietnam, China, Myanmar, Taiwan, and India.

**Distribution in India:** Kerala, Andhra Pradesh, West Bengal, Arunachal Pradesh, Karnataka, Tamilnadu, and Pondicherry.

**Habitat:** Ponds, slower reaches of rivers, tidal mangrove streams, pools, etc.

**Remarks:** The food habits of *Rhagadotarsus* are almost same as most Gerrids — any insects trapped in the surface film of water. They are feeble swimmers.

### Genus *Metrocoris* Mayr, 1865

**Diagnosis:** Body colouration yellowish to light brown, with black markings on dorsum. A longitudinal marking on the interocular space of head. Males are usually larger than the females. Body dorsally sub-triangular, dorso-ventrally flattened, covered with short fine sparse black hairs. Head blunt, projecting in front of eyes. Pronotum of macropterous forms enlarged. Propleura clothed with dark bristle-like hairs. Metasternum reduced to small, triangular sclerite. Abdominal tergites with some golden pubescence. Male abdominal sternum VIII longer, broadly concave. Female abdominal sternum VII strongly developed and apically modified. Male fore femur may be incrassate or moderately incrassate or sometimes slender, with or without indentations, constrictions and teeth. Female fore femur slender, without any modification. Male genital segment elongated and large. Parameres usually large and sometimes visible from outside in some species.

### *Metrocoris anderseni* Chen and Nieser, 1993: Image 58. a–f

**Material examined:** Regn.no. 2974/H15, 1 male, 15.iii.2012, Rabijhora, Teesta River, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of apterous male 7.5–7.6 mm and width 3.35mm. Apterous female attains a length of 5.2mm and width 3.1mm.

**Description:** Interocular dark mark arrow-head shaped, bifid posteriorly. Head, pronotum with distinct markings. Antennae brown with the first segment

yellowish basally. Abdomen blackish dorsally. Venter yellowish. Head 1.89mm in width. Interocular width 0.75mm. Pronotum bulbous in male, distinctly broader than head, width of pronotum 1.96mm. Male fore femur (Image 58c & d) strongly incrassate, apical third constricted but without ventral indentation, a bipartite sub-apical tooth. Inner margin of fore tibia with a sharp sub basal tooth-like elevation. Female fore femur slender. Mid femur longer than hind femur.

**Genitalia:** Male genital segment VIII (Image 58e & f) long, length 1.62mm and width 1.16mm. Pygophore prolonged ventrally, constricted before apex. Proctiger long and narrow. Paramere large and hook-like, extending beyond genital segments laterally and with blunt apex. Endosomal sclerite well-developed. Dorsal sclerite long and curved apically. Female genital segment VII large, apical half broadly lobed, and with a median notch, strongly curved upward.

**Global distribution:** India.

**Distribution in India:** Uttar Pradesh and West Bengal.

**Habitat:** Hill streams.

**Remarks:** This species is a new record to West Bengal. They are closely related to *Metrocoris falcatus* Chen and Nieser and can be distinguished by its genital structures.

### *Metrocoris murtiensis* Basu, Polhemus and Subramanian, 2016: Image 59. a–g and Image 60. h–p

**Material examined:** Regn.no. 4696/H15, 2 males, 7 females, 7 nymphs, 17.iii.2012, Gorumara National Park, continuation of Murti River, small pool, Jalpaiguri District, West Bengal, India, coll. S. Basu; 5 males, 5 females, 13 nymphs, 18.iii.2012, forested pool in front of Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of apterous male 4.9mm and body width across mesoacetabula 2.29mm. Apterous female attains a length of 4.1mm and body width across acetabula 2.18mm.

**Description:** Dorsal body coloration yellowish to orange with dorsal black markings. Interocular dark mark on head arrow-shaped, bifid posteriorly, posterior margin connected with dark margin of eye on each side. Head width subequal to pronotum width. Head length 0.68mm, width 1.46mm. Eyes 2.3 times longer than broad, length 0.72mm, width 0.31mm. Interocular width 0.56mm. Posterior half of eyes covering propleura by 0.32mm. Length of antennal segments 1–4: 2.09mm, 0.80mm, 0.57mm, 0.49mm, second segment slightly



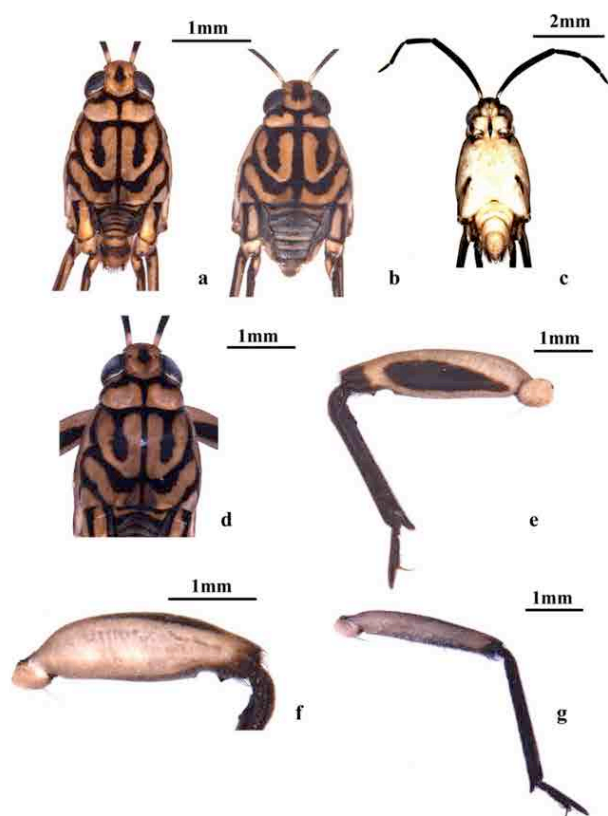


Image 59. a–h. *Metrocoris murtiensis* Basu et al., 2016. a. Dorsal view of apterous male; b. Dorsal view of apterous female; c. Ventral view of male; d. Head and pronotum; e. Male fore femur and tibia, dorsal view; f. Male fore femur, ventral view; g. Female fore femur, ventral view

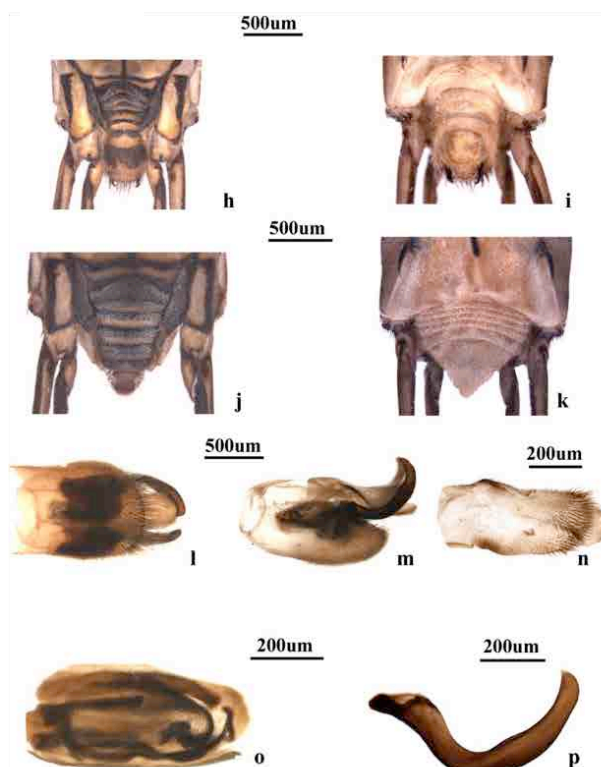


Image 60. h–p. *Metrocoris murtiensis* Basu et al., 2016. h. Dorsal view of male genital segments; i. Ventral view of male genital segment; j. Dorsal view of female genital segment; k. Ventral view of female genital segment; l. Male genitalia dissected, dorsal view; m. Lateral view of male genitalia with paramere; n. Male pygophore; o. Male paramere; p. Endosomal sclerite of male

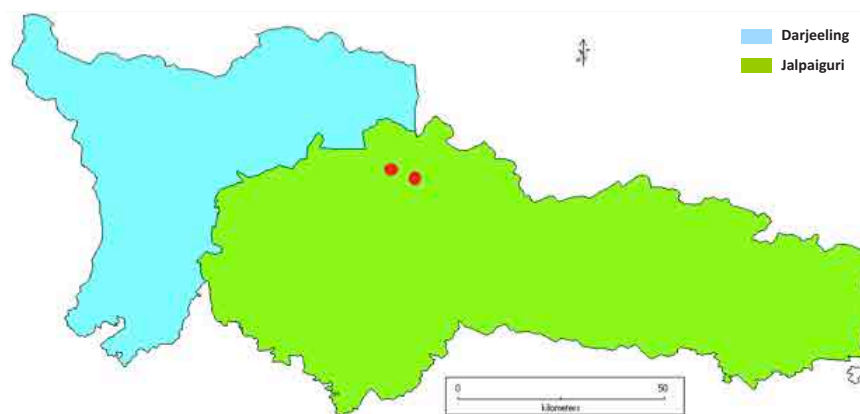


Figure 48. Distribution of *M. murtiensis* Basu et al. in the study area

longer than third. Rostrum reaching upto forecoxa, length 1.32mm. Pronotum bulbous, 2.6 times broader than long. Pronotum length 0.54mm, width 1.44mm. Meso- and metanota 1.2 times broader than long. Male fore femur strongly incrassate, stout, broad, with dorsally broad black median elongated marking, in some individuals the markings extending attaching to

the rectangular markings distally, marked with subapical indentation, bearing a more or less sharp subapical tooth followed by a bidentate tooth near distal margin, visible in both dorsal and ventral view. Fore femur hairy near distal margin, ratio of length/width 3.5 (length/width=2.05/0.58). Fore tibia modified, with a strong curvature basally, bearing a small pointed tooth near

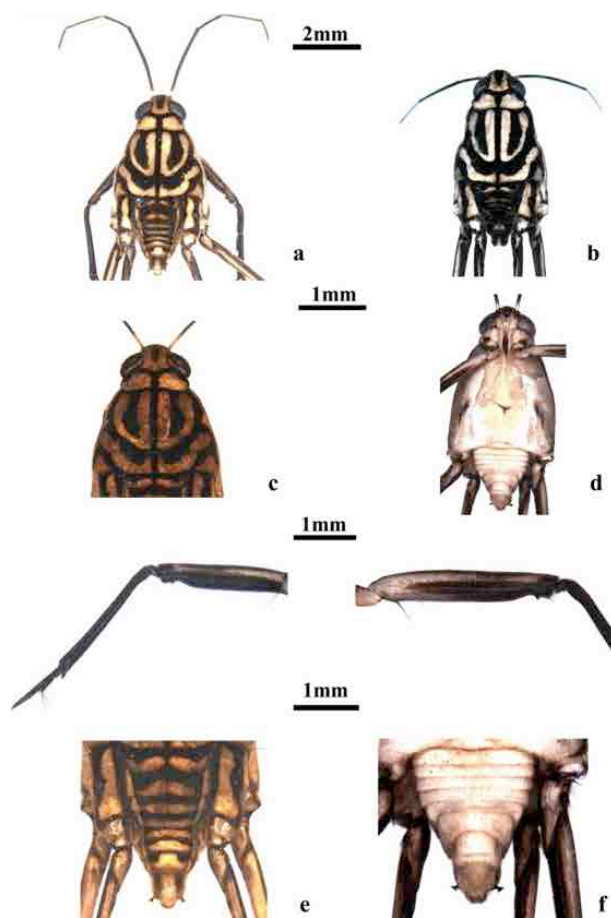


Image 61. a–h. *Metrocoris lavitra* Basu et al., 2016. a. Dorsal view of apterous male; b. Dorsal view of apterous female; c. Head and pronotum, dorsal view; d. Ventral view of male; e. Male fore leg, dorsal view; f. Male fore leg, ventral view; g. Male abdominal tergite, dorsal view; h. Male abdominal sternite, ventral view.

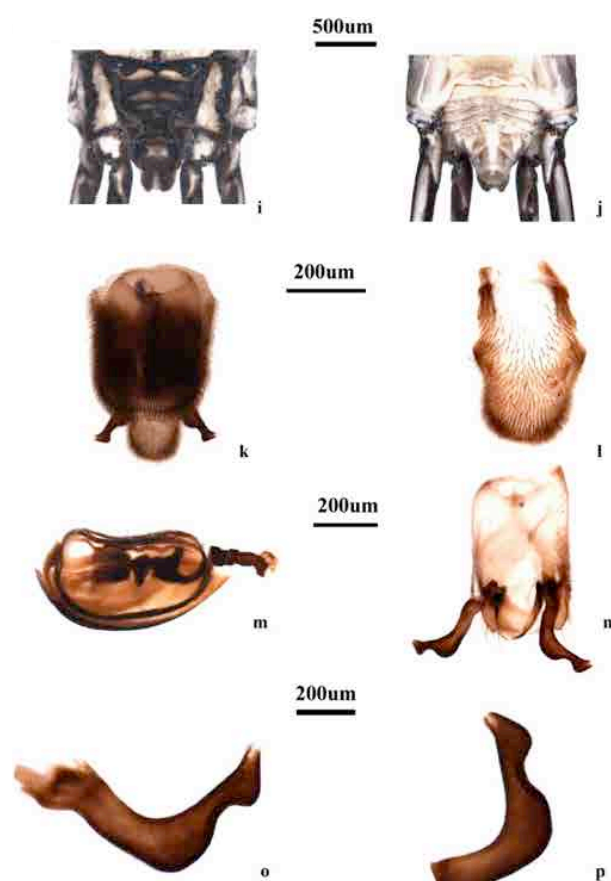


Image 62. i–p. *Metrocoris lavitra* Basu et al., 2016. i. Female abdominal tergite, dorsal view; j. Female abdominal sternite, ventral view; k. Dissected male genitalia; l. Proctiger of male; m. Endosomal sclerite; n. Pygophore of male; o, p. Male paramere, two different views

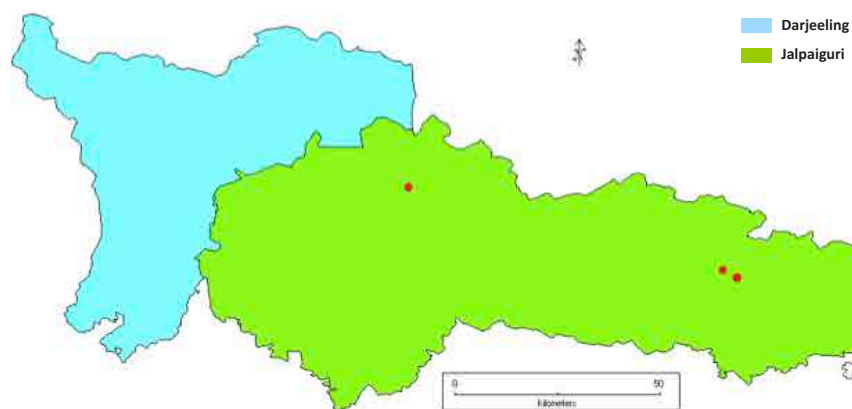


Figure 49. Distribution of *M.lavitra* Basu et al. in the study area

distal margin. Fore trochanter with three long setae. Fore, middle, and hind tibiae and tarsi with dark pilosity. Abdomen length including genital segments 1.91mm (along midline). Genital segment 1.1 times longer than broad, covered with dense short hairs anteriorly and

long hairs posteriorly.

Genitalia: Segment VIII large and with dense pilosity, bearing two broad black semi-circular markings separated by distinct gap, almost covering genital segment. Length of genital segment VIII 0.92mm.

Pygophore (Image 60n) prolonged, hairy. Proctiger prolonged, truncated distally. Parameres (Image 60p) projecting slightly outward from abdominal segment VIII ventrally, large, stout, curved distinctly, with an almost acute apex and a small hook, twisted medially, then broadened and finally tapering slightly with uniform thickness towards the apex. Female abdominal sternum VII (Image 60k) length 0.66mm, width 0.63mm, moderately large, broad, and triangular with up-folded rectangular median lobe entirely covering rounded genital segments, laterally convex, hairy dorsally.

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** Small forested pools or stagnant waterbodies.

**Remarks:** This species is prevalently found in Gorumara National Park and Chapramari Wildlife Sanctuary.

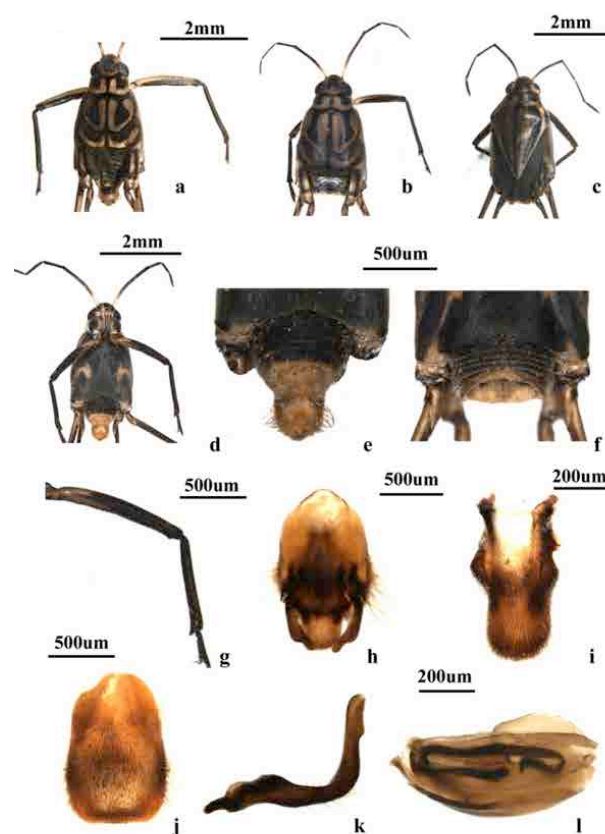
***Metrocoris lavitra* Basu, Polhemus, Subramanian & Saha, 2016: Image 61. a–f and Image 62.g–n**

**Material examined:** Regn.no. 4622/H15, 3 males, 21 females, 19.iv.2013, Chilapata Forest, Bania River, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 male, 10.iii.2011, Chapramari Wildlife Sanctuary, stream in front of Chapramari Railway Gate, Jalpaiguri District, West Bengal, India, coll. S. Basu; 5 males, 7 females, 19.iv.2013, Chaitanyajhora, stream flowing through Rajabhatkhawa Forest, Buxa Tiger Reserve Range, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

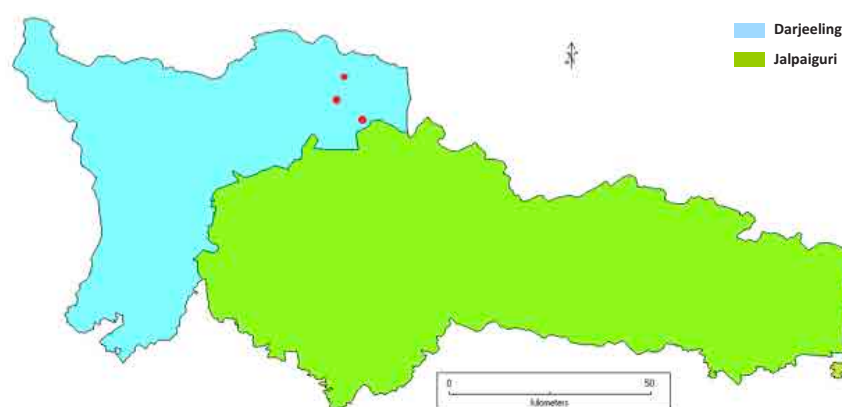
**Morphology:** Size: Body length of male 6.3mm, width across mesoacetabula 3.16mm. Body length of female 5.49mm, width across mesoacetabula 2.69mm.

**Description:** Body colour varying from dark orange to yellowish, with scattered black markings. Interocular

dark mark black, triangular, bluntly pointed posteriorly. Head length 0.67mm, width 1.61mm. Posterior eye width 1.4 times width of eye. Eye length 0.8mm. Posterior half of eye covering almost half of propleuron. Interocular eye width 0.49mm. Length of antennal



**Image 63. a–l. *Metrocoris dinendrai* Basu et al., 2016. a. Dorsal view of apterous male; b. Dorsal view of apterous female; c. Dorsal view of macropterous female; d. Ventral view of male; e. Abdominal sternite of male; f. Abdominal sternite of female; g. Male fore leg, ventral view; h. Dissected male genital segment; i. Proctiger of male; j. Pygophore of male; k. Paramere of male; l. Endosomal sclerite of male**



**Figure 50. Distribution of *M. dinendrai* Basu et al. in the study area**

segments 1–4: 2.48mm, 0.89mm, 1.16mm, 0.86mm. Rostrum length 1.72mm, reaching fore trochanter. Pronotum 3.3 times as broad as long (width 1.52mm, length 0.45mm). Pronotum slightly bulbous. Meso- and metanota slightly broader than long (width 2.78mm, length 2.53mm). Fore femur slender, ratio of length/width 6.87, with slight curvature marked with small, prominent apical tooth and long hair fringe distally, two long setae basally, inner margin with a row of short hairs. Inner surface of tibia hairy, without indentation but with several small spines arranged equidistantly from base to apex.

**Genitalia:** Male abdominal tergite VIII subquadrate, length 0.61mm, width 0.63mm, densely covered with black and golden short stiff hairs. Pygophore broader than long. Proctiger elongated, convex medially on both sides, with small, angular lateral lobes, clothed with dense hairs. Parameres symmetrical, projecting prominently from genital segment, sickle-shaped, outer margin sinuate, apex expanded to form small head, tip rounded. Female sternum V with medially invaginated apical margin, sternites II–IV with dense thick hairs medially and the density reduced laterally towards the margin. Sternum VII elongated, bilobed, laterally constricted basally, fringed with golden short hairs and with concave apical margin.

**Global distribution:** India.

**Distribution in India:** West Bengal.

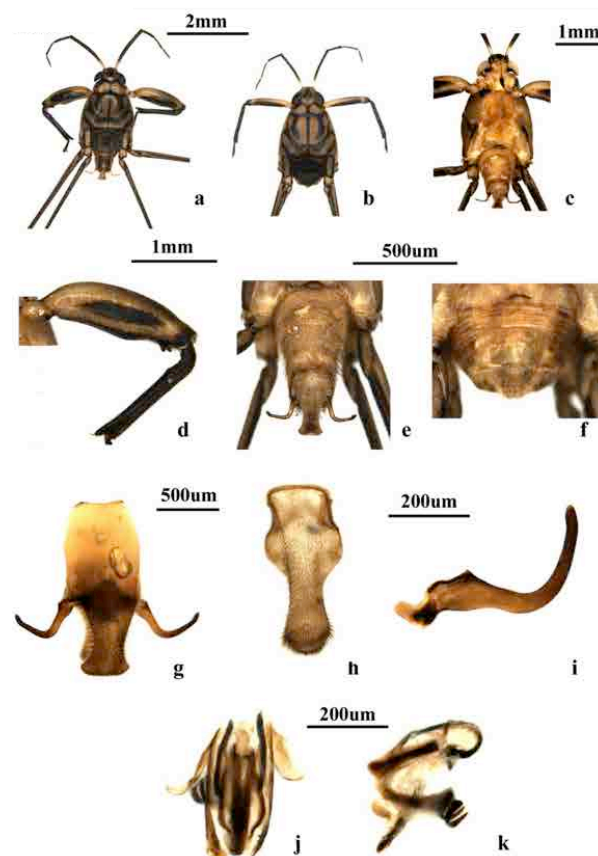
**Habitat:** Slow-flowing streams, rivers, and forested pools.

**Remarks:** This species does not belong to any other group of *Metrocoris* group and forms *Metrocoris lavitra* group.

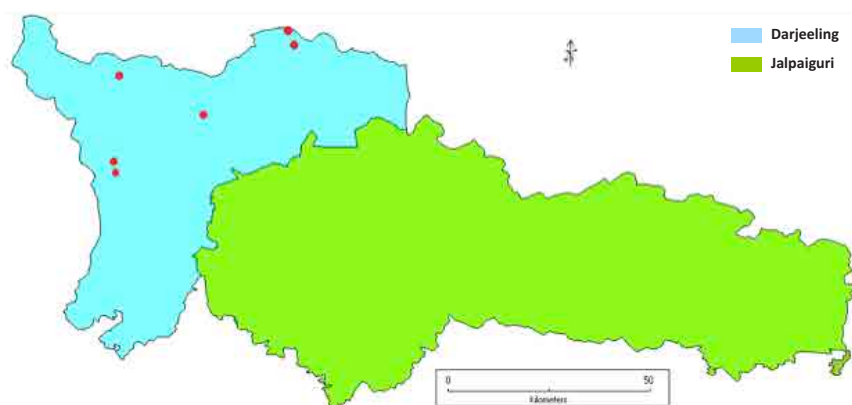
***Metrocoris dinendrai* Basu, Polhemus & Subramanian, 2016: Image 63. a–f**

**Material examined:** Regn.no. 4775/H15, 2 males,

1 female, 31 nymphs, 3.x.2012, roadside cascades within Neora Valley National Park, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 5 nymphs, 3.x.2012, a stream on the way to Chengey Falls, near Lava, Darjeeling District, West Bengal, India, coll.



**Image 64. a–k. *Metrocoris deceptor* Basu et al., 2016. a. Dorsal view of apterous male; b. Dorsal view of apterous female; c. Ventral view of apterous male; d. Fore leg of male; e. Abdominal sternites of male; f. Abdominal sternites of female; g. Dissected male genital segment; h. Proctiger of male; i. Male paramere; j. Endosomal sclerite, dorsal view; k. Endosomal sclerite, lateral view**



**Figure 51. Distribution of *M. deceptor* Basu et al. in the study area**



S. Basu; 4 males, 2 females, 1 nymph, 1.x.2013, stream near Gorubathan, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length 5.42mm, maximum width across mesoacetabula 2.53mm.

**Description:** Dorsal body coloration yellowish to orange with dorsal black markings. Interocular dark mark rectangular, bifid posteriorly, anterior margin not connected with dark mark of postclypeus. Head width 1.36mm, length 0.73mm. Interocular region wider than eye, widths 0.61mm and 0.25mm, respectively. Length of antennal segments 1–4: 2.29mm, 0.97mm, 0.88mm, 0.65mm, first segment longer than combined lengths of rests. Fore femur slender and slightly curved at middle, ratio of length/width approximately 6.5, ventral surface with small constriction near middle, without indentation or tooth, with short dense hair fringe ventrally near apex, inner margin with rows of short hairs. Inner margin of fore tibia not modified, bearing rows of short hairs.

**Genitalia:** Male abdominal sternite VIII elongate, sub-oval, length 1.27mm, width 0.86mm, densely clothed with fringe of golden hairs. Posterior margin of abdominal tergite VIII straight. Pygophore elongate, heavily setiferous, apex truncate. Proctiger moderately elongate, lateral margins slightly convex, isolating angular basal lobes, apex broadly rounded, posterior margin with dense hair fringe. Parameres symmetrical, strongly curved near midpoint, apical section expanded to small head with outer margin concave, apex blunt, inner and outer margins with long distinct setae, several whitish dots distributed throughout. Female abdominal sternum VII semi-circular, length 0.30mm, width 1.07mm, slightly constricted laterally, clothed with short golden pubescence.

**Global distribution:** India.

**Distribution in India:** West Bengal and Sikkim.

**Habitat:** Waterfalls, cascades, and streams.

**Remarks:** This species belongs to *Metrocoris compar* group.

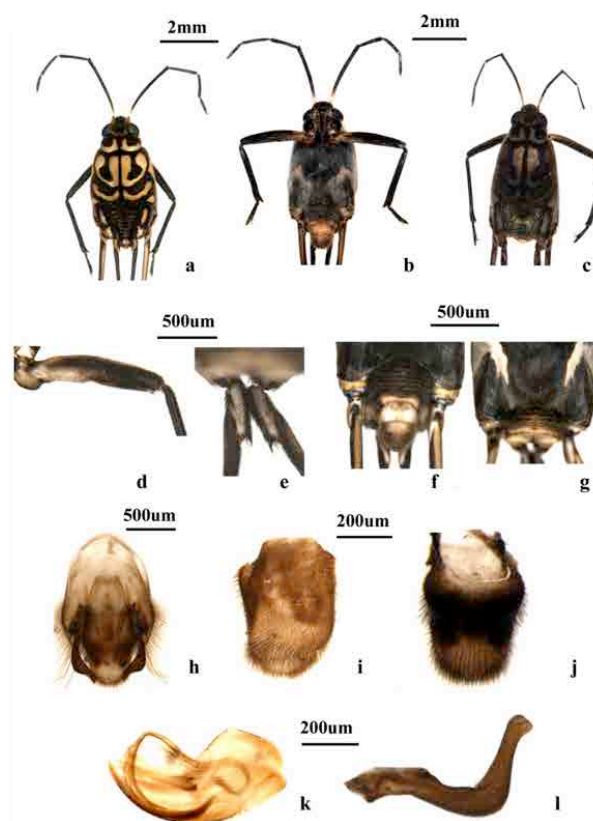


Image 65. a–i. *Metrocoris darjeelingensis* Basu et al., 2016. a. Dorsal view of apterous male; b. Ventral view of apterous male; c. Dorsal view of apterous female; d. Male fore leg, ventral view; e. Female hind trochanter; f. Male abdominal sternites; g. Female abdominal sternites; h. Dissected genital segment, ventral view; i. Male pygophore; j. Male proctiger; k. Endosomal sclerites of male; l. Male paramere

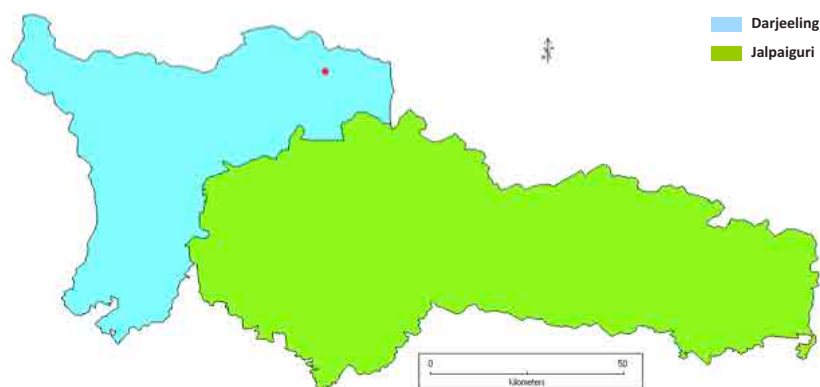


Figure 52. Distribution of *M. darjeelingensis* Basu et al. in the study area

***Metrocoris deceptor* Basu, Polhemus and Subramanian, 2016: Image 64. a–k**

**Material examined:** Regn.no. 4644/H15, 24 males, 16 females, 23.iii.2013, Rishi River, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 1 female, 7 nymphs, 23.iii.2013, stagnant pool beside Rishi River, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 5 males, 4 females, 1 nymph, 22.iii.2013, Darjeeling District, Teesta River, Chitre Bridge, West Bengal, India, coll. S. Basu; 3 males, 4 females, 3 nymphs, 21.iii.2013, Darjeeling District, Manjukhola, Phuguri Tea Estate, West Bengal, India, coll. S. Basu; 2 males, 4 females, 11 nymphs, 20.iii.2013, Darjeeling District, falls near Bunkulung, West Bengal, India, coll. S. Basu; 3 males, 5 females, 4.v.2013, Darjeeling District, Srikhola, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 6.10–6.90 mm, maximum body width 2.64–3.0 mm. Female body length 5.30–6.72 mm, maximum body width 3.27–3.40 mm.

**Description:** Dorsally body yellowish orange with distinct black markings. Interocular area with broad arrow shaped marking medially. Head length of male 0.74mm and width 1.54mm. Pronotum wider than long, length 0.553mm and width 1.59mm. Fore femur strongly incrassate, ratio length/width=3.22(2.68mm/0.83mm), constricted in apical third, with bipartite apical tooth, without any ventral indentation. Fore femora of female slender, with long stout hairs at basal half. Length of abdomen 2.87mm and width 1.62mm, abdominal tergites black with dense golden pubescences.

**Genitalia:** Male genital segment VIII elongated, large, rectangular in dorsal view, length 1.45mm and width 1.04mm. Dorsally pygophore prolonged and sub apically constricted, with straight apical margin. Proctiger long distally narrowed. Paramere long, hook shaped, pointed apically. Female genital segment VII with large medial lobe, with longitudinal ridge laterally from anterior end of hind margin and with small wing shaped lobes, medial lobe sub-trapezoidal, with distinctly notched posterior margin.

**Global distribution:** India.

**Distribution in India:** West Bengal and Sikkim.

**Habitat:** Hill Streams.

**Remarks:** This species is closely related to *Metrocoris quynhi* Tran and Zettel.

***Metrocoris darjeelingensis* Basu, Polhemus and Subramanian, 2016: Image 65. a–l**

**Material examined:** Regn.no.4652/H15, 2 males, 1

female, 14 nymphs, 3.x.2012, cascades within Neora Valley National Park, Darjeeling District, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male ranges from 5.04–5.2 mm, body width across mesoacetabula 2.43–2.45 mm. Body length of female ranges from 4.54–4.62mm, body width across acetabula 2.49–2.53 mm.

**Description:** Dorsal body coloration yellowish to orange with distinct black markings. Interocular dark mark on head rectangular, bifid posteriorly, posterior margin connected with dark margin of eye on each side. Head length 0.64mm, width 1.46mm. Length of antennal segments 1–4: 2.0mm, 0.77mm, 0.73mm, 0.61mm. Rostrum reaching beyond forecoxa, length 1.61mm. Pronotum slightly bulbous, 2.8 times broader than long. Pronotum length 0.51mm, width 1.45mm. Male fore femurs slender and hairy, dorsally black and ventrally with black median elongated marking, basally yellow, without any modification, but with a slight invagination near middle. Fore tibia without any modification. Fore femur of female slender, elongated, without any modification. Female hind trochanter with a pointed apex bearing a distinct, tapering tuft of long hairs.

**Genitalia:** Segment VIII in male elongated and with dense pilosity, lateral margins with few long setae. Pygophore prolonged, broad and setiferous. Proctiger prolonged, truncated distally, with distinct dark long setae throughout. Parameres not visible externally, large, stout, curved distinctly in the middle, twisted medially, then broadened and finally tapering slightly towards the truncated apex and the posterior end, with 2–3 setae near middle and several white dots distributed up to apex. Endosoma poorly sclerotised, with dorsal sclerite long, expanded horizontally and recurved proximally; lateral sclerite apically bent a little upward, almost straight, ventral sclerite long, not extending beyond the dorsal sclerite, concave sub-medially. Abdominal sternum VII of female small, broad and rectangular, hairy, laterally little constricted and with a smooth caudal margin entirely covering rounded genital segments, laterally convex, hairy dorsally.

**Global distribution:** India.

**Distribution in India:** West Bengal, Sikkim, Arunachal Pradesh.

**Habitat:** Cascades, waterfalls, and hill streams.

**Remarks:** This species is recently collected from Arunachal Pradesh after West Bengal and Sikkim.

**Genus** *Ventidius* Distant

**Diagnosis:** Head including eyes more than twice as wide as long in middle. Eye elongate, covering

lateral margin of pronotum. Antennae slender and long, first segment always long, sparsely armed with black bristles. Rostrum short and transverse, both anterior and posterior margins concave, lateral margins rounded. Metanotum without median longitudinal sulcus. Fore leg relatively long and slender, femur with

or without a small tubercle on inner margin, sparsely clothed with long hairs. Fore tibia with a narrow inner apical process defined by a depression on both surfaces, tarsus with distinct claws and with arolium. Mid femur armed with spinous bristles sparsely. Hind femora straightly narrowed apically, sparsely clothed with spinous bristles. Abdominal ventrites anteriorly strongly reduced. Seventh segment ventrally a little shorter or longer than all preceeding sternites together. Parameres well-defined. Endosoma with definitive dorsal plate turned black. Female seventh sternite concave on posterior margin.

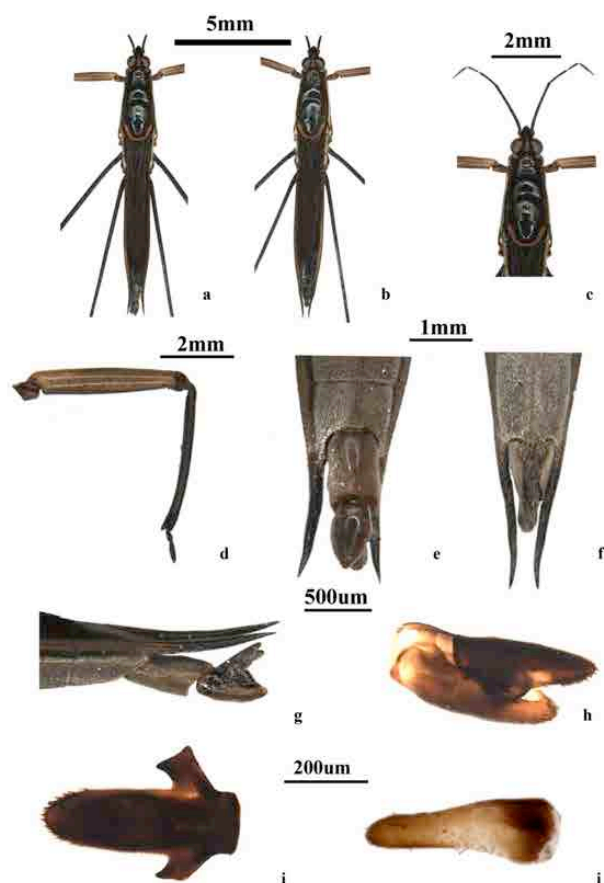
***Ventidius (Ventidius) sushmae* Gupta Image 66. a–h**

**Material examined:** Regn.no.2952/H15, 1 male, 4 females, 5 nymphs, 8.iii.2011, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu; 6 males, 15 females, 17.iv.2013, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

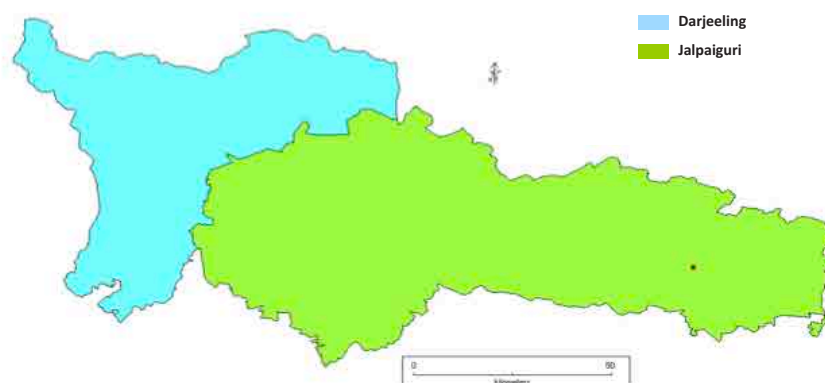
**Morphology:** Size: Body length of male 2.5–3.5 mm, maximum width across mesoacetabula 1.8–1.9 mm; female body length 2.65–3.7 mm, maximum width across mesoacetabula 1.9–2.1 mm.

**Description:** Dorsally yellowish brown to greenish yellow with black markings. Head with a triangular median spot and a pair of lateral black stripes, head including eyes much wider than long. Eyes rounded on outer margin, covering lateral margin of pronotum. Rostrum short, surpassing hind margin of presternum. Pronotum short, lateral margin rounded and anterior and posterior margin concave. Metacetabulum broad, with postero-lateral angle simple. Metasterum highly reduced and represented by a small transverse sub-triangular plate. Fore leg (Image 66d) relatively simple, long, not clothed with long hairs on inner margin.

**Genitalia:** Male seventh sternite deeply concave apically. Genital segment VIII (Image 66e & f) with



**Image 66. a–h. *Ventidius (Ventidius) sushmae* Gupta, 1981. a. Dorsal view of male; b. Dorsal view of female; c. Head with antenna; d. Male fore leg; e. Male genital segment, dorsal view; f. Male genital segment, ventral view; g. Female genital segment, ventral view; h. Male paramere**



**Figure 54. Distribution of *V. (Ventidius) sushmae* in the study area**

posterior margin broadly rounded. Pygophore apically rounded. Paramere well developed, symmetrical (Image 66h), broadly rounded apically. Female seventh sternite (Image 66g) distinctly longer than all segments together, posterior margin straight.

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** Slow-flowing streams.

**Remarks:** This species is widely distributed in northern parts of West Bengal and mostly found in slow-flowing streams with rocky or sandy bottom substrates.

### Genus *Cylindrostethus* Fieber

**Diagnosis:** Large, elongated, cylindrical water striders. Dorsally, body colouration back to brown with yellowish stripes on pronotum and longitudinal band of silvery pubescence. Head vertex with inner margins of eyes strongly convergent anteriorly. Eyes large, protruding. Antennae thick and relatively short, first segment greater than combined length of second and third segment. Antennal tubercles divergent anteriorly. Rostrum reaching to the posterior margin of head, with a long third rostral segment. Pronotum roughly hexagonal in shape, posterior margin straight. Mesonotum long with rounded posterior margin. Metanotum with distinct longitudinal sulcus along midline. Fore femora enlarged, apical margin notched, bearing a small teeth at inner apical margin. Fore claws weakly sub-apical. Mid leg longer than the hind leg. Abdominal tergite I shorter than II, with sinuate anterior margin, tergite II–VI sub-equal in length. Connexival spines well-developed. Male proctiger narrower apically, often with lateral projections. Male parameres small, symmetrical.

### *Cylindrostethus productus* (Spinola, 1840): Image 67. a–j

1840. *Gerris productus* Spinola, Essai Sur less

insectes hemipteres rhynchotes on heteropteres, 64.

1910b. *Janias elegantulus* Distant, *Annals and Magazine of Natural History*, 5 (8): 145.

**Material examined:** Regn.no.3162/H15, 1 male, 2 females, from jhora in front of Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India,

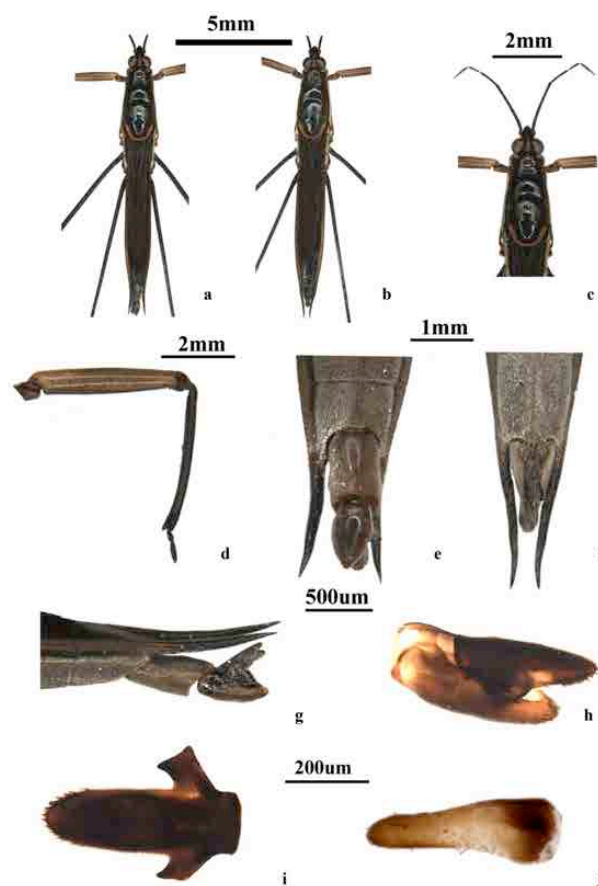


Image 67. a–j. *Cylindrostethus productus* (Spinola, 1840). a. Dorsal view of male; b. Dorsal view of female; c. Head and pronotum; d. Male fore leg, ventral view; e. Male genital segment, ventral view; f. Female genital segment, ventral view; g. Male genital segment, lateral view; h. Male genitalia dissected; i. Male proctiger; j. Male paramere

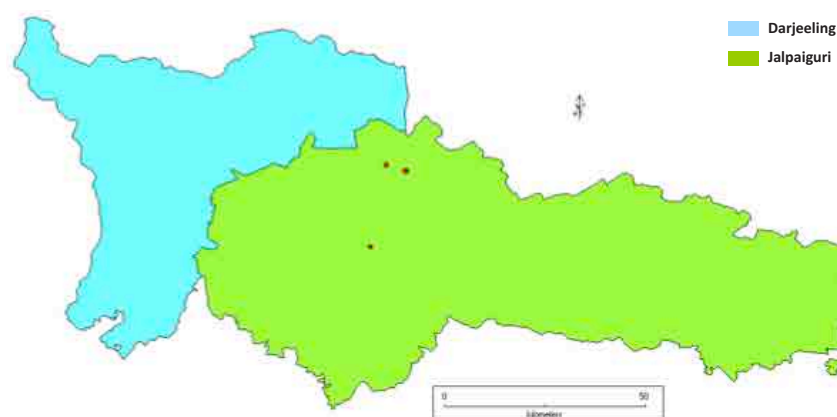


Figure 54. Distribution of *C. productus* (Spinola) in the study area



18.iii.2012, coll. S. Basu; 1 male, 1 female, 10.iii.2011, jhora in front of Chapramari Rail Gate, Jalpaiguri District, West Bengal, India, coll. S. Basu; 3 females, 9.xi.2013, Khunia more, Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll. M. Chakrabarty; 5 males, 6 females, 17.iii.2012, small jhora within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male ranges from 24.2–24.4mm, maximum body width across mesoacetabula 3.37mm. Female body length ranges from 24.5–24.6mm, maximum body width across mesoacetabula 3.1mm.

**Description:** Very large species, dark and elongate. Length of head 1.74mm and width 0.62mm, black marked with a yellow line vertically. Interocular width 0.91mm. First antennal segment distinctly longer than the rest, length of antennal segments 1–4: 3.46mm, 1.32mm, 0.82mm, 1.21mm. Eyes large, reddish brown. Length of pronotum 1.03mm and width 2.22mm. Meso and metasternum marked with a prominent vertical keel medially. Fore femora of male slender, long, marked with a small tooth near tibial margin and with a row of short hairs on the inner margin, dorsal surface of fore femur in both sexes lack spinules only on extreme distal end. Connexival spines long. Abdomen length 13.33mm and width 2.29mm.

**Genitalia:** Male genital segment length 3.34mm, width 1.1mm, elongated. Male proctiger (Image 67l) distinctive, with a prolonged median lobe. Connexival spines not exceeding tip of proctiger in male. Pygophore broad. Male paramere (Image 67), not well-developed and small. Length of female genital segment 1.79mm and width 0.85mm.

**Global distribution:** India, Sri Lanka, Myanmar, and Nepal.

**Distribution in India:** Punjab, Kerala, Madhya Pradesh, Maharashtra, Tamilnadu, Uttar Pradesh, Karnataka, Odisha, Uttar Pradesh, and West Bengal.

**Habitat:** Streams, waterfalls, and pools within jungles.

**Remarks:** This species can be easily recognized by their long connexival spines and are found abundantly

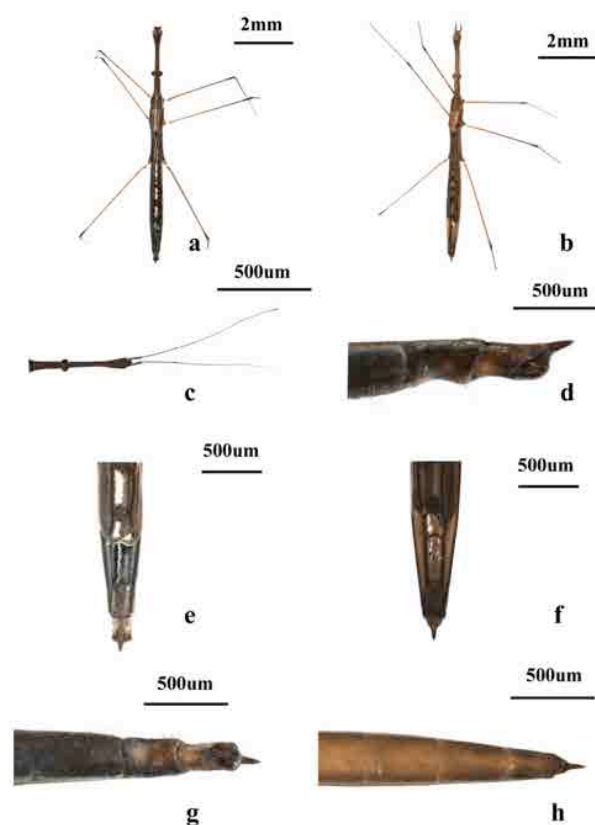


Image 68. a–h. *Hydrometra greeni* Kirkaldy, 1898. a. Dorsal view of male; b. Dorsal view of female; c. Head and antennae; d. Male genital segment, lateral view; e. Male genital segment, dorsal view; f. Female genital segment, dorsal view; g. Male genital segment, ventral view; h. Female genital segment, ventral view

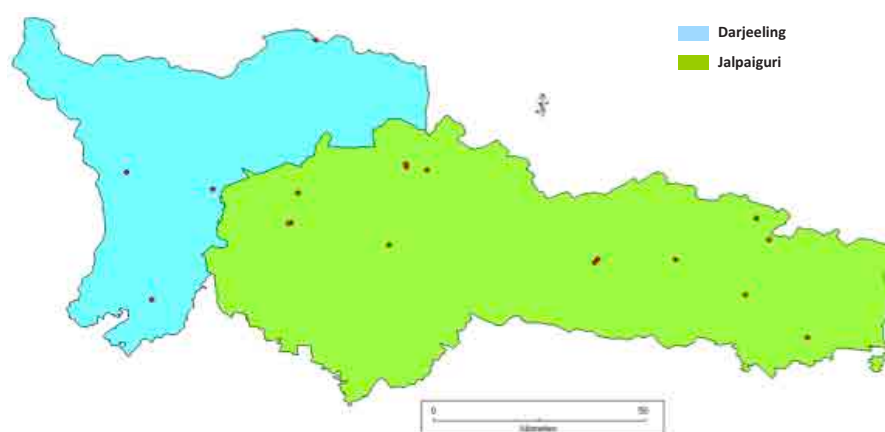


Figure 55. Distribution of *H. greeni* Kirkaldy in the study area

in the slow-flowing streams flowing across jungles or forests.

#### Family Hebridae Amyot & Serville, 1843

Body small, inconspicuous, predacious plump-bodied bugs called 'Velvet Water Bugs'. The body is densely covered with velvety hydrofuge piles. The antennae are four-segmented. The short legs are equally spaced and the tarsal claws are apical. Many species of hebrids have prominent white markings on hemelytra. The size ranges from 1.5–3mm.

#### Genus *Timasius* Distant, 1909

**Diagnosis:** Body small, ranges from 3.0–4.0mm. Colour dark brown to black. Head moderately declivous. Eyes prominent, located near base of head. Antennae about half as long as body, slender, four-segmented, antenniferous tubercle laterally produced, fourth segment of antenna with a pre-apical sensory pit with modified hair. Pronotum with anterior collar and a pair of more or less distinct sub-median carinae. Longitudinal carinae of thoracic venter united on metasternum before the tubercle carrying the scent orifice. Tarsal claw well-developed. Fore wings with two closed cells apically. Male genitalia asymmetrical. Parameres small, often with bristles.

##### *Timasius* sp.

**Material examined:** Regn.no. 4709/H15, 2 nymphs, 14.iii.2012, jhora coming from Sinchal Lake, near Mongpu, Darjeeling District, West Bengal, India, coll. S. Basu.

**Remarks:** This species was identified only upto the generic level as adults were not present in collection.

#### Family Hydrometridae Billberg, 1820

Body extremely slender, size ranges from 7–20mm, stick-like bugs with thread-like legs and a very elongated head which is as long as the thorax. Eyes located midway on head. The adults are dimorphic in respect of wings.

#### Genus *Hydrometra* Latrielle

**Diagnosis:** Body elongated, stick-like, slender. Colouration varies from dark brown to light brown. Head long, slender. Antecypeus is quite variable in shape, ranging from conical to transverse and truncate. The rostrum long, slender, usually reaching at least to the eyes. Three forms occur in this genus such as micropterous, brachypterous, and macropterous. The first abdominal tergite distinct in most species. Each abdominal sternite bear a pair of widely separated ventrally directed trichobothria or setae. The sixth

sternite often bears tufts of setae near the posterior margin. The seventh sternite possesses variety of modifications, with distinctive pattern of setiferation, spine-like setae arranged in rows. The male genital segment VIII modified. The shape of female genital segment also varies species wise.

#### *Hydrometra greeni* Kirkaldy, 1898: Image 68. a–h

**Material examined:** Regn.no.3170/H15, 1 male, 19.iii.2013, Buri Torsha River, Bish Khutia, border between South Khairabari and North Khairabari Reserve forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 female, 16.ix.2011, canal within Gava Ganga and Kamala Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 2 females, 20.iii.2013, falls near Bunkulung, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 1 female, 6.iii.2011, Jayanti River, Jayanti Forest Bungalow, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 6.iii.2011, Jayanti River, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 2 females, 18.iii.2012, jhora in front of Chapramari Wildlife Sanctuary, Jalpaiguri District, West Bengal, India, coll. S. Basu; 3 males, 10.iii.2011, jhora in front of Chapramari Rail Gate, Jalpaiguri District, West Bengal, India, coll. S. Basu; 5 males, 3 females, 17.iii.2013, Kalikhola, between Gorumara and Chapramari Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 4 males, 4 females, 9.iii.2011, Murti River, Chalsa, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 females, 19.iv.2013, Poro River, Poro Beat, Chilapata Forest Range, Alipurduar District, West Bengal, India, coll. S. Basu; 1 male, 1 female, 19.iv.2013, Raidhak River, Alipurduar District, West Bengal, India, coll. S. Basu; 2 females, 8.iii.2011, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu; 3 males, 3 females, 17.iii.2012, small jhora within Gorumara National Park, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 23.iii.2013, stagnant pool beside Rishi River, Rishikhola, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 19.iii.2013, stagnant pool, North Khairabri Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 10 males, 15 females, 20.iii.2012, stagnant pool within Mahananda Wildlife Sanctuary, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 19.iii.2012, Teesta Canal, near Odlabari, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 female, 13.iii.2011, Teesta Canal, Teesta Barrage, Gajaldoba, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 13.iii.2011, wetland beside Gajaldoba, Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 17.iv.2013,

Dima River, Damanpur Forest, Alipurduar District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length of male ranges from 10.2–11.4mm. Female may attain a length of about 11.2–11.8mm. Maximum body width of male 0.53mm and maximum body width of female 0.65mm.

**Description:** The general colour of the body brownish yellow. In male, the venter darker in colour, while in female, the venter pale yellowish brown. A narrow white stripe extends along the median line of the body from the posterior margin of eyes to the posterior margin of pronotum. Head 15.9 times as long as the width ( $L/W=3.03/0.19$ ). Clypeus bluntly conical. Rostrum reaches a length of 2.38mm, reaching beyond the eyes, but not surpassing the head. First antennal segment short, third antennal segment longer than second. Length of antennal segments 1–4: 0.43mm, 1.10mm, 2.03mm, 0.94mm. Interocular width 0.09mm. Length of pronotum 0.64–0.66 mm and width 0.52–0.56 mm. Length of eye 0.22mm and width 0.12mm. Pronotum with an encircling row of pits parallel to the anterior margin, posterior lobe of pronotum with a median longitudinal row of pits. The hemelytra large and long, extending to the posterior margin of fourth abdominal segments in brachypterous forms. Abdomen 8.9 times longer than width ( $L/W=4.54/0.51$ ). In male, the length of genital segment 0.59mm and width 0.24mm. In dorsal view, sides of seventh segment of abdomen almost parallel. Fore femora not surpassing the apex of head and hind femora not surpassing the tip of abdomen. The distance between fore and mid coxa 0.86mm.

**Genitalia:** Seventh sternite of male is transversely depressed and hairy as in the posterior half of sixth abdominal segment. Posterior dorsal margin of seventh

segment is fringed with short stiff hairs. The terminal dorsal process of male sharp. In female, the last dorsal abdominal segment broader behind than in front and with a sharp ovipositor.

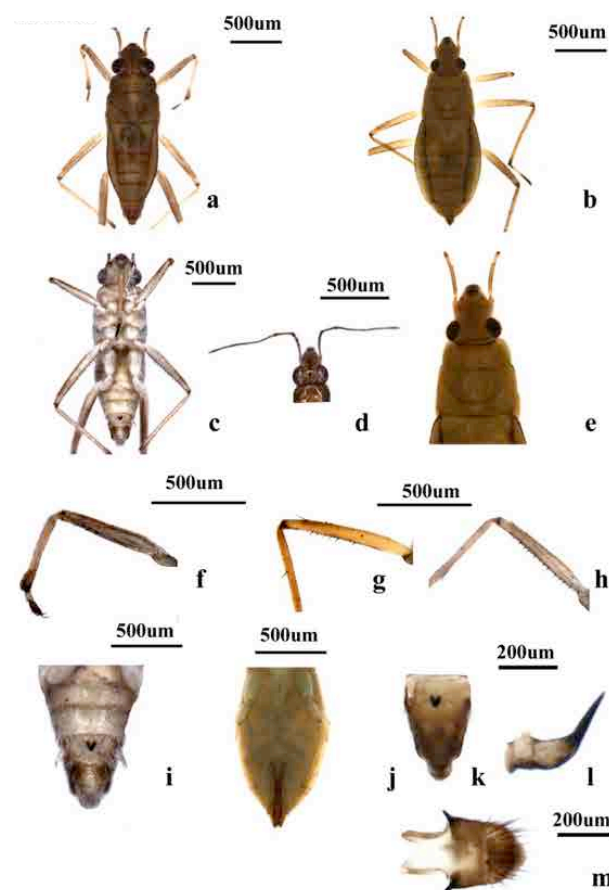


Image 69. a–m. *Mesovelia vittigera* Horvath, 1895. a. Dorsal view of male; b. Dorsal view of female; c. Ventral view of male; d. Head and antennae; e. Head and pronotum; f. Male fore leg; g. Mid femur of male; h. Mid femur of female; i. Male genital segment, ventral view; j. Female genital segment, ventral view; k. Male genitalia dissected; l. Male paramere; m. Male proctiger

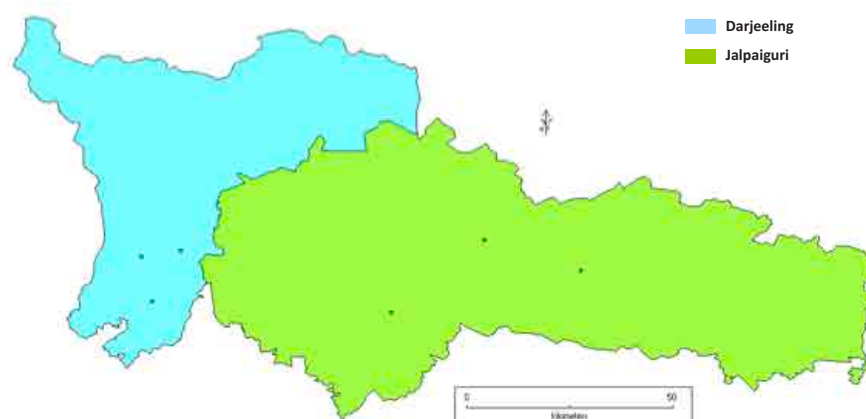


Figure 56. Distribution of *M. vittigera* Horvath in the study area

**Global distribution:** Bangladesh, China, Nepal, Sri Lanka, Sumatra, Thailand, Vietnam, and India.

**Distribution in India:** Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamilnadu, Uttar Pradesh, and West Bengal.

**Habitat:** River beds, streams, stagnant pools within forests, ponds, lakes with algal bloom or floating vegetation, swamps, paddy fields, rocky up and low lands of streams.

**Remarks:** A widespread species found throughout the world. This species is attracted to light.

#### Family Mesoveliidae Douglas & Scott, 1867

Body small, slender, semi-aquatic, greenish insects characterised by the saw-like ovipositor and three-segmented tarsi. The macropterous forms have 2–3 closed cells in the forewing, ocelli, and exposed scutellum, while the apterous forms lack ocelli, scutellum, and wing pads.

#### Genus *Mesovelgia* Mulsant & Ray

**Diagnosis:** Body slender, attains a length of 2.0–4.0mm. Dorsally yellowish green in colour with some brownish patterns. Head usually distinctly prolonged and deflected in front of eyes. Head length distinctly less than thorax, with three pairs of cephalic trichobothria. Antennae long, slender, with third and fourth segment longer and thinner than first and second segments. Pronotum length shorter or subequal to mesonotum in apterous forms. Macropterous forms having a pair of ocelli on the posterior part of head, while the apterous forms lacking ocelli. The scutellum in macropterous form elevated, fore wings with three closed cells. Legs slender marked with spines and bristles, hind leg long. All tarsi three segmented with two apical claws. The

scent gland orifice distinct and situated in tergite IV medially. Male genital segment large. Females are larger than males, with well-developed ovipositor.

#### *Mesovelgia vittigera* Horvath: Image 69. a–m

1901b. *Mesovelgia orientalis* Kirkaldy, *Annali del Museo Civico di storia Naturale Giacomo Doria*, **20**: 808.

1903. *Mesovelgia mulsanti* White: Distant, *Fauna of British India*, **2**: 169.

**Material examined:** Regn.no.3176/H15, 2 males, 1 female, 19.iii.2013, Buri Torsha River, Bish Khutia, border between South Khairabari and North Khairabari

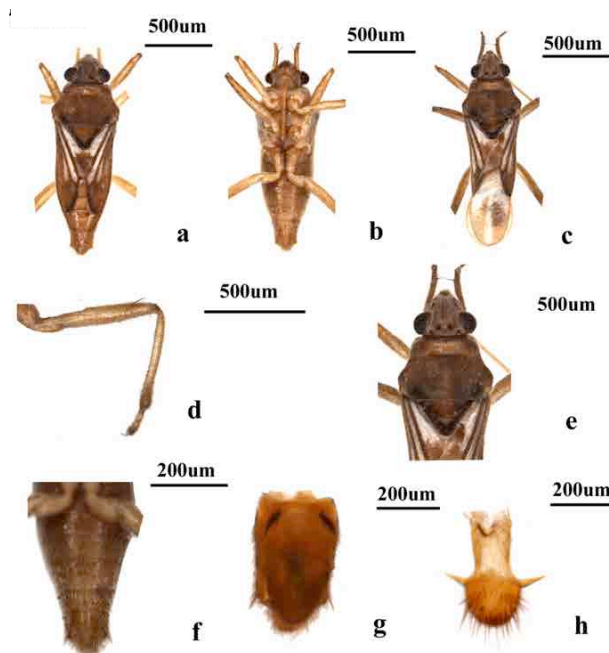


Image 70. a–h. *Mesovelgia horvathi* Lundblad, 1934. a. Dorsal view of male; b. Ventral view of male; c. Dorsal view of macropterous female; d. Mid femur of male; e. Head, pronotum; f. Male genital segment, ventral view; g. Male genital segment dissected; h. Male proctiger

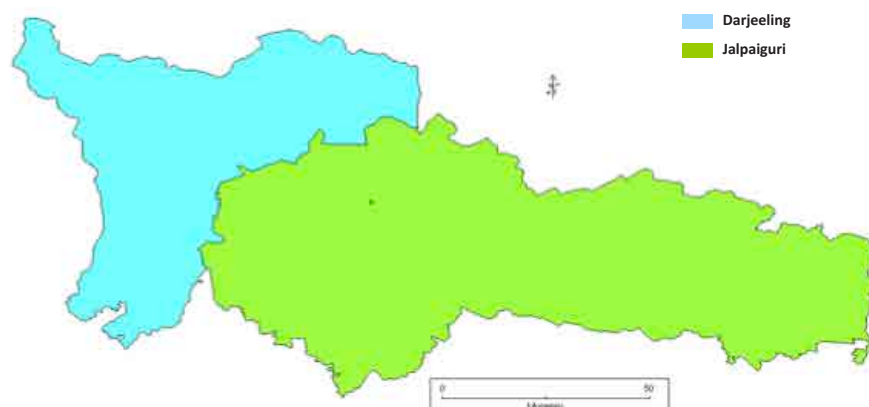


Figure 57. Distribution of *M. horvathi* Lundblad in the study area



Reserve Forest, Jalpaiguri District, West Bengal, India, coll. S. Basu; 6 males, 2 females, 16.ix.2011, Ghospukur Dighi, Kamala Bagan, Darjeeling District, West Bengal, India, coll. S. Basu; 2 males, 2 females, 4.x.2013, jhora beside Kiranchandra Tea Garden, Darjeeling District, West Bengal, India, coll. S. Basu; 1 male, 3.x.2013, pond at Binnaguri, Jalpaiguri District, West Bengal, India, coll. S. Basu; 5 males, 3 females, 3.x.2013, pond at Mainaguri, Jalpaiguri District, West Bengal, India, coll. S. Basu; 1 female, 4.x.2013, Shivmandir, Siliguri, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length varies from 2.0–2.4mm; maximum width of body across third abdominal segment 0.61mm.

**Description:** Yellowish or greenish dorsally. Females are larger than males; in male, length of the head 0.43mm and width 0.32mm. Eyes oblong, 1.8 times wider than length ( $W/L=0.22/0.12$ ). Pronotum (0.56mm) 1.75 times wider than head (0.32mm), interocular width 0.21mm. Rostrum 0.99mm, reaching beyond mesocoxa. Antennal length 1–4: 0.31mm, 0.29mm, 0.44mm, 0.53mm. Abdomen slender in male but wider in female with prominent segmentation. Venter yellowish. Posterior margin of mid femur armed with row of black spines (10–17) in both sexes.

**Genital segment:** Male genital segment VIII 0.39mm in length and 0.25mm in width, with stout black hair tufts on the middle and a pair of brush-like hairs laterally. Male paramere small, curved as in Image 69I. In female, ovipositor prominent, bulging out of the body.

**Global distribution:** Malaysia, Singapore, Africa, Australia, Egypt, Indonesia, Palestine, Philippines, Syria, Sri Lanka, Samoa Island, China, Japan, and India.

**Distribution in India:** Andaman and Nicobar Islands, Arunachal Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Odisha, Pondicherry, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Stagnant or lentic water bodies, mainly ponds, lakes, river banks, floating vegetation, brackish water habitats.

**Remarks:** This species is very widely distributed in India. They prefer stagnant or slow-flowing water covered by emergent or floating vegetation.

#### ***Mesovelvia horvathi* Lundblad, 1934: Image 70. a–h**

**Material examined:** Regn.no. 3165/H15, 1 male, 17.ix.2011, pond near Baradighi, Malbazar, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Body length not more than

2.5mm. Brachypterous male attains a length of 1.9mm and in female, the body length 2.1mm.

**Description:** Body light yellow to greenish in colour. The macropterous forms have two or three closed cells in the forewing, ocelli, while the apterous forms lack ocelli ad scutellum. Head length 0.3mm and width 0.36mm. Interocular width 0.192mm. Eye length 0.145mm and width 0.09mm. Length of pronotum 0.57mm and width 0.63mm. Rostrum long, surpasses the meso coxa and reaching upto midway of body and upto the meta coxa. Length of rostrum 0.82mm. Length of male fore femur 0.50mm and width 0.07mm. Mid femur hairy below and length 0.49mm. In female, mid femur with two, three, or four spines arranged ventrally at inner margin.

**Genital segment:** Length of male genital segment 0.19mm and width 0.18mm, elongated, without any median spine, but with two lateral groups of spines as in Image 70g. The male paramere is prominently curved. Proctiger elongated, apex round. In female, the ovipositor is saw-like and projecting outward.

**Global distribution:** India, Indonesia, Malaysia, Sri Lanka, Thailand, and Vietnam.

**Distribution in India:** Tamil Nadu and West Bengal.

**Habitat:** Freshwater ecosystems like ponds, pools, lakes, and slow-flowing streams with floating vegetation.

**Remarks:** They are small, slender, greenish bugs, carnivorous in nature, and feed on a variety of dead insects found on water surface. Apterous forms usually outnumber the macropterous forms.

#### **Family Veliidae Amyot & Serville, 1843**

Body small (1.8–18mm), oval or elongate bugs. The general colour varies from yellowish brown to grey or black, with dorsum often marked with yellow or brown or silvery spots. Wing polymorphism is common and apterous forms are the most commonly encountered morphs. Presence of pre-apical claws, short legs, and absence of ocelli.

#### **Genus *Microvelia* Westwood, 1834**

**Diagnosis:** Adults may be apterous or macropterous. Body usually elongate, oval or sub-oval. Colour varies from black or dark brownish above with yellowish brown markings. Body covered with relatively short pilosity. Head shorter than wide, shortly or moderately produced in front of eyes, with a shiny distinct median furrow and a pair of pseudocular pits at base. Antennae relatively long, with small tubercles situated closely to margin of eyes, fourth antennal segments longer than second and third. Pronotum usually longer than head, with large, transverse pale marking or paired

spots anteriorly, concave anteriorly, bordered by dark punctures. Macropterous forms having pronotum with distinctly raised humeral angles, the wing reaching abdominal end, long, venation of fore wings forming

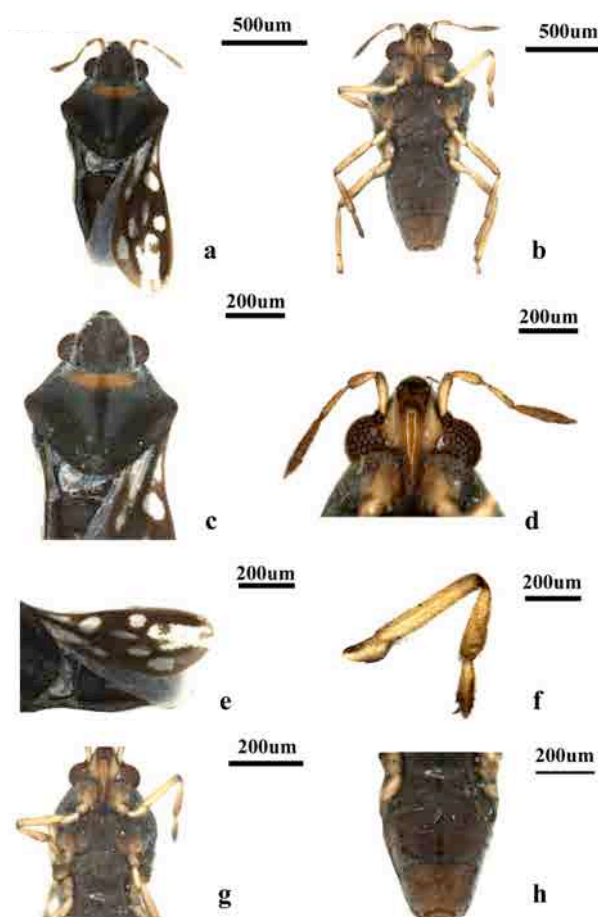
four closed cells, black with whitish stripes and spots. Fore femora moderately thickened, not modified. Fore tibiae of male with a comb on inner surface near apex. Mid tibiae with long row of curved hairs on inner surface. Claws of mid and hind legs long, slender, with bristle-like arolia. Abdomen relatively long with evenly rounded laterally, depressed or with hair tufts and tubercles. Mid leg distinctly longer than fore leg and shorter than hind leg.

***Microvelia (Microvelia) albomaculata* Distant, 1910:**  
**Image 71. a–h**

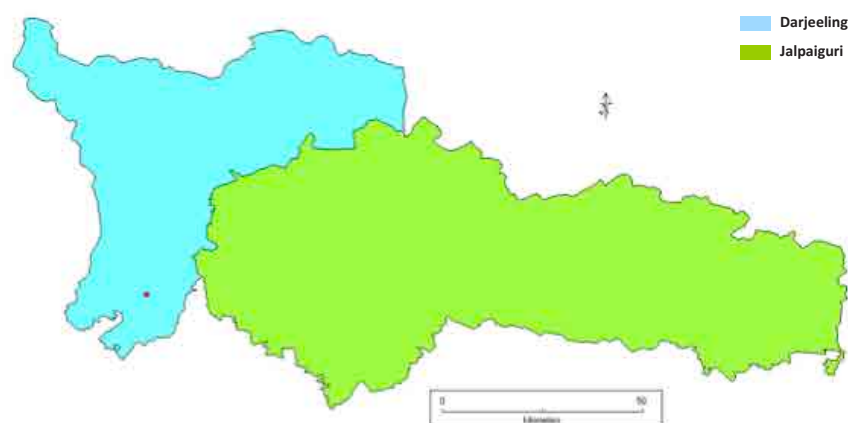
**Material examined:** Regn.no. 4771/H15, 1 male, 1 female, 16.ix.2011, Ghoshpukur Dighi, Kamala Bagan, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 1.3–1.8mm, maximum body width of male 0.37mm. Female body length 1.4–2.0mm, maximum body width of female 0.41mm.

**Description:** Body dull black dorsally with a grayish pubescence. Length of head 0.25mm and width in front of eyes 0.20mm. Head subglobosely arched. Interocular width 0.24mm. Rostrum 0.37mm in length, reaching beyond fore trochanter. Eye length 0.11mm and width 0.06mm, a marginal fascia to head continued inside eyes to base. Length of antennal segments 1–4: 0.07mm, 0.07mm, 0.10mm, 0.16mm. A reddish or yellowish brown marginal fascia on pronotum anteriorly, not reaching the anterior angles. Pronotum 0.39mm in length. Humeral width 0.59mm. Hemelytra spotted with grayish white, of which a large spot present at clavus, corium with two large basal marginal spots, three irregularly shaped spots in transverse series, a large sub-apical spot on membrane and a smaller sub-apical spot at inner margin, lateral margins of



**Image 71. a–h. *Microvelia (Microvelia) albomaculata* Distant, 1910.**  
a. Dorsal view of female; b. Ventral view of female; c. Head and pronotum; d. Antennae and rostrum; e. Marking pattern of wing; f. Fore femora, tibia and tarsus; g. Pro, meso and metasternum; h. Female genital segment



**Figure 58. Distribution of *M. albomaculata* Distant in the study area**

hemelytra concavely sinuate and finely hirsute. Fore femur 0.29mm in length. Length of abdomen 0.74mm and width 0.38mm.

Genitalia: Female genital segment 0.22mm in length and 0.25mm in width, tapering towards the end, much

broader apically.

**Global distribution:** India and Bangladesh.

**Distribution in India:** West Bengal.

**Habitat:** Ponds and lakes.

**Remarks:** This species can be easily recognized by the marking patterns on wings.

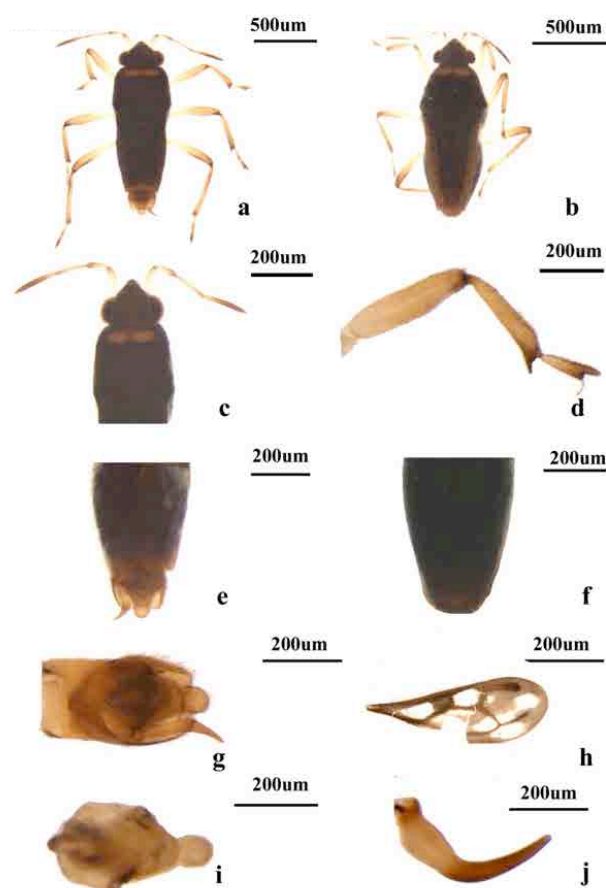


Image 72. a–j. *Microvelia (Microvelia) douglasi* Scott, 1874. a. Dorsal view of male; b. Dorsal view of female; c. Head with antennae and pronotum; d. Fore leg of male; e. Male genital segment, ventral view; f. Female genital segment, ventral view; g. Male genitalia dissected; h. Marking pattern of wing; i. Male proctiger; j. Paramere of male

***Microvelia (Microvelia) douglasi* Scott, 1874: Image 72. a–j**

1903. *M. repentiana* Distant, *Fauna of British India*, 3: 174.

1909. *M. kumaonensis* Distant, *Annals and Magazine of Natural History*, 5(8): 500.

**Material examined:** Regn.no. 4634/H15, 1 male, 2 females, 8.iii.2011, Sikhiajhora, Alipurduar District, West Bengal, India, coll. S. Basu; 1 female, 19.iii.2012, Teesta Canal near Odlabari, Jalpaiguri District, West Bengal, India, coll. S. Basu; 12 females, 8 males, 12.iii.2012, wetland beside Gajaldoba Teesta Barrage, Jalpaiguri District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Apterous male reaches a length of 1.45–1.6mm and apterous females may attain a length of 1.65–2.0mm.

Description: Body 3.3 times longer than width (BL/BW=1.45/0.44). Length of head 0.22mm and width including eyes 0.37mm. Head and pronotum dull black. Interocular width 0.22mm. Length of antennal segment 1–4: 0.14mm, 0.12mm, 0.18mm, 0.25mm, yellowish brown in colour, second segment shorter than the rests. Pronotum with the lateral angles subacutely prominent. Hemelytra pale brown. Length of abdomen 0.89mm and width 0.40mm. Length of fore femora 0.33mm. Fore tarsae single-segmented, whereas mid and hind tarsae two-segmented.

Genitalia: Male genital segment 0.24mm in length and 0.23mm in width. Usually one paramere projecting

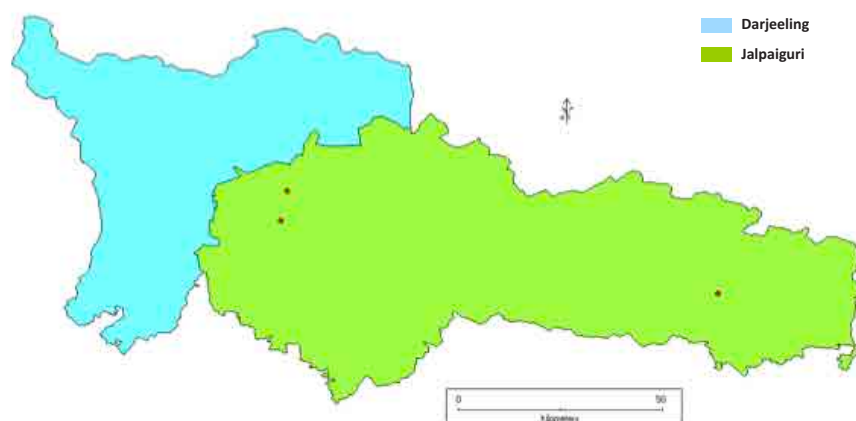


Figure 59. Distribution of *M. douglasi* Scott in the study area

outward of the genital segment and the other one hidden inside (Image 72g). Paramere curved with more or less pointed tip. In female, the length of seventh segment 0.24mm and width 0.35mm.

**Global distribution:** India, Australia, Japan, Indonesia, and Sri Lanka.

**Distribution in India:** Andaman and Nicobar Islands,

Arunachal Pradesh, Kerala, Karnataka, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh, and West Bengal.

**Habitat:** Stagnant pools and ponds with vegetation.

**Remarks:** This species was described by Distant as *M. kumaonensis* from Bhim Tal, Kumaon. This, in turn, proved that this species was also found in high altitudinal wetlands.

#### Genus *Rhagovelia* Mayr

**Diagnosis:** Body elongated sub-oval or oval, relatively small. Head small with a cleavage line originating from the posterior margin and extends down to the anteclypeus. Eyes large, usually as wide as the vertex at the posterior margin. Antennae four-segmented with a conspicuous protuberance at base. Pronotum well-developed posteriorly. In some females, pronotum develops into a long, narrow process. The mesonotum completely hidden beneath the pronotum. Metasternal scent glands present, connected by a transverse suture across the sternum. Fore wing not well-differentiated into corium, clavus and membrane, with small apical cells. Hind wing with venation. The first abdominal tergite reduced, with a median elevated area. Third to seventh abdominal sternum occasionally armed with a median longitudinal elevation. Hind femur shorter than tibiae. Mid tarsae with a deep cleft which possess leaf-like claws and plumose hairs, arising from the base. Hind tarsae three-segmented. Mid femur and hind femur modified with several spine-like structures.

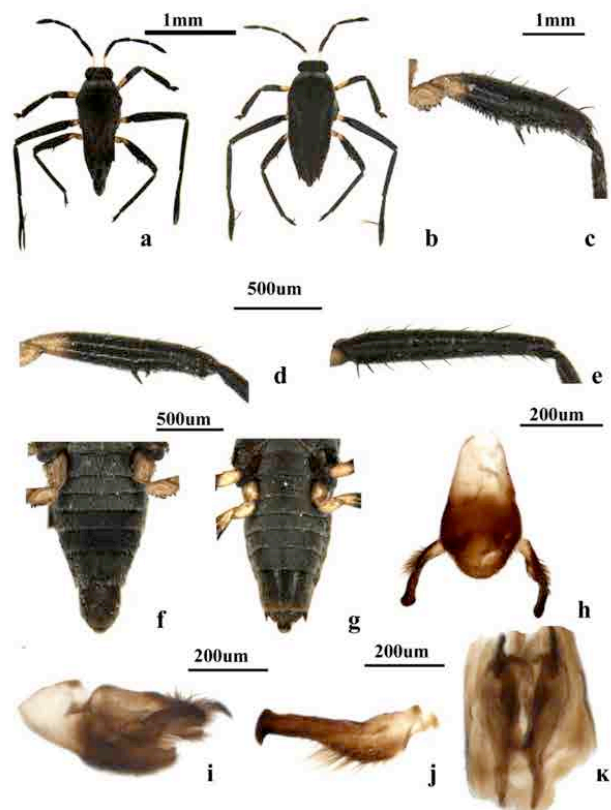


Image 73. a–k. *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1936. a. Dorsal view of male; b. Dorsal view of female; c. Hind femur of male; d. Hind femur of female; e. Mid femur of male; f. Male genital segment, ventral view; g. Female genital segment, ventral view; h. Male pygophore with paramere; i. Lateral view of male genital segment; j. Male paramere; k. Dorsal view of endosomal sclerite

#### *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1936: Image 73. a–k

1934. *Rhagovelia femorata* var. *sumtrensis* Lundblad, Archiv für Hydrobiologie - Supplement, 4: 287.

**Material examined:** Regn.no. 4599/H15, 5 males, 4 females, 4 nymphs, 21.iii.2015, Jorkhola, Bunkulung, Darjeeling District, West Bengal, India, coll. S. Basu; 2

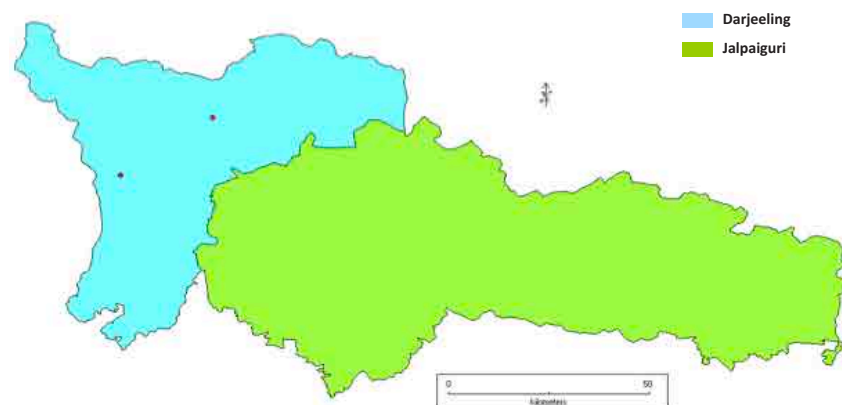


Figure 60. Distribution of *R. sumatrensis* Lundblad in the study area



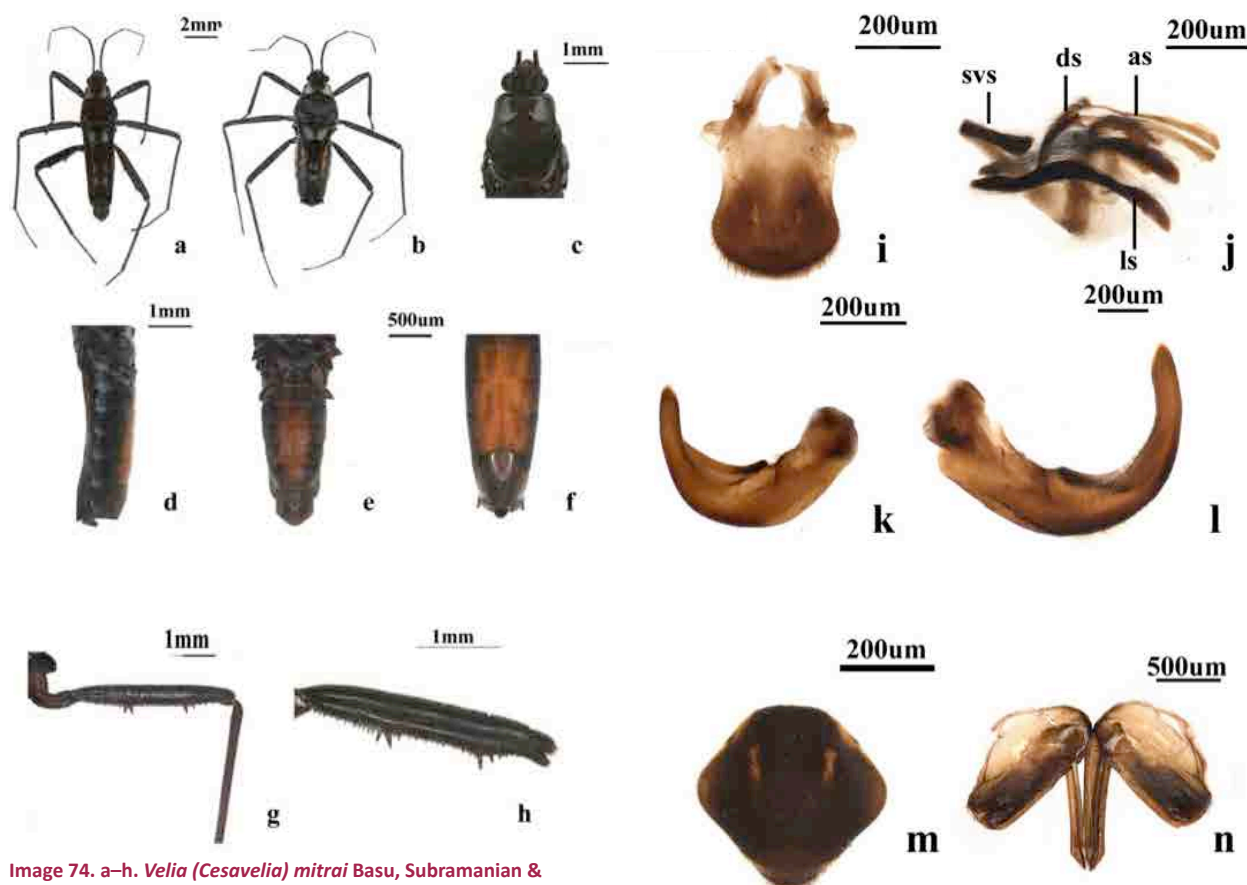


Image 74. a–h. *Velia (Cesavelia) mitrai* Basu, Subramanian & Polhemus, 2013. a. Apterous male, dorsal view; b. Apterous female, dorsal view; c. Apterous male, head and pronotum, dorsal view; d. Female abdomen, lateral view; e. Male genital segments, ventral view; f. Female genital segments, ventral view; g. Male metafemur, dorsal view; h. Male metafemur, detail showing pattern of spination

Image 75. i–n. *Velia (Cesavelia) mitrai* Basu, Subramanian & Polhemus, 2013. i. Male genital capsule, dorsal view; j. Endosomal sclerites of male, lateral view; k. Male proctiger dorsal view; l. Male paramere, external view; m. Male paramere, internal view; n. Female ovipositor

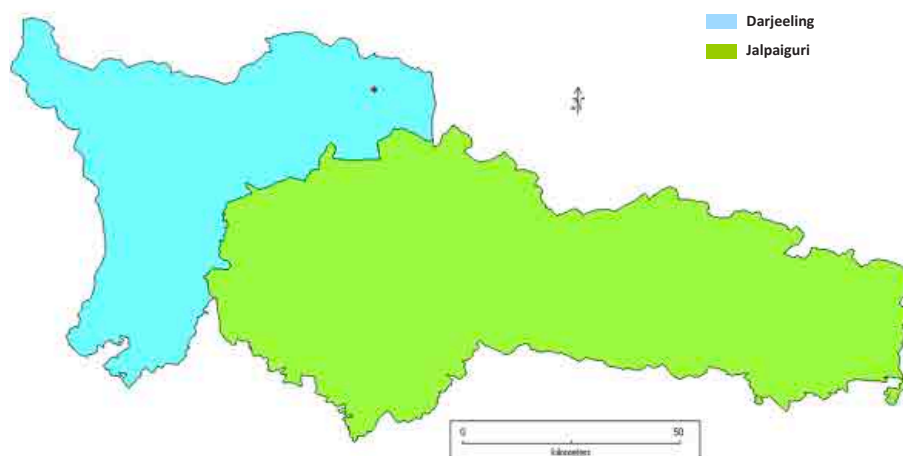


Figure 61. Distribution of *V. mitrai* Basu et al. in the study area

males, 10 females, 15.iii.2012, Teesta River, Rabijhora, Darjeeling District, West Bengal, India, coll. S. Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Male body length 2.43–2.46 mm,

body width 0.91mm. Female body length 2.46–2.5 mm, body width 0.93–0.97 mm.

**Description:** Body dark black. Head length 0.18mm. Length of eye 0.23mm and width 0.14mm. Interocular

width 0.29mm. Length of antennal segment 1–4: 0.43mm, 0.27mm, 0.38mm, 0.35mm. Pronotum 3.68 times wider than long ( $W/L=0.70/0.19$ ), anterior margin of pronotum black, bearing an orange brown transverse band medially, surrounded by black margins, posterior margin of pronotum either slightly concave or straight. Humeral width 0.84mm. Length of abdomen 1.46mm and width 0.64mm. Mid coxae slightly embrowned. Male mid femur (Image 73f) with three to four slender sharp spines ventrally on basal half. Male hind femur with 14–18 basal teeth reaching to base of femur, distally followed by seven to nine teeth after the long, curved middle spine. Female hind femur (Image 73h) with three to six basal, one middle, and five to six distal teeth. Hind trochanter with four to six black denticles.

**Genitalia:** Male genital segment VIII 0.33mm in length and 0.28mm in width. Male paramere (Image 73) short, slightly curved with more or less bluntly pointed apex and with few scattered pegs. Pygophore (Image 73) elongated, broad. Dorsal sclerite as in Image 73.

**Global distribution:** China, Malaysia, Indonesia, India, and Africa.

**Distribution in India:** Andaman and Nicobar Islands, Sikkim, and West Bengal.

**Habitat:** Streams, cascades, and riffles with sandy bottom.

**Remarks:** It is a wide spread species and distribution ranges from North India to Indian Ocean islands.

#### Genus *Velia* (*Cesavelia*) Koçak & Kemal, 2010

**Diagnosis:** Body elongated, larger species, blackish dorsally. The first antennomere distinctly longer than the head width. Hind femur slender in both sexes, distinctly shorter than hind tibiae. Meso-trochanter

unarmed. In female, meta-trochanter unarmed. Meta-femur of male slender or moderately incrassate and heavily armed than female, where it is slender, usually with small irregular teeth on flexor side. Male genital segment relatively large. Proctiger plate-shaped. Paramere prominent and strongly curved. In females, proctiger plate-shaped covering gonocoxae.

#### *Velia* (*Cesavelia*) *mitrai* Basu, Subramanian and Polhemus, 2013: Image 74. a–h, Image 75. i–n

**Material examined:** Regn.no.2946/H15, 2males, 3females, 3.iii.2012, small stream, Neora Valley National Park, Darjeeling District, West Bengal, India, coll. S.Basu, in wet preservation, Zoological Survey of India, Kolkata.

**Morphology:** Size: Length of apterous male ranges from 7.0–7.2 mm, maximum width of body (across thorax) 1.8mm. Length of female ranges from 7.3–7.4 mm, body maximum width 1.8–1.9 mm, width 1.8–1.9 mm.

**Description:** Body color black, with scattered silvery pubescent patches dorsally. Head black with a prominent median furrow, antennae, eyes and legs black. Head length 0.68mm, width 1.10mm. Length of first antennomere 2.2 times head length and 1.4 times head width. Head width 1.8 times as long as interocular space. Pronotum black, with broad patches of silvery pubescence laterally and a transverse orange patch anteromedially. Pronotum length 1.47 times as long as eye length (pronotum 0.59mm, eye 0.40mm). Mesofemur 2.0 times as long as pronotal width. Metatibia 1.0 times as long as metafemur, 1.8 times as long as metatarsus. Second mesotarsus 1.3 times as long as third tarsomere. Flexor side of meso- and metatibia with erect setae. Metatrochanter with eight

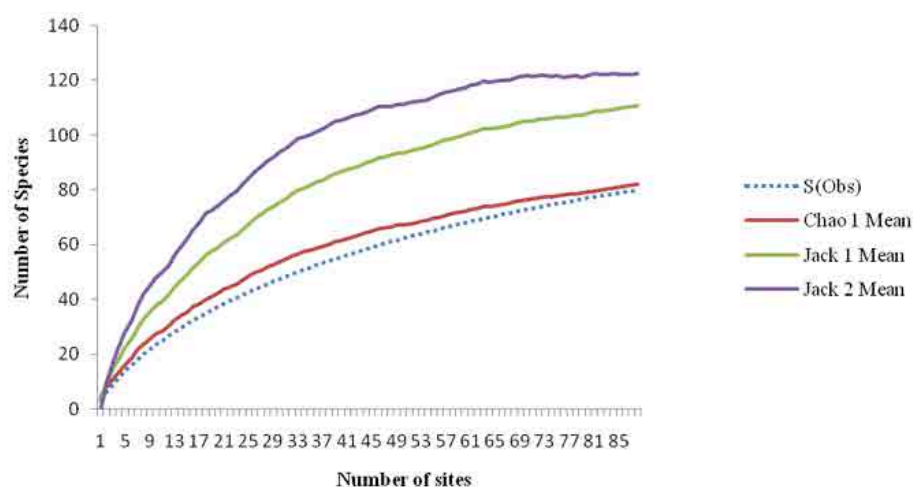


Figure 62. Observed and Estimated Species Richness of across 86 sampling sites.

denticles, fifth and sixth denticles somewhat longer than the remainder. Metafemur of male stout, 6.4 times as long as wide (Image 75 k & l), posterior margin bearing prominent spines (Image 75 k & l), starting with 12 small teeth, followed by two long diverging teeth, continued with 10 small teeth, then another larger tooth, followed by seven small teeth of progressively decreasing size to apex (Image 75l). Metafemur of female slender and slightly longer than in male, lacking spines. Abdominal tergites II, V, and VI with dense patches of silvery pubescence laterally, smaller patches of silvery pubescence present at anterolateral angles of tergites III and IV. Abdominal sternites II–VI dark orange-brown medially. Length of abdominal tergites 4.20mm, maximum width 1.50mm. Connexival spines in male short with apices pointed when viewed both dorsally and laterally. Posterior connexival apices longer than in male, pointed when viewed both dorsally and laterally (Image 74f), covered with short hairs.

Genitalia: Male genital segment VIII 1.1 times as long

as wide, elongated and hairy below (Image 74g & Image 75i). Proctiger of moderate length, slightly expanded distally with posterior margin broadly rounded, bearing long setae laterally and medially, basal lobes small (Image 75m). Male paramere evenly curved, slightly twisted medially, apex moderately rounded. Endosoma with lateral sclerite relatively slender, expanded centrally, broadly curved along its length (Image 75n). Ovipositor of female as in Image 75.

**Global distribution:** India.

**Distribution in India:** West Bengal.

**Habitat:** Small, unpolluted, shaded high mountainous streams flowing through forests.

**Remarks:** This species is closely related to *Velia tomokunii* Polhemus and Polhemus from Nepal.

#### Diversity assessment

##### Estimation of Species richness (Fig. 62)

Figure 62 depicts the observed and estimated species richness for the 86 sampling sites of the present study

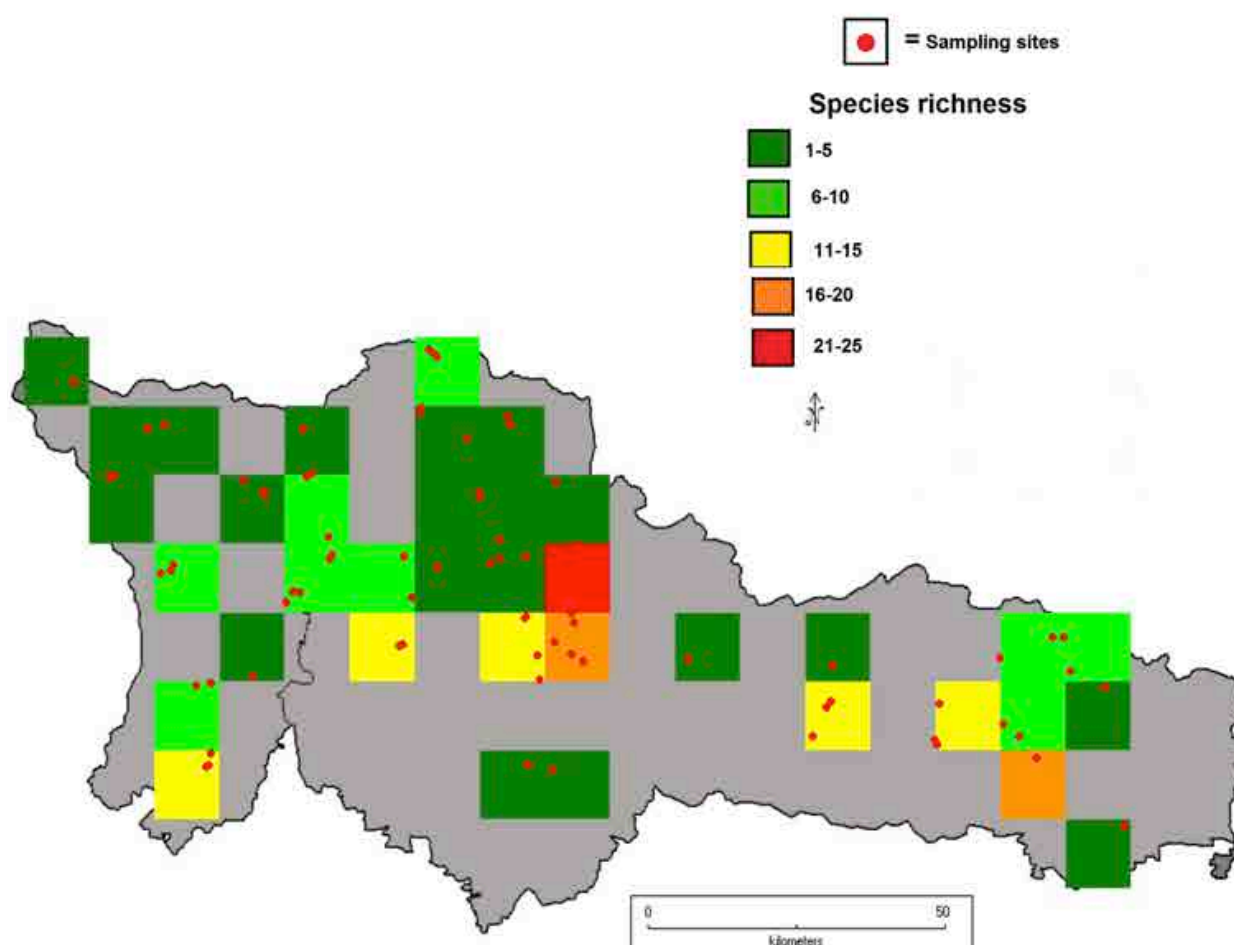


Figure 63. Species richness map across the study area

area. Species accumulation curves plotted against sites showed that the slope of the curve rapidly increases in the beginning as new taxa were recorded with increasing number of sites. According to Chao1 mean, a total of 82 species (of which 61 species were identified upto the species level as only nymph or females found in collection) were estimated from the study sites, whereas Jack1 mean and Jack2 mean indicate that the species richness would have exceeded 110 and 122, respectively. This estimated species richness is slightly higher than the observed richness as many of the species of aquatic and semi-aquatic Hemiptera are cryptic in habit and hence might not have been collected during the survey. This trend indicates that there might be a possibility of a few taxa that were missed during the collection because of their ambiguousness or infrequency. The gradual flattening of the curves, however, shows that most of the common and existing taxa would have been sampled and hence can be used as a reasonable estimate of the total species richness for the study sites sampled.

#### Species richness mapping across the study area (Fig. 63)

Species richness is simply the number of species of a given taxon in unit study area or in the chosen assemblage. This richness measure in ecological study is the most intuitive measure of biodiversity. The current study using GIS mapping tools shows that the Gorumara National Park and Chapramari Wildlife Sanctuary areas of Jalpaiguri are the richest zones as maximum number of species (21–26) occurred in this area. This region is free of human disturbances and is under protected areas. The Lataguri-Kalmati-Baradighi of Malbazar and Alipurduar region is the second highest richness zone showing 16–20 species occurrence. Most of the areas of Darjeeling, including Kalimpong, Rishikhola, Pedong, Mongpu, Mirik, Ghoom, Sonada, Sevoke, Kalijhora, and Gorubathan except Phansidewa-Kharibari-Naxalbari region, shows lowest species richness and only 1–5 species were recorded from this mostly hilly region. The areas of Gajaldoba, Raimatang, Madarihat and Jayanti of Alipurduar region also represents the lowest species richness zone, which may be attributed to the greater degree of anthropogenic disturbances like grazing, pisciculture, dam construction, etc. in the area.

## DISCUSSION

The Eastern Himalayan region recognized by the international community as biodiversity hotspots is well represented by a large number and variety of flora and fauna with high degree of endemism. The knowledge on aquatic and semi-aquatic Hemiptera is limited to the taxonomic preliminaries, recording few species from different parts of this region. Little attention has been paid to the faunal documentation of water bugs from the Eastern Himalayan States except the works on the State of Meghalaya (Bal & Basu 1999), Tripura (Bal & Basu 2000), Arunachal Pradesh (Thirumalai 2002), Sikkim (Bal & Basu 2003), Manipur (Bal & Basu 2004), and West Bengal (Bal & Basu 1994) by Zoological Survey of India as a part of their routine survey. In this context, the present study was a pioneer effort and conducted through surveying various wetlands including ponds, lakes, streams, rivers, waterfalls, roadside seeps, etc. across the Darjeeling Himalayan and Jalpaiguri sub-Himalayan regions of West Bengal. The survey methods consisted of repeated collection of mainly adults at 86 different sampling sites from March 2011 to October 2013 as adults are required to make species-level determinations in most cases. In order to investigate faunal diversity from a wide array of habitats of the study area, collections were carried out at headwaters of different rivers as well as at various points downstream.

The survey focusing on species identification and documentation resulted in a total of 2003 examples belonging to 61 species under 34 genera and 14 families of which 15 species are new records to the State of Bengal and one species of *Enithares unicata* Lundblad is a new report to India. Bal & Basu (1994) reported a total of 22 species from both Darjeeling and Jalpaiguri Districts. The current study further adds a total of 40 different species to the checklist of Darjeeling and Jalpaiguri region. Further, the present study also addressed the diagnosis of common and existing species with detail photographs and genitalic structures, which are not discussed earlier and a special approach was to prepare a key for identifying the family, genera, and species of aquatic and semi-aquatic Hemiptera of Darjeeling and Jalpaiguri region of West Bengal. During the survey, 11 species were already described new to science and published in reputed journals, which indicates that the Himalayan and sub-Himalayan regions of West Bengal harbour rich diversity of aquatic and semi-aquatic Heteroptera. Though, due to inaccessibility to many regions and climatic harshness of this region, many areas remain unexplored. Two families, Ochteridae



and Gelastocoridae were not encountered during the present study as they are cryptic in nature and hence might have been overlooked during the survey. The present study highlights that genera like *Velia*, *Amemboa*, *Micronecta*, *Heleocoris*, *Aphelocheirus*, *Ventidius*, *Metrocoris*, *Sigara*, *Tiphotrephes*, etc. are poorly documented within West Bengal, and more extensive field surveys are required to understand the distribution and diversity of this group. It is also expected that other Eastern Himalayan states of India, including the northern parts of West Bengal, may also harbour more new species or new genus, which might have easily gone undetected in this underexplored region because of their cryptic habits.

The majority of threats to freshwater biodiversity are linked to human population growth and development and also the increasing demand for natural resources. The Darjeeling Himalaya and Jalpaiguri Sub-Himalaya are famous for tourism being its major source of revenue. The area is under severe pressure due to rapid urbanization as a consequence of growing tourism business and these emerging threats have made this area ecologically fragile. Many macroinvertebrate fauna including aquatic and semi-aquatic Heteroptera are increasingly at risk due to anthropogenic threats imposed in the streams and all other water bodies in Eastern Himalayan region. The contribution to the knowledge on water bugs to the structure and function of freshwater ecosystems has emphasized the need for the study of the local, regional, and global diversity profiles and also to formulate relevant conservation strategies for these bugs. The observed and estimated species richness in the current study clearly shows that the sampling was adequate to address diversity of water bugs in the study area.

The current research also highlighted the gap areas and the areas with rich biodiversity by using GIS applications. Mapping of species is important for management of biodiversity, species protection, and prediction of possible impacts of land use or climate changes, which require detailed information on the distribution of organisms and the relationship between organisms and environmental variables. Once spatial distribution is mapped, the distribution and abundance can be monitored efficiently with respect to time and future changes as opined by Qamar et al. (2011). The fundamental need is for extensive and good quality field surveys over the study area. These surveys, however, have serious constraints such as lack of fundings for carrying out fieldwork, need of experts in taxonomy, and regulations set by the existing legislation in some

parts, especially in the protected areas of West Bengal.

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## SYSTEMATIC ACCOUNT

## Key to the Infraorders of aquatic and semi-aquatic Heteroptera

- Antennae hidden and inserted beneath eyes, shorter than the head, not visible from above; head without trichobothria; always occur in winged forms; lives in submerged water; true aquatics and a few shore bugs ..... Nepomorpha Popov
- Antennae conspicuous and inserted in front of eyes, longer than the head, clearly visible from above; head with three pairs of trichobothria; wingless or winged forms; lives on the surface of the water, walking or skating; semi-aquatic and surface bugs ..... Gerromorpha Popov

## Key to the Families of Nepomorpha Popov, 1968

1. Ocelli present ..... 2  
Ocelli absent ..... 3
2. Rostrum very long and slender, reaching the hind coxae; fore femora not thickened and non-raptorial; tarsal formula 2:2:3 .....  
..... Ochteridae Kirkaldy  
Rostrum short and stout, not reaching beyond the hind coxae and extended upto the posterior margin of prosternum; fore femora thickened markedly and raptorial; tarsal formula 2:2:2 .....  
..... Gelastocoridae Kirkaldy
3. Rostrum short, triangular, not distinctly segmented; fore tarsi scoop-shaped and single-segmented, fringed with setae ..... 4  
Rostrum long, cylindrical, cone-shaped, beak-like, distinctly segmented; fore tarsi single or more segmented, not scoop-shaped and without setae ..... 5
4. Body length 2mm or more; scutellum concealed, entirely or nearly entirely covered by pronotum; labium with a distinct transverse groove ..... Corixidae Leach  
Body length less than 2mm; scutellum exposed; labium without transverse groove ..... Micronectidae Jaczewski
5. Body long and slender; abdomen with a pair of slender, long, non-retractile respiratory siphon with spiracles at its base ..... Nepidae Latreille  
Body oval or oblong, hemispherical; abdominal spiracles short or absent ..... 6
6. Respiratory siphon short, flat, retractile, strap-like; wing membranes with distinct veins ..... Belostomatidae Leach  
Respiratory siphon absent; wing membranes without veins ..... 7
7. Forelegs raptorial; body dorso-ventrally flattened; abdomen with spiracles ..... 8  
Forelegs non-raptorial; body dorsally convex or elongated; abdominal spiracles absent ..... 9
8. Rostrum very long and slender, extending beyond the hind coxae; fore femora broadened slightly; antennae short, not reaching the lateral margins of the head; abdominal spiracles with rosettes ..... Aphelocheiridae Fieber  
Rostrum relatively short and stout, extending beyond the fore coxae; fore femora broadened distinctly; antennae long, extending past the lateral margins of the head; abdominal spiracles lacking rosettes ..... Naucoridae Leach
9. Head and pronotum fused; antennae one- or two-

- segmented ..... Helotrephidae Esaki & China
- Head and pronotum not fused and separate; antennae three- or four-segmented ..... 10
- 10. Body elongated, length more than 3mm; hind tibiae and tarsi ciliated; claws of hind tarsi inconspicuous; rostrum four-segmented .....  
..... Notonectidae Latreille  
Body ovoid, length less than 3mm; hind tibiae and tarsi not ciliated; hind tarsi with a pair of well-developed claws; rostrum three-segmented ..... Pleidae Fieber

## Family Aphelocheiridae

Key to the Species of Genus *Aphelocheirus* Westwood, 1833

1. Hemelytra touching each other medially in brachypterous forms; Body length 7.0–7.7mm; Propleura broadly rounded posteriorly .....  
..... *Aphelocheirus* (*A.*) *thirumalaii* Basu, Subramanian & Saha, 2013
- Hemelytra narrowly separated from each other in brachypterous forms; Body length 7.8–8.8mm; Propleura rounded bluntly with inner propleural projection notched apically .....  
..... *Aphelocheirus* (*A.*) *pradhanai* Zettel, 1998

## Family Belostomatidae

## Key to the Subfamily of the Family Belostomatidae Leach, 1815

- Body length less than 30mm; hind tibiae and tarsi similar to mid tibiae and tarsi; first segment of rostrum longer than half of the second segment ..... Belostomatinae Leach, 1815
- Body length more than 30mm; hind tibiae and tarsi strongly compressed, thin, much broader than the mid tibiae and tarsi; first segment of rostrum approximately half the length of the second segment ..... Lethocerinae Lauck & Menke, 1961

Key to the Species of the Genus *Diplonychus* Laporte, 1833

1. Large species, hemelytra without spiny patch on corium; fore tarsi two-segmented; respiratory straps without cluster of setae .....  
..... *Diplonychus annuatus* (Fabricius, 1781)
- Small species, hemelytra with spiny patch on corium; fore tarsi single segmented; respiratory straps with cluster of setae ..... *Diplonychus rusticus* (Fabricius, 1781)

## Family Corixidae

## Key to the Species of the Family Corixidae Leach, 1815

1. Vertex with rows of obscure punctures posteriorly; fore femur with two pairs of small spines just distal to stridulatory area ... *Sigara promontoria* (Distant, 1910)
- Vertex with a low obscure longitudinal carina posteriorly; fore femur lacking such spines .....  
..... *Sigara kempi* (Hutchinson, 1940)

## Family Micronectidae

## Key to the Species of the Family Micronectidae Jaczewski, 1924

1. Medium to small species, length less than 3.3mm .... 2
- Large elongate species, length more than 3.3mm; hemelytra with darker longitudinal stripes which vary from distinct unbroken to broken stripes



- ..... *Micronecta scutellaris scutellaris* (Stal, 1858)
2. Hemelytra marked with distinct unbroken or broken stripes, but not punctuate ..... 3  
Hemelytra marked with distinct dark dots or punctuate ..... *Micronecta haliploides* Horvath, 1904
  3. Dark pattern on corium consisting of four distinct solid, regular parallel bands; pronotum a pair of sub-oval curved darker stripes, which may be indistinct or fragmented, no transverse stripe ..... *Micronecta ludibunda* Breddin, 1905  
Dark pattern on corium streaky, irregularly linear or indistinct; pronotum not as above ..... 4
  4. Medium sized species, length upto 3.3mm; free lobe of eighth tergite sigmoid in outline in male ..... *Micronecta quadristrigata* Breddin, 1905  
Small species, length less than 3.0mm; free lobe of eighth tergite not like above in male ..... 5
  5. Head pale yellow, with an obscure central, elongated orange spot on the anterior part of vertex, free lobe of eighth tergite almost rectangular in male ..... *Micronecta desertana desertana* Distant, 1920  
Head dull yellow with dull orange stripe on frons and with a pair of obscure orange spots near inner margin of eyes; free lobe of eighth tergite not as above ..... *Micronecta khasiensis* Hutchinson, 1940

#### Family Nepidae

##### Key to the Subfamily of the Family Nepidae Latreille, 1802

- 1 Body dorso-ventrally flattened; parasternites visible; head distinctly narrower than pronotum, partly enclosed in the anterolateral pronotal angles ..... *Nepinae* Latreille, 1802  
Body not dorso-ventrally flattened, more or less cylindrical; parasternites concealed, not visible; head and pronotum sub-equal in width, not enclosed between the anterolateral pronotal angle ..... *Ranatrinae* Douglas & Scott, 1865

##### Key to the Genus of Subfamily Ranatrinae Douglas & Scott, 1865

- 1 Eyes in lateral view globose, not reflexed downwards or not obscuring ventral margin of head; respiratory siphon usually long and slender (except in *R. gracilis* group) ..... *Ranatra* Fabricius, 1790  
Eyes in lateral view reflexed downwards, obscuring ventral margin of head; respiratory siphon short, stout and about one-fourth of the length of the body ..... *Cercotmetus* Amyot & Serville, 1843

##### Key to the Species of Genus *Ranatra* Fabricius, 1790

1. Male body length excluding siphon less than 25mm; eye width less than or slightly less than interocular space ..... 2  
Male body length excluding siphon much greater than 25mm (28–30mm); eye width equal to or greater than interocular space; male genital capsule not distally invaginated ..... *Ranatra digitata* Hafiz & Pradhan, 1947
2. Vertex usually rounded between eyes; mid and hind tibiae with long semi-erect hairs on ventral surface ..... 3  
Vertex usually slightly raised between eyes, occasionally developed into a vestigial tubercle; mid and hind tibiae with long, fine hairs on ventral surface; male parameres distally hook-

like with several stout spines on inner margin ..... *Ranatra filiformis* Fabricius, 1790

3. Second and third segments of antennae with many stout spines; mesosternum rounded and shining with V-shaped cleft between midcoxae and metasternal plaque lozenge-shaped, sometimes with a median keel, otherwise almost flat ..... *Ranatra varipes varipes* Stal, 1861  
Second and third segments of antennae with fewer spines than typical form; mesosternum always broadly depressed for its entire length with a conspicuous median keel, lateral margins sometimes carinate and metasternal plaque almost triangular with an obtuse apex ..... *Ranatra varipes atrophata* Montandon, 1903

#### Family Notonectidae

##### Key to the Subfamily of the Family Notonectidae Latreille, 1802

1. Hemelytral commissure with definite hair-lined pit at anterior end; males with rostral prong ..... *Anisopinae* Hutchinson, 1929  
Hemelytral commissure without definite hair-lined pit at anterior end; males without rostral prong ..... *Notonectinae* Latreille, 1802

##### Key to the Genus of the Subfamily Notonectinae Latreille, 1802

1. Mid femora of male with an anteapical pointed protuberance; antennae four-segmented; eyes not holoptic ..... *Enithares* Spinola, 1837  
Mid femora of male without any pointed protuberance; antennae three-segmented; eyes holoptic ..... *Nychia* Stal, 1860

##### Key to the Species of Genus *Enithares* Spinola, 1837

1. Pronotal humeral width usually less than three times of median length; Hind femur slightly expanded distally and with a slight depression on anterior surface near trochanter margin; Outer claw of mid leg conspicuously thickened and bent inward ..... *Enithares mandalayensis* Distant, 1910  
Pronotal humeral width about three times of median length; Hind femur not as above and lacking depression; Outer claw of mid leg not as above ..... *Enithares unicata* Lundblad, 1933

##### Key to the Species of Genus *Anisops* Spinola, 1837

1. Synthipsis narrow, less than one third the anterior width of vertex ..... 2  
Synthipsis wide, one-third or more than the anterior width of vertex; anterior margin of the vertex not extended beyond eyes ..... *Anisops paranigroloneatus* Brooks, 1951
2. Eyes holoptic basally ..... *Anisops breddini* Kirkaldy, 1901  
Eyes not holoptic ..... 3
3. Robust species; frons produced anteriorly into a cephalic horn which is acuminate at apex in males ..... *Anisops sardeus sardeus* Herrich-Shaffer, 1850  
Slightly fusiform species; frons produced anteriorly into cephalic horn, apex of which with a median depression ..... *Anisops nasutus* Fieber, 1851

**Key to the families of Gerromorpha Popov, 1971**

1. Claws of fore tarsus pre-apical, i.e., inserted before apex of tarsae ..... 2  
Claws of fore tarsus apical, i.e., inserted at the tip of tarsae ..... 3
2. Body elongated or oval and size ranges from 2–40 mm; hind femora long, reaching beyond the abdomen; midleg distinctly longer than hind leg and inserted closer to hind leg than fore leg; head without a median groove; metasternum with a median scent gland opening, but lateral channels absent ..... Gerridae Leach  
Body small, oval or elongated and size ranges from 1.8–18 mm; hind femora short, not reaching beyond the apex of abdomen; mid leg shorter than hind leg and inserted about midway between fore leg and hind leg; head with a central median groove; metasternum with a pair of closely spaced scent glands, suture-like channels present ..... Veliidae Amyot & Serville
3. Body elongated, slender, stick-like; head as long as or longer than thorax; eyes located at about midway of head; metasternal scent gland openings absent ..... Hydrometridae Billberg  
Body small, slender, not stick-like; head short and stout and not exceeding the combined length; eyes at rear end of head; metasternal scent gland openings present ..... 4
4. Venter of head with longitudinal groove to receive rostrum; tarsae two-segmented; legs without bristles ..... Hebridae Amyot & Serville  
Venter of head not grooved; tarsae three-segmented; legs with scattered, stiff black bristles or spines ..... Mesoveliidae Douglas & Scott

**Family Gerridae****Key to the Subfamily of the Family Gerridae Leach, 1815**

1. Metacetabular suture dorsally continues to the posterior margin of mesonotum; first fore tarsal segment reduced or shorter than the second segment ..... 2  
Metacetabular suture dorsally not reaching to the posterior margin of mesonotum; first fore tarsal segment not reduced or longer than the second segment ..... 3
2. First abdominal segment ventrally well-retained; fore femur about twice as long as tibia ..... Rhagadotarsinae Lundblad, 1934  
First abdominal segment ventrally absent; fore femur a little longer than tibia ..... 4
3. First antennal segment usually with preapical spine-like hairs; fore tarsae with well-developed arolia; head between eyes not widened posteriorly ..... Eotrechinae Matsuda, 1960  
First antennal segment without any spine-like hairs; fore tarsae not as above; head between eyes widened posteriorly ..... 5
4. Antennae a little shorter than body, first antennal segment distinctly longer than the three following segments together; first abdominal tergite with nearly straight anterior margin ..... Ptilomerinae Bianchi, 1896  
Antennae much shorter than body, first antennal segment longer than the two following segments together; first abdominal tergite with W-shaped anterior margin ..... Cylirostethinae Matsuda, 1960
5. Metasternum extremely reduced, only represented by a very short sub-triangular plate enclosing the scent orifice; pronotum not prolonged in apterous forms ..... Halobatinae Bianchi, 1896

Metasternum well-developed; pronotum prolonged in apterous forms ..... Gerrinae Bianchi, 1896

**Key to the Genus of Subfamily Eotrechinae Matsuda, 1960**

1. Larger species, length more than 8.0mm; male genital segment with a pair of black antler-shaped projections ..... *Chimarrhometra* Bianchi, 1896  
Smaller species, length less than 8.0mm; male genital segment either simple or modified, but not as above ..... 2
2. First antennal segment longer than the second segment; first segment of mid tarsus shorter than the second segment ..... *Onychotrechus* Kirkaldy, 1903  
First antennal segment sub-equal to second and third segment; first segment of mid tarsus longer than the second segment ..... *Amemboa* Esaki, 1925

**Key to the Species of Genus Amemboa Esaki, 1925**

1. Fore femur relatively slender, with two separate hair tufts beyond middle ..... *Amemboa kumari* (Distant, 1910)  
Fore femur more or less incrassate, with three hair tufts ..... 2
2. Fore femur modified with three hairy black patches located almost equidistantly, followed by a shallow curvature distally; Pygophore widened basally, but tapering distally; Lateral arms of proctiger long, slender and curved, weakly narrowed towards truncated apex ..... *Amemboa mahananda* Basu, Subramanian & Polhemus, 2014  
Fore femur modified with three hair patches, basally with elongated patch of stiff sub-erect hairs, followed by a thin pointed patch of hairs and distally with a elongated patch of short hairs; pygophore widened basally, but distally modified into narrow elongated process; Lateral arms of proctiger bifurcated at middle forming two slender arms ..... *Amemboa bifurcata* Basu, Subramanian & Polhemus, 2014

**Key to the Genus of Subfamily Ptilomerinae Bianchi, 1896**

1. Hind femora much longer than mid femora; mid femur of male with ventral hair fringe ..... *Ptilomera* Amyot & Serville, 1843  
Hind femora sub-equal to or shorter than mid femora; mid femora without any hair fringe in male ..... 2
2. Second antennal segment longer than third segment; mid tibia with fringe of rather conspicuous hairs in both sexes; connexivum slanting towards middle basally ..... *Heterobates* Bianchi, 1896  
Second antennal segment a little shorter than third segment; mid tibia without any hair fringe; connexivum broad, almost perpendicularly erected ..... *Pleciobates* Esaki, 1930

**Key to the Species of the Genus Ptilomera Amyot and Serville, 1843**

1. Metacoxa without any spine at rear margin; females without connexival spines ..... *Ptilomera (Proptilomera) himalayensis* Hungerford & Matsuda, 1958
2. Metacoxa with prominent spine at rear margin; females with connexival spines ..... *Ptilomera (Ptilomera) laticaudata* (Hardwicke, 1823)

**Key to the Genus of Subfamily Halobatinae Bianchi, 1896**

1. Eyes not overlapping anterolateral angles of mesonotum; mid femur thickest, without any bristles; first abdominal tergite bisunate or sometimes obliterated anteriorly ..... *Metrocoris* Mayr, 1865
- Eyes overlapping anterolateral angles of mesonotum; mid femur straightly narrowed apically, armed with spinous bristles sparsely; first abdominal segment nearly straight on anterior margin ..... *Ventidius* Distant, 1910

**Key to the Genus of Subfamily Gerrinae Leach, 1815**

1. Dorsal surface of head almost uniformly dark with some markings; venter generally dark ..... 2
- Dorsal surface of head light or dark with longitudinal light stripes or elongate spots; venter generally light yellow ..... 3
2. Hind tibia at least four times as long as first hind tarsal segment; connexival spines prominent and well-developed ..... *Aquarius* Schellenberg, 1800
- Hind tibia rarely more than three times as long as first tarsal segment; connexival spines not well developed ..... *Gerris* Fabricius, 1794
3. Head typical with U-shaped yellow band; pronotum with one large pale spot medially ..... *Neogerris* Matsumura, 1913
- Head typical with a pair of yellow sublateral stripes; pronotum with a pair of vertical pale stripes medially ..... *Limnogonus* Stal, 1868

**Key to the Species of Genus *Gerris* Fabricius, 1794**

1. Larger species, size more than 9mm; Pronotal lobe rufous; Male sternum 7 with hind margin broadly concave, not medially emarginated; Female sternum 7 with hind margin medially produced ..... *Gerris* (*Macrogeris*) *gracilicornis* (Horvath, 1879)
2. Smaller species, size less than 9mm; Pronotal lobe black; Male sternum 7 with hind margin medially notched; Female sternum 7 with hind margin broadly concave ..... *Gerris* (*Gerris*) *nepalensis* Distant, 1910

**Key to the species of Genus *Limnogonus* Stal, 1868**

1. Connexivum terminating in a fairly prominent spine; Pronotal lobe usually without a median pale stripe, but with a pair of small, yellow markings; Mesosternum without any patch of golden pubescence posteriorly on the dilated part ..... *Limnogonus* (*L.*) *nitidus* (Mayr, 1865)
- Connexivum not as above; Pronotal lobe with a median pale stripe and a pair of small yellow markings; A large elongate patch of short golden pubescence posteriorly on the dilated part of mesosternum ..... *Limnogonus* (*L.*) *fossarum fossarum* (Fabricius, 1775)

**Key to the species of Genus *Metrocoris* Mayr, 1865**

1. Thoracic venter entirely black with an yellowish notch ..... 2
- Thoracic venter pale yellowish in color ..... 3
2. Interocular dark mark rectangular, bifid anteriorly; fore femur slender with a little median invagination ventrally ..... *Metrocoris darjeelingensis* Basu et al., 2016
- Interocular dark mark rectangular, bifid posteriorly;

- fore femur slender, slightly curved at middle, with long dense hair fringe ventrally near tibial margin ..... *Metrocoris dinendrai* Basu et al., 2016
3. Interocular dark mark arrow head shaped, bifid posteriorly ..... 4
- Interocular dark mark triangular; fore femur slender with a little curvature, bearing a small, prominent apical tooth and long hair fringe distally ..... *Metrocoris lavitra* Basu et al., 2016
4. Fore femur strongly incrassate, without any indentation ..... 5
- Fore femur strongly incrassate with indentation and a square shaped bidentate tooth; paramere large, stout, curved distinctly with an almost acute apex ..... *Metrocoris murtiensis* Basu et al., 2016
5. Body length of adult 7.6mm; abdominal segment VIII long; paramere large and hook shaped with blunt apex ..... *Metrocoris anderseni* Chen & Nieser, 1993
- Body length of adult 6.1–6.9mm; abdominal segment VIII rectangular; paramere long, hook shaped with pointed apex ..... *Metrocoris deceptor* Basu et al., 2016

**Family Mesoveliidae****Key to the Species of the Family Mesoveliidae Douglas & Scott, 1867**

1. Male abdominal sternum VIII with a pair of black tuft of hairs anteriorly, but without the median group of black spines; posterior margin of mid-femur with only 1–2 black spines distally ..... *Mesovelia horvathi* Lundblad, 1934
- Male abdominal sternum VIII with a tuft of median stout black spines and with one pair of pale tuft of hairs laterally; posterior margin of mid femur with row of black spines, usually 10–17 distally ..... *Mesovelia vittigera* Horvath, 1895

**Family Veliidae****Key to the subfamily of the family Veliidae Amyot and Serville, 1843**

1. Mid tarsae deeply cleft, with leaf-like claws and plumose or setose swimming fan arising from the base of cleft ..... Rhagoveliinae China & Usinger, 1949
- Mid tarsae not deeply cleft, without plumose or setose swimming fan ..... 2
2. Fore tarsae one segmented, but mid and hind tarsae two-segmented ..... Microveliinae China & Usinger, 1949
- Fore, mid and hind tarsae three-segmented ..... Veliinae China & Usinger, 1949

**Key to the species of the genus *Microvelia* Westwood, 1834**

1. Pronotum with a pair of dull yellowish orange horizontal stripes; male genital segment (VIII) typical with right paramere projecting outward, left paramere rudimentary ..... *Microvelia* (*M.*) *douglasi* Scott, 1874
- Pronotum with a small reddish brown marginal fascia anteriorly; male genital segment (VIII) otherwise ..... *Microvelia* (*M.*) *albomaculata* Distant, 1909

**Appendix 1. Details of study sites of Darjeeling and Jalpaiguri region.**

Sampling sites	Latitude (°N)	Longitude (°E)	Altitude (m)	Habitat	Riparian land use
<b>Darjeeling District</b>					
Bagdodgra, Sanyasithan Tea Garden	26.6949	88.2872	128	Riffles	Tea garden
Canal within GavaGanga and Kamala Tea Garden	26.5756	88.2826	101	Irrigation canal	Tea garden
Durbin forest, Ghoombhanjang	26.9986	88.1391	1718	Pool	Forest
Chel River, Gorubathan	26.9730	88.6997	369	Riffles	Village
Dhobijhora, Mongpu	26.9729	88.3701	1124	Cascades	Forest
Falls near Bunkulung, near Mirik	26.8677	88.2288	564	Cascades	Forest
Bijanbari Bazar, Stream	27.0653	88.1908	779	Riffles	Village
Ghoshpukur dighi, Kamala Bagan	26.5934	88.2870	107	Lake	Village
Jhora beside Kiranchandra Tea Garden	26.6914	88.2634	139	Irrigation canal	Tea garden
Jhora near Bagora Hills	26.9900	88.3372	1224	Cascades	Forest
Jhora near Gorubathan	26.9663	88.7000	370	Cascades	Village
Jhora near Kalimpong	27.0896	88.6098	1528	Cascades	Forest
Jhora near Manebhanjang	26.9946	88.1310	1774	Cascades	Forest
Jhora near Mongpu, coming from Sinchal Lake	26.9724	88.3657	1181	Cascades	Forest
Jhora on the way to Changay Falls, Lava	27.0520	88.6800	1639	Cascades	Forest
Jhora on the way to Lava from Kalimpong	27.0960	88.6098	1855	Cascades	Forest
Jhora within Neora Valley National Park	27.0828	88.7437	2006	Pool	Forest
Jorkhola, Bunkulung	26.8595	88.2248	575	Riffles	Forest
Kalijhora, near Teesta Coronation Bridge	26.9083	88.4684	230	Run	Forest
Mahananda River, within Mahananda WS	26.8122	88.4033	174	Riffles	Forest
Manjukhola, Phuguri Tea Estate, Near Mirik	26.8557	88.2091	878	Irrigation canal	Tea garden
Panchanoi River, Mahananda WS	26.8279	88.4231	170	Riffles	Forest
Rabijhora, near Teesta River	26.9955	88.4337	187	Riffles	Damsite
Rellykhola, Teesta, Teesta Bazar	27.0007	88.4424	213	Run	Damsite
Rishi River, Site 1, Rishikhola	27.1735	88.6311	554	Riffles	Forest
Rishi River, Site 2, Rishikhola	27.1798	88.6227	517	Riffles	Forest
Shivmandir, Siliguri	26.7054	88.34982	114	Riffles	Village
Small Jhora within Neora Valley National Park	27.0711	88.74787	1610	Pool	Forest
Srikhola	27.1324	88.0767	1874	Riffles	Forest
Stagnant pool beside Rishi River, Rishikhola,	27.1696	88.6351	563	Pool	Forest
Stagnant waterbody within Mahananda WS	26.8288	88.4139	180	Pool	Forest
Stream, near Pulbazar	27.0721	88.2157	726	Riffles	Village
Teesta near Sevoke Coronation Bridge	26.8767	88.4696	152	Run	Forest
Teesta River near coronation bridge, Kalijhora	26.8812	88.4736	150	Run	Forest
Teesta, Chitre Bridge	27.0635	88.4288	295	Cascades	Forest
Bhimbar Dighi, near Sayedabad Tea Garden	26.5748	88.2808	102	Lake	Tea garden
<b>Jalpaiguri District</b>					
Buxa Jhora, near Buxa Fort, Buxa TR Range	26.7622	89.5996	630	Riffles	Forest
Chel River, near Ranichera T.G., Malbazar	26.8640	88.6348	159	Riffles	Tea garden



Sampling sites	Latitude (°N)	Longitude (°E)	Altitude (m)	Habitat	Riparian land use
Gourjanjhora, near Mal	26.9052	88.7322	238	Cascades	Tea garden
Jhora within Chapramari WS	26.8640	88.8330	208	Riffles	Forest
Jhora within Chilapata Forest, Mendabari Beat	26.6121	89.4000	78	Riffles	Forest
Jaldhaka River, Nagrakata	26.8720	88.8953	164	Run	Village
Jayanti Forest Bungalow	26.7618	89.5820	766	Riffles	Forest
Jaldhaka, Ramshai, Gorumara NP	26.7277	88.8587	102	Pool	Forest
Kalikhola, border between Gorumara and Chapramari National Park	26.8716	88.8744	168	Pool	Forest
Kalipur Wetland, within Gorumara NP	26.7380	88.8415	106	Pool	Forest
Khunia More, Chapramari WS	26.8725	88.8702	178	Riffles	Forest
Jayanti River, Alipurduar	26.7122	89.6097	206	Pool	Forest
Mal River	26.8696	88.7165	151	Riffles	Village
Mujnai River, Madarihat	26.7211	89.2429	145	Riffles	Village
Murti River, near Murti Rail Bridge	26.8825	88.8292	172	Riffles	Village
Murti River, Samsing	26.9889	88.8174	415	Riffles	Forest
Murti River, Chalsa	26.8799	88.8294	166	Riffles	Village
Murti River, in front of Murti Banani Bungalow	26.8413	88.8285	137	Riffles	Forest
Murti River, Media camp, Gorumara NP	26.7839	88.8457	115	Riffles	Forest
Murti River, on the way to Chalsa	26.8398	88.82819	137	Riffles	Village
Neora River, near rail bridge	26.8792	88.7715	165	Riffles	Village
Pond 1, Baradighi, Malbazar	26.7915	88.7711	120	Pond	Agricultural field
Pond 2, Baradighi, Malbazar	26.7899	88.7700	115	Pond	Agricultural field
Pond at Mainaguri	26.5681	88.8147	86	Pond	Agricultural field
Pond near Domohoni	26.5779	88.7753	88	Pond	Agricultural field
Pond near Rhino Camp, Gorumara NP	26.7559	88.8153	120	Pond	Forest
Poru River, Poru Beat, Chilapata Forest Range	26.6660	89.408	93	Run	Tea garden
Raidhak River, Alipurduar	26.4884	89.6927	51	Run	Village
Raimatang River, Raimatang, Buxa TR range	26.7327	89.5000	164	Riffles	Forest
ChaitanyaJhora within Buxa Tiger Reserve, Rajabhatkhawa	26.6174	89.5305	77	Riffles	Forest
Jhora in front of Chapramari WS	26.8724	88.8735	167	Pool	Forest
Sikhia Jhora	26.5863	89.5571	65	Pool	Forest
Small jhora within Gorumara NP	26.7001	88.7929	99	Riffles	Forest
Buri torsha Riverside, South Khairabari RF	26.6183	89.2123	80	Pool	Forest
Jhora near Bagrakote Tea Garden	26.8799	88.5837	181	Irrigation canal	Tea garden
Buri Torsa River, Bish khutia, border between South Khairabari & North Khairabari RF	26.6599	89.2332	99	Pool	Forest
Stagnant pool within Gorumara NP	26.7355	88.7890	124	Pool	Forest
Stagnant pool, North Khairabari Reserve Forest, Madarihat	26.6684	89.2402	102	Pool	Forest
Dhupjhora, Gachbari, Murti River	26.8042	88.8254	126	Riffles	Forest
Dhupjhora, Murti River, within Gorumara NP	26.7974	88.8423	124	Riffles	Forest
Sukhajhora, near Malbazar	26.8755	88.7308	158	Riffles	Village
Teesta Canal near Odlabari	26.8203	88.5969	130	Irrigation canal	Village

Sampling sites	Latitude (°N)	Longitude (°E)	Altitude (m)	Habitat	Riparian land use
Teesta Canal, Teesta barraige, Gajaldoba	26.7494	88.5768	111	Irrigation canal	Damsite
Dhupjhora, near Murti	26.8416	88.8269	143	Irrigation canal	Agricultural field
Dima River, Damanpur Forest, Buxa TR	26.6353	89.5049	85	Run	Forest
Wetland beside Gajaldoba Teesta Barrage	26.7523	88.5823	112	Pool	Damsite
Wetland within Chapramari NP	26.8976	88.8507	215	Pool	Forest
Bajekhola, Jayanti Forest, Buxa TR	26.6896	89.6621	188	Riffles	Forest
Bania River, Chilapata Forest	26.6065	89.4042	74	Run	Forest







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## Monograph

### Water bugs (Insecta: Hemiptera: Heteroptera) of Himalayan and sub-Himalayan regions of West Bengal, India

-- Srimoyee Basu, Kailash Chandra, Kumrapuram Apadodharanan Subramanian & Goutam Kumar Saha,  
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