



## A faunistic survey of the aquatic and semi-aquatic bugs (Hemiptera, Heteroptera) of the Tiger Reserves in Telangana, India

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**ABSTRACT.** The diversity and distribution of aquatic and semi-aquatic Hemipterans were studied from Amrabad and Kawal Tiger Reserve of the state Telangana. This report documents 38 species of aquatic and semi-aquatic hemipterans belonging to 22 genera and ten families from Amrabad and Kawal Tiger Reserve. Interestingly, 20 species were noted as additions to the state of Telangana. Two species *Ranatra libera* Zettel, 1999 and *Rhagovelia sumatrensis* Lundblad, 1933 were observed, where both species are new distributional records to peninsular India. Kawal Tiger Reserve (KTR) showed higher species diversity than the Amrabad Tiger Reserve (ATR) with respect to species richness. The present report is the first documentation from both tiger reserves on aquatic and semi-aquatic hemipterans from the state of Telangana.

**Key words:** Aquatic diversity, Gerromorpha, Nepomorpha, distributional records

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### INTRODUCTION

Aquatic and semi-aquatic bugs are one of the most diverse fauna in the aquatic ecosystem and belong to the suborder Heteroptera (true bugs). Among Heteroptera (true bugs), two infra orders are strongly connected to the aquatic environment, i.e. Nepomorpha (aquatic bugs), usually live submerged in the waterbodies, while Gerromorpha (semi-aquatic bugs) can be found on the water surface or close to the water shore (Schuh & Weirauch, 2020). Globally, more than 4800 species belonging to 343 genera and 22 families have been reported, of which 4656 species belonging to 326 genera and 20 families comprise freshwater bugs (Polhemus & Polhemus, 2008). In India, nearly 350 species of aquatic and semi-aquatic hemipterans have been reported till now (Chandra et al., 2017; Jehamalar & Chandra, 2020). Telangana state is situated on the Deccan Plateau of Peninsular India. The Geographical area of Telangana State is 112077 sq. km, and the forest area is 26903.70 sq. km, 24% of the total geographical area (TSCCC, 2023). According to classification by Champion and Seth (1968), the forests of Telangana fall under dry teak forest, southern dry mixed deciduous forest, dry deciduous scrub, dry savannah forest, Hardwicke forest, dry bamboo brakes, and southern thorn forest. About 21.77% (5856.04 sq. km) of total forest area is included in protected areas, divided into 12 Protected Areas, consisting of 7 Wildlife Sanctuaries & 3 National Parks in the state (TSCCC, 2023). Amrabad and the Kawal Tiger Reserves are later notified as two Tiger reserves in the state.

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A few scattered studies have been carried out in and around Hyderabad (Deepa & Rao, 2007; Deepa, 2013) that recorded 14 species of aquatic Hemiptera belonging to eight genera and five families. Later on post bifurcation of the state of Andhra Pradesh, two studies have been made which recorded 28 species belonging to 14 genera and six families from Telangana (Chandra et al., 2021). The present study, hence, focuses on the taxonomy, diversity and distribution of aquatic and semi-aquatic Hemiptera from both Amrabad and Kawal Tiger Reserves, Telangana, and this will also be the first faunal documentation from these two tiger reserves.

## MATERIAL AND METHODS

**Study area.** Kawal Tiger Reserve is a tropical dry deciduous forest dominated by teak plantation and located in the northern part of the state, in Adilabad, Asifabad and Nirmal districts and lies between 19°04'48"-19°19'12"N and 78°33'36"-79°05'24"E. Amrabad Tiger Reserve is a mixed tropical dry deciduous forest and located in the southern of the state in Nagarkurnool and Nalgonda districts of Telangana State and lies between 16°03'00"-16°31'12"N and 78°17'24"-79°12'36"E. Extensive study has been carried out in the two Tiger reserves between September 2018 and December 2021.

**Collection, preservation and identification.** The aquatic bug collections were made by random sampling by using long-handled nylon water nets and a stainless steel fine-meshed strainer. The collected specimens were preserved in 70% ethyl alcohol and 10% formaldehyde solution and stored in 50 ml glass vials. The specimens were examined under an Olympus SZX10 stereomicroscope, and photographed under Leica M205A. Identification was done following standard literature (Lansbury, 1972, 1973; Bal & Basu, 1994; Thirumalai, 1999; Jehamalar & Chandra, 2013; Basu et al., 2015; Jehamalar & Chandra, 2016, 2020; Tran & Zettel, 2021). The following abbreviation was used for the name of depositories: BNHS – Bombay Natural History Society, Mumbai, India; BMNH – Museum of Natural History, London, UK; HNHM - Hungarian Natural History Museum, Budapest, Hungary; ZUKU – Zoological Museum, Kansas University, USA; MNHN - Muséum National d'Histoire Naturelle, Paris, France; NHMD – Natural History Museum, Denmark; NHMW - Naturhistorisches Museum Wien, Austria; NHRS - Naturhistoriska Riksmuseet, Stockholm, Sweden; ZMUC - Zoological Museum, University of Copenhagen, Copenhagen, Denmark; ZMUH – Zoologisches Museum, Universität Hamburg, Germany. All the identified specimens were registered and deposited in the National Zoological Collection of Zoological Survey of India, Freshwater Biology Regional Centre, Hyderabad, Telangana.

## RESULTS

A total number of 38 species have been identified from the Amrabad and Kawal Tiger Reserves, belonging to 22 genera and ten families. Kawal Tiger Reserve showed higher species diversity than the Amrabad Tiger Reserve, with 34 species belonging to 19 genera and ten families. Whereas 28 species belong to 18 genera and eight families were noted from Amrabad Tiger Reserve. Moreover, two new records of distributions from peninsular India were documented here in this study, *Ranatra libera* Zettel, 1999 and *Rhagovelila sumatrensis* Lundblad, 1933. Around 20 species were observed for the first time in Telangana. Both the Tiger reserves have different family-wise species compositions, as shown in Figure 2. The details of the examined species, along with their global distribution, are discussed below.

### *Taxonomic hierarchy*

**Class Insecta Linnaeus, 1758**

**Order Hemiptera Linnaeus, 1758**

**Suborder Heteroptera Latreille, 1810**

**Infraorder Nepomorpha Popov, 1971**

**Family Nepidae Latreille, 1802**

**Genus *Laccotrephes* Stål, 1865**

***Laccotrephes elongatus* Montandon, 1907**

*Laccotrephes elongatus* Montandon, 1907, Syntype ♂. – BNHS.

**Material examined.** 2♂♂, 20.iii.2020, Gundampally; 1♂, 2♀♀, 29.xii.2021, Pathatharlapadu, J. Deepa & party, leg.

**Distribution.** **India:** Arunachal Pradesh, Assam, Bihar, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Manipur, Meghalaya, Nagaland, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal (Deepa, 2013). **Elsewhere:** China, Japan, Nepal, Pakistan, and Taiwan (Deepa, 2013).

***Laccotrephes griseus* (Guérin-Méneville, 1844)**

*Nepa griseus* Guérin-Méneville, 1844, 343–831, Holotype ♂. – Dhaka, Bangladesh.

**Material examined.** 1♂, 3♀♀, 22.xii.2021, Stream near Bairampally; 1♂, 20.xii.2021, Stream near Bolghatpalle; 1♂, 1♀, Octopus view point, 03.x.2020; 1♀, 24.xii.2021 Mallela Theertham waterfalls; 1♂, 28.xii.2021, Pond near Udampur; 1♂, Pond near Dharmajipet, 2♂♂, 2♀♀, 27.xii.2021, Stream near Indanpally, 3♂♂, 5♀♀, 29.xii.2021, Pathatharlapadu, J. Deepa & party, leg.

**Distribution.** **India:** Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu (Chandra et al., 2020); Telangana (Chandra et al., 2021); Tripura, Uttar Pradesh and West Bengal (Chandra et al., 2020). **Elsewhere:** Malaysia, Myanmar, Seychelles, Sri Lanka, and Thailand (Chandra et al., 2020).

***Laccotrephes ruber* (Linnaeus, 1764)**

*Nepa ruber* Linnaeus, 1764, 3: 18, Syntype ♂. – BMNH.

**Material examined.** 1♂, 2♀♀, 19.ix.2019, Pond near Ambagiri; 1♂, 2♀♀, 22.xii.2021, Pond near Bairampally; 2♀♀, 20.xii.2021, Umamaheshwaram; 2♂♂, 4♀♀, 03.x.2020, Octopus view point; 1♂, 3♀♀, 21.xii.2021, Pond near Nadimpalle; 3♂♂, 2♀♀, 27.xii.2021, Stream near Dharmajipet; 9♂♂, 17♀♀, 29.xii.2021, Pathatharlapadu; 1♂, 28.xii.2021, Stream near Gangapur, J. Deepa & party, leg.

**Distribution.** **India:** Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Sikkim, Tamil Nadu (Chandra et al., 2020); Telangana (Chandra et al., 2021); Tripura, Uttar Pradesh and West Bengal (Chandra et al., 2020). **Elsewhere:** China, Japan, Nepal, Pakistan, and Taiwan (Chandra et al., 2020).

**Subfamily Ranatrinae Douglas & Scott, 1865*****Cercotmetus brevipes* Montandon, 1909**

*Cercotmetus brevipes* Montandon, 1909, 7:65, Holotype ♂. – Sumatra, Indonesia.

**Material examined.** 1♂, 24.xi.2019, Pulgampanndri, J. Deepa & party, leg.

**Distribution.** **India:** Assam, Kerala, Madhya Pradesh, Maharashtra, Meghalaya (Chandra et al., 2020) and Telangana (**New record**). **Elsewhere:** Indonesia (Sumatra, Java), Borneo, Vietnam, China, Thailand, Malaysia, Singapore, and Philippines (Chandra et al., 2020).

***Ranatra digitata* Hafiz & Pradhan, 1947**

*Ranatra digitata* Hafiz & Pradhan, 1947, 371–372, Holotype ♂. – Titilagarh, Bihar.

**Material examined.** 1♂, 20.xii.2021, Umamaheshwaram; 1♂, 20.xii.2021, Pond near Bolghatpalle; 3♂♂, 3♀♀, 21.xii.2021, Pond near Nadimpalle; 1♂, 28.xii.2021, Pond near Udampur, J. Deepa & party, leg.

**Distribution.** **India:** Andhra Pradesh, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Madhya Pradesh and West Bengal (Chandra et al., 2020); Arunachal Pradesh, Delhi, Karnataka, Kerala, Maharashtra, Odisha, Pondicherry, Manipur, Meghalaya, Rajasthan, Telangana and Uttar Pradesh (Deepa, 2013). **Elsewhere:** China, Nepal, Pakistan, Philippines, and Sri Lanka (Deepa, 2013).

***Ranatra elongata* Fabricius, 1790**

*Ranatra elongata* Fabricius, 1790, 1:228, ♂. – NHMD.

**Material examined.** 1♂, 2♀♀, 20.iii.2020, Gundampally; 1♂, 2♀♀, 27.xii.2021, Stream near Indanpally, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu (Chandra et al., 2020); Telangana (Chandra et al., 2021); Tripura, Uttar Pradesh and West Bengal (Chandra et al., 2020). **Elsewhere:** Australia (Deepa, 2013); Denmark (Chandra et al., 2021); Nepal (Deepa, 2013), and Sri Lanka (Chandra et al., 2020).

***Ranatra libera* Zettel, 1999 (Figs 1A–1C)**

*Ranatra libera* Zettel, 1999:427–430, Holotype ♂. – Bago, Myanmar.

**Material examined.** 1♂, 20.xii.2021, Umamaheshwaram (16°22'21"N, 78°43'37.92"E); 1♂, 21.xii.2021, Nadimpally (16°24'25.2"N, 78°40'55.92"E); 1♀, 28.xii.2021, Udampur (19°11'51.72"N, 78°53'11.76"E), J. Deepa & party, leg.

**Diagnosis.** Body length of males 27.59–28.12 mm, female 29.08 mm. Respiratory siphon length 25.56–26.34 mm. Head width 2.87–2.90 mm. Vertex higher than eyes. Space between the middle coxae narrower than hind coxae. Metasternum posterior margin convex. Parameres relatively broad, apical hook slender, strongly curved at the base. Gap between the hook and main body of the paramere very narrow. The apical part of hook narrow.

**Distribution. India:** Meghalaya (Jehamalar & Chandra, 2020) and Telangana (**New record**). **Elsewhere:** Myanmar and Thailand (Tran & Zettel, 2021) (Fig. 1E).

**Remarks.** *Ranatra libera* belongs to the *R. biroi* species group described by Lansbury (1972). Prior to Tran & Nguyen (2016), it was only known from its type locality in Bago (Myanmar). However, it now appears to also be present in Thailand. In a later study by Jehamalar and Chandra (2020), this species was recorded not only from Meghalaya but also from the Indian subcontinent for the first time (Fig. 1E). The paramere structure and shape of *R. libera* is the important diagnostic feature which differs from the other species in this genus (Fig. 1B). This species was collected both from lentic and lotic habitats in the study areas.

***Ranatra varipes atropha* Montandon, 1903**

*Ranatra atropha* Montandon, 1903, 124: 318, Paratype ♂. – Singapore.

**Material examined.** 3♂♂, 2♀♀, 21.xii.2021, Umamaheshwaram; 1♀, 1♂, 20.xii.2021, Pond near Bolghatpalle; 1♂, 02.x.2020, Mallela Theertham waterfalls; 1♂, 29.xii.2021, Kannapur, J. Deepa & party, leg.

**Distribution. India:** Assam, Bihar, Karnataka, Madhya Pradesh, Puducherry, Tamil Nadu (Basu et al., 2018); Telangana (**New record**) and West Bengal (Basu et al., 2018). **Elsewhere:** Indonesia, Singapore, Sri Lanka, and Thailand (Lansbury, 1972).

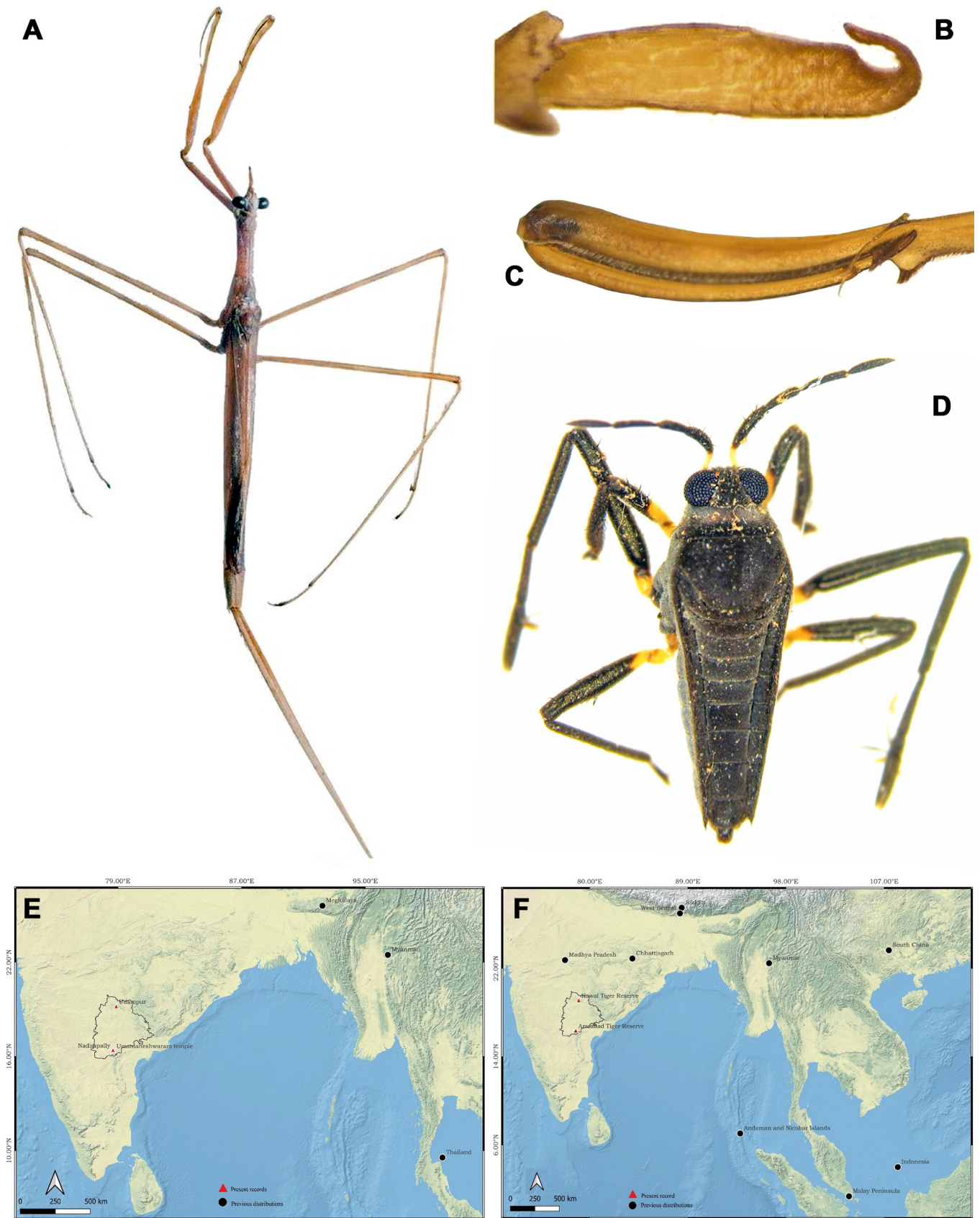
**Family Belostomatidae Leach, 1815****Subfamily Belostomatinae Leach, 1815*****Diplonychus annulatus* (Fabricius, 1781)**

*Nepa annulata* Fabricius, 1781, 20: 333, Holotype ♂. – Coromandel, India.

**Material examined.** 2♂♂, 2♀♀, 03.x.2020, Octopus view point; 1♀, 10.iii.2020, Gundampally, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu (Chandra & Jehamalar, 2012); Telangana (Chandra et al., 2021); Uttar Pradesh and West Bengal (Chandra & Jehamalar, 2012). **Elsewhere:** Bangladesh, and Pakistan (Chandra & Jehamalar, 2012).





**Figure 1.** The newly recorded species, and their distribution maps. **A-C., E.** *Ranatra libera* Zettel, 1999. **A.** Adult male, general habitus; **B.** Right paramere; **C.** Right foreleg with femoral teeth; **D., F.** *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1933.

***Diplonychus molestus* (Dufour, 1863)**

*Appasus molestum* Dufour, 1863, 333:20, Holotype ♂. – New Granada.

**Material examined.** 7♂♂, 9♀♀, 20.xii.2021, Pond near Bolghatpalle; 2♂♂, 4♀♀, 03.x.2020, Octopus view point; 1♀, 21.xii.2021, Pond near Nadimpalle; 1♂, 1♀, 28.xii.2021, Pond near Udampur, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab (Chandra & Jehamalar, 2012); Telangana (Chandra et al., 2021), Tripura, Uttar Pradesh and West Bengal (Chandra & Jehamalar, 2012). **Elsewhere:** New Granada.

***Diplonychus rusticus* (Fabricius, 1781)**

*Nepa rustica* Fabricius, 1781, 20: 333, Holotype ♂. – Coromandel, India.

**Material examined.** 2♂♂, 4♀♀, 28.xii.2021, Pond near Udampur; 1♂, 1♀, 27.xii.2021, Pond near Dharmajipet; 3♂♂, 3♀♀, 29.xii.2021, Pathatharlapadu, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu (Chandra & Jehamalar, 2012); Telangana (Chandra et al., 2021), Tripura, Uttar Pradesh and West Bengal (Chandra & Jehamalar, 2012). **Elsewhere:** Australia, Austria, China, Formosa, Indonesia, Japan, Malay Peninsula, Myanmar, New Zealand, Philippines, Sri Lanka, Thailand, and New Guinea (Chandra & Jehamalar, 2012).

**Family Coridae Leach, 1815*****Corixa affinis* Leach, 1817**

*Corixa affinis* Leach, 1817, 18:39, Holotype ♂. – BMNH.

**Material examined.** 1♂, 21.xii.2021, Pond near Nadimpalle; 2♂♂, 13.ix.2018, Pathatharlapadu, J. Deepa & party, leg.

**Distribution. India:** Jammu & Kashmir (Thirumalai, 2007) and Telangana (**New record**). **Elsewhere:** Russia (Aukema & Rieger, 1995).

**Family Micronectidae Jaczewski, 1924*****Micronecta scutellaris scutellaris* (Stål, 1858)**

*Sigra scutellaris* Stål, 1858, 28:102, Holotype ♂. – Mozambique, Africa.

**Material examined.** 2♂♂, 04.x.2020, Mannanur gate; 1♂, 1♀, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Assam, Bihar, Chandigarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh (Thirumalai and Sharma, 2008), Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal (Chandra et al., 2020) and Telangana (Chandra et al., 2021). **Elsewhere:** Bangladesh, Egypt, Morocco, Southeast China, Israel, Jordan, Mozambique, Saudi Arabia, Sinai, Syria, and Yemen (Chandra et al., 2020).

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

*Heleocoris bengalensis* Montandon, 1910, 653:19, Holotype ♂. – Matale, Sri Lanka.

**Material examined.** 1♂, 1♀, 27.xii.2021, Stream near Indanpally, J. Deepa & party, leg.

**Distribution. India:** Madhya Pradesh (Basu et al., 2018); Telangana (**New record**); Uttar Pradesh and West Bengal (Basu et al., 2018). **Elsewhere:** Indonesia, Sri Lanka (Basu et al., 2018).

***Heleocoris indicus* Montandon, 1897**

*Heleocoris indicus* Montandon, 1897, 3:31, Syntype ♂. – BMNH.

**Material examined.** 10♂♂, 16♀♀, 6.ii.2020, Stream near Pulgampanndri, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Chhattisgarh, Karnataka, Kerala, Maharashtra, Tamil Nadu (Jehamalar & Chandra, 2016) and Telangana (**New record**).

**Family Notonectidae Latreille, 1802****Subfamily Anisopinae Hutchinson, 1929*****Anisops barbatus* Brooks, 1951**

*Anisops barbatus* Brooks, 1951, 387:64, Holotype ♂. – Odisha, India.

**Material examined.** 4♂♂, 8♀♀, 20.xii.2021, Umamaheshwaram; 3♂♂, 5♀♀, 03.x.2020, Octopus view point; 2♂♂, 2♀♀, 04.x.2020, Mannanur gate; 2♀♀, 27.xii.2021, Stream near Indanpally, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Island, Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu (Jehamalar & Chandra, 2013); Telangana (Chandra et al., 2021); Uttar Pradesh and West Bengal (Jehamalar & Chandra, 2013). **Elsewhere:** Southeast and Southwest China, Indonesia, Malaysia, Singapore, and Taiwan (Jehamalar & Chandra, 2013).

***Anisops bouvieri* Kirkaldy, 1904**

*Anisops bouvieri* Kirkaldy, 1904, 116:64, Holotype ♂. – MNHN.

**Material examined.** 1♂, 03.x.2020, Octopus view point; 1♂, 11.ix.2019, Pathatharlapadu, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu (Basu et al., 2018); Telangana (Chandra et al., 2021); Uttar Pradesh and West Bengal (Basu et al., 2018). **Elsewhere:** Bangladesh, China, Indonesia, Malaysia, Myanmar, New Guinea, Singapore, Thailand, and Vietnam (Basu et al., 2018).

***Anisops breddini* Kirkaldy, 1901**

*Anisops breddini* Kirkaldy, 1901, 34:5, Holotype ♂. – BMNH.

**Material examined.** 2♂♂, 1♀, 20.xii.2021, Stream near Bolghatpalle; 1♂, 1♀, 04.x.2020, Umamaheshwaram; 2♂♂, 27.xii.2021, Stream near Indanpally, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Kerala, Madhya Pradesh, Odisha, Tamil Nadu (Chandra et al., 2020); Telangana (**New record**); Tripura, Uttar Pradesh and West Bengal (Chandra et al., 2020). **Elsewhere:** Bangladesh, Borneo, Brunei, Cambodia (Chandra et al., 2020); Indonesia, Java (Basu et al., 2018); Myanmar, New Guinea, Philippines (Chandra et al., 2020); Singapore (Nieser et al., 2005); Southwest China (Chandra et al., 2020); Sri Lanka, Sulawesi (Basu et al., 2018); Thailand, Vietnam, and West Malaysia (Chandra et al., 2020).

***Anisops kuroiwae* Matsumura, 1915**

*Anisops kuroiwae* Matsumura, 1915, 109:65, Holotype ♂. – Okinawa, Japan.

**Material examined.** 1♂, 03.x.2020, Octopus view point; 2♂♂, 1♀, 04.x.2020, Mannanur gate; 4♂♂, 2♀♀, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Delhi, Madhya Pradesh, Manipur, Sikkim (Jehamalar & Chandra, 2013); Telangana (**New record**); Tripura, Uttar Pradesh and West Bengal (Jehamalar & Chandra, 2013). **Elsewhere:** Hainan, Indonesia, Iriomote Island, Korea, Malaysia, Southeast and southwest China, Southern Japan, Taiwan, and the Philippines (Chandra et al., 2020).



### Subfamily Notonectinae Latreille, 1802

#### *Enithares ciliata* (Fabricius, 1798)

*Notonecta ciliata* Fabricius, 1798, 524: 68, Holotype ♂. – ZMUC.

**Material examined.** 2♂♂, 2♀♀, 20.xii.2021, Umamaheshwaram; 2♂♂, 1♀, 24.xii.2021, Mallela Theertham waterfalls; 2♂♂, 4♀♀, 17.iii.2019; 2♀♀, 04.x.2020, Mannanur gate; 2♂♂, 28.xii.2021, Stream near Balandpur, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Karnataka, Haryana, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Rajasthan, Tamil Nadu (Jehamalar & Chandra, 2013); Telangana (Chandra et al., 2021); Tripura, Uttarakhand, Uttar Pradesh and West Bengal (Jehamalar & Chandra, 2013). **Elsewhere:** Bhutan, Indonesia (Sumatra), Malaysia, Mauritius, Sri Lanka, Southeast and Southwest China, Thailand, and Vietnam (Jehamalar & Chandra, 2013).

#### *Enithares fusca* Brooks, 1948

*Enithares fusca* Brooks, 1951, 21:46, Holotype ♂. – ZUKU.

**Material examined.** 1 ♂, 28.xii.2021, Stream near Balandpur, J. Deepa & party, leg.

**Distribution. India:** Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu (Thirumalai, 2007), Telangana (**New record**).

### Family Pleidae Fieber, 1951

#### *Paraplea frontalis* (Fieber, 1844)

*Ploa frontalis* Fieber, 1844, 336: 74, Holotype ♂. – Madhupur, India.

**Material examined.** 2♂♂, 03.x.2020, Octopus view point; 2♂♂, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Bihar, Chhattisgarh, Chandigarh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Punjab, Tamil Nadu (Jehamalar & Chandra, 2016); Telangana (**New record**) and West Bengal (Jehamalar & Chandra, 2016). **Elsewhere:** Indonesia, Moluccas, Sri Lanka, Southeast China, Taiwan, Thailand, and West Malaysia (Jehamalar & Chandra, 2016).

### Infraorder Gerromorpha Popov, 1971

#### Family Mesoveliidae Douglass & Scott, 1867

##### Subfamily Mesoveliinae Douglass & Scott, 1867

#### *Mesovelia horvathi* Lundblad, 1934

*Mesovelia horvathi* Lundblad, 1934, 12: 1-195. Holotype ♂. – Sumatra, Indonesia.

**Material examined.** 2♂♂, 28.xii.2021, Pond near Udampur, J. Deepa & party, leg.

**Distribution. India:** Chhattisgarh, Madhya Pradesh Tamil Nadu (Jehamalar & Chandra, 2016); Telangana (**New record**) and West Bengal (Jehamalar & Chandra, 2016). **Elsewhere:** Australia, China, Japan, Indonesia, Malaysia, Philippines, Sri Lanka, Thailand, and Vietnam (Andersen & Weir, 2004).

#### *Mesovelia vittigera* Horváth, 1895

*Mesovelia vittigera* Horváth, 1895, 160:78, Holotype ♂. – HNHM.

**Material examined.** 1♂, 10.iii.2020, Pichakuntla cheruvu, 1♂, 10.iii.2020, Utnoor, J. Deepa & party, leg.

**Distribution. India:** Assam, Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Bihar, Chandigarh, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu (Chandra et al., 2020); Telangana (**New record**), Uttarakhand, Uttar Pradesh and West Bengal (Chandra et al., 2020). **Elsewhere:** Albania, Algeria, Angola, Australia, Balearic Island, Bangladesh, Benin, Botswana, Bulgaria, Burkina Faso, Cameroon, Congo, Croatia,



Egypt, Ethiopia, France, Ghana, Greece, Guinea, Indonesia, Iraq, Israel, Italy, Ivory Coast, Japan, Jordan, Kenya, Laos, Lebanon, Lesotho, Libya, Madagascar, Malaysia, Maltese Islands, Mariana Islands, Mascarene Islands, Mauritania, Moldova, Montenegro, Morocco, Myanmar, Namibia, New Caledonia, Nigeria, Oman, Pakistan, Papua New Guinea, Philippines, Portugal, Romania, Russia, Saudi Arabia, Senegal, Solomon Islands, Somalia, South Africa, Spain, Sri Lanka, Syria, Thailand, Taiwan, Tanzania, Tunisia, Turkey, Uganda, United Arab Emirates, Vietnam, Yemen, Zambia, and Zimbabwe (Chandra et al., 2020).

### Family Hydrometridae Billberg, 1820

#### Subfamily Hydrometrinae Billberg, 1820

##### *Hydrometra greeni* Kirkaldy, 1898

*Hydrometra greeni* Kirkaldy, 1898, 165:29, Holotype ♀. – Punduloya, Sri Lanka.

**Material examined.** 2♂♂, 1♀, 11.ix.2019, Pathatharlapadu, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu (Chandra et al., 2020); Telangana (**New record**), Uttarakhand, Uttar Pradesh and West Bengal (Chandra et al., 2020). **Elsewhere:** Bangladesh, Cambodia, South China, Indonesia, Laos, Malay Peninsula, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, and Vietnam (Chandra et al., 2020).

### Family Veliidae Amyot & Serville, 1843

#### Subfamily Rhagoveliinae Chen & Usinger, 1949

##### *Rhagovelia (Neorhagovelia) sumatrensis* Lundblad, 1933 (Fig. 1D)

*Rhagovelia femorata* var. *sumatrensis* Lundblad, 1933, 287: 92, Holotype ♂. – Sumatra, Indonesia.

**Material examined.** 4♂♂, 9♀♀, 12.xiii.2021, Mallela Theeratham waterfalls (16°15'56.52"N, 78°51'14.76"E); 3♂♂, 8♀♀, 06.ii.2020, Stream near Pulgampanndri (19°14'52.8"N, 78°35'28.68"E), J. Deepa & party, leg.

**Diagnosis.** The average body length of males 2.8 mm, females 3.1 mm. Body entirely black-coloured. Anterior region of pronotum orange brown transverse band, where posterior margin straight. Males have 3–4 spines at the basal half of the mid femur. Males bear 14–18 teeth at the basal half of the hind femur, whereas females have only 3–6 teeth. At the distal half males possess 7–8 teeth, and females with 5–6 teeth. Connexival tip of the female with a short setal tuft.

**Distribution. India:** Andaman & Nicobar Islands, Chhattisgarh, Madhya Pradesh, Sikkim (Jehamalar & Chandra, 2016); Telangana (**New record**) and West Bengal (Basu et al., 2018). **Elsewhere:** Indonesia, Myanmar, Peninsular Malaysia, and South China (Yang & Polhemus, 1994) (Fig. 1F).

**Remarks.** This species may be easily identified by the presence of short, sharp spines ventrally on the basal portion of the male mid-femur and the structure of the male parameres. They are found in floating waters with slow to moderately fast currents and sandy-bottomed streams (Yang & Polhemus, 1994). In the Kawal Tiger reserve, we collected this species from a roadside, a small sandy stream with a very small amount of water with minimal water current likewise, in the Amrabad Tiger reserve, we collected it beside the waterfalls where the water current was moderate.

##### *Rhagovelia (Rhagovelia) ceylanica* Lundblad, 1936

*Rhagovelia ceylanica* Lundblad, 1936, 28 (21):32, Holotype ♂. – Sumatra, Indonesia, ZMUH.

**Material examined.** 3♂♂, 6♀♀, 06.ii.2020, Stream near Pulgampanndri, J. Deepa & party, leg.

**Distribution. India:** Assam, Bihar, Himachal Pradesh, Kerala, Maharashtra, Meghalaya, Odisha, Punjab, Tamil Nadu (Chandra et al., 2020); Telangana (**New record**) and Uttar Pradesh (Chandra et al., 2020). **Elsewhere:** Indonesia, Sri Lanka (Chandra et al., 2020).

## Family Gerridae Leach, 1815

### Subfamily Rhagadotarsinae Breddin, 1905

#### *Rhagadotarsus kraepelini* Breddin, 1905

*Rhagadotarsus kraepelini* Breddin, 1905, 137:97, Holotype ♂. – ZMUH.

**Material examined.** 3♂♂, 3♀♀, 13.viii.2021; 4♂♂, 6♀♀, 23.xii.2021, Vatavarlapally pond, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Arunachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Puducherry, Tamil Nadu (Chandra et al., 2012); Telangana (**New record**) and West Bengal (Chandra et al., 2012). **Elsewhere:** South China, Palau, Papua New Guinea, Philippines (Chandra et al., 2020); Indonesia, Malaysia, Myanmar, Singapore, Sri Lanka, Taiwan, Thailand, and Vietnam (Basu et al., 2018).

### Subfamily Gerrinae Bianchi, 1896

#### *Neogerris parvulus* (Stål, 1859)

*Gerris parvulus* Stål, 1859, 265: 107, Holotype ♂. – NHRS.

**Material examined.** 11♂♂, 14♀♀, 28.xii.2021, Pond near Udampur; 1♂, 27.xii.2021, Pond near Dharmajipet, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh (Chandra et al., 2020); Arunachal Pradesh, Assam, Odisha, Pondicherry, Tamil Nadu (Basu et al., 2018); Telangana (**New record**), Uttar Pradesh and West Bengal (Basu et al., 2018). **Elsewhere:** Bangladesh, China, Iran, Japan, Java, Malay Peninsula, Myanmar, New Guinea, Oman, Philippines, Pakistan, Singapore, Sri Lanka, Solomon Islands, Taiwan, and Vietnam (Chandra et al., 2020).

#### *Linnogonus fossarum fossarum* (Fabricius, 1775)

*Cimex fossarum* Fabricius, 1775, 727:105, Holotype ♂. – ZMUC.

**Material examined.** 1♂, 22.xii.2021, Stream near Bairampalle; 2♂♂, 20.xii.2021, Stream near Bolghatpalle; 17♂♂, 19♀♀, 21.xii.2021, Pond near Nadimpalle; 1♂, 03.x.2020, Octopus view point; 1♀, 28.xii.2021, Pond near Udampur; 9♂♂, 8♀♀, 27.xii.2021, Stream near Indanpally, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Pondicherry, Punjab, Rajasthan, Tamil Nadu (Chandra et al., 2020); Telangana (Chandra et al., 2021) and West Bengal (Chandra et al., 2020). **Elsewhere:** Bangladesh, China, Hong Kong, Indonesia, Japan, Malay Peninsula, Myanmar, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, and Vietnam (Chandra et al., 2020).

#### *Linnogonus nitidus* (Mayr, 1865)

*Hydrometra nitida* Mayr, 1865, 443:105, Holotype ♂. – NHMW.

**Material examined.** 1♂, 2♀♀, 21.xii.2021, Pichakuntla cheruvu; 3♂♂, 3♀♀, 22.xii.2021, Pond near Bairampalle; 1♂, 21.xii.2021, Pond near Nadimpalle; 2♀♀, 24.xii.2021, Mallela Theertham waterfalls; 2♀♀, 03.x.2020, Octopus view point; 1♂, 27.xii.2021, Stream near Indanpally; 3♂♂, 3♀♀, 28.xii.2021, Pond near Gangapur; 2♂♂, 2♀♀, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

**Distribution. India:** Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Odisha, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh (Chandra et al., 2020), Telangana (Chandra et al., 2021) and West Bengal (Chandra et al., 2020). **Elsewhere:** Bangladesh, Bhutan, China, Indonesia, Laos, Maldives, Malaysia, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, and Vietnam (Chandra et al., 2020).

***Linnometra fluviorum* (Fabricius, 1798)**

*Cimex fluviorum* Fabricius, 1798, 2:177, Lectype ♂. – BMNH.

**Material examined.** 2♂♂, 20.ix.2018; 2♀♀, 12.viii.2021; 6♂♂, 10♀♀, 24.xii.2021; 21♂♂, 27♀♀, 28.xii.2018; 3♂♂, 2♀♀, 14.ii.2020, Mallela Theertham waterfalls; 1♂, 2♀♀, 10.viii.2021, Saleshwaram; 11♂♂, 7♀♀, 28.xii.2021, Stream near Gandipochama temple, J. Deepa & party, leg.

**Distribution. India:** Andhra Pradesh, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Tamil Nadu (Chandra et al., 2020); Telangana (Chandra et al., 2021) and West Bengal (Chandra et al., 2020). **Elsewhere:** Reunion Islands, Sri Lanka (Chandra et al., 2020).

**Subfamily Eutrochinae Matsuda, 1960*****Amemboa kumari* (Distant, 1910)**

*Onychotrechus kumari* Distant, 1910, 5:145, Holotype ♂. – Travancore, Kerala.

**Material examined.** 3♂♂, 2♀♀, 24.xii.2021, Mallela Theertham waterfalls, J. Deepa & party, leg.

**Distribution. India:** Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Odisha, Tamil Nadu (Chandra et al., 2020); Telangana (**New record**), and West Bengal (Chandra et al., 2020).

***Onychotrechus rhexenor* Kirkaldy, 1903**

*Onychotrechus rhexenor* Kirkaldy, 1903, 44:108, Holotype ♂. – BMNH.

**Material examined.** 2♂♂, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

**Distribution. India:** Chhattisgarh, Karnataka, Kerala, Maharashtra, Rajasthan, Tamil Nadu (Chandra et al., 2020) and Telangana (**New record**). **Elsewhere:** Socotra Island (Chandra et al., 2020).

**Subfamily Cylindrostethinae Matsuda, 1960*****Cylindrostethus productus* (Spinola, 1840)**

*Gerris productus* Spinola, 1840, 2:184, Syntype ♂. – BMNH.

**Material examined.** 3♂♂, 7♀♀, 12.viii.2021, 6♂♂, 3♀♀, 24.xii.2021, 1♀, 02.x.2020, Mallela Theertham waterfalls; 8♂♂, 11♀♀, 4.ii.2020, Stream near Balandpur; 1♀, 24.ix.2020, Stream near Gangapur; 1♀, 23.ix.2020, Stream near Allampalli, J. Deepa & party, leg.

**Distribution. India:** Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Tamil Nadu (Jehamalar & Chandra, 2016); Telangana (Chandra et al., 2021); Uttarakhand, Uttar Pradesh and West Bengal (Jehamalar & Chandra, 2016). **Elsewhere:** Nepal and Sri Lanka (Jehamalar & Chandra, 2016).

**Subfamily Ptilomerinae Amyot & Serville, 1843*****Ptilomera agriodes* Schmidt, 1926**

*Ptilomera agriodes* Schmidt, 1926, 15:63, Type ♂. – Tiruchirappalli, India.

**Material examined.** 14♂♂, 19♀♀, 12.viii.2021, 11♂♂, 19♀♀, 24.xii.2021, 22♂♂, 19♀♀, 12.ii.2021, Mallela Theertham waterfalls; 10♂♂, 9♀♀, 10.viii.2021, Saleshwaram, J. Deepa & party, leg.

**Distribution. India:** Chhattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu (Chandra et al., 2020) and Telangana (Chandra et al., 2021).

**Subfamily Halobatinae Matsuda, 1960*****Metrocoris communis* (Distant, 1910)**

*Euodus communis* Distant, 1910, 151:112, Holotype ♂. – BMNH.

**Material examined.** 2♂♂, 2♀♀, 21.xii.2021, Pichakuntla Cheruvu; 6♂♂, 9♀♀, 24.xii.2021, 1♂, 2♀♀, 12.viii.2021, 1♂, 2♀♀, 14.ii.2020, Mallela Theertham waterfalls; 1♂, 18.iii.2019, Ramanapenta; 22♂♂, 25♀♀, 28.xii.2021, Stream near Gangapur; 6♂♂, 5♀♀, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

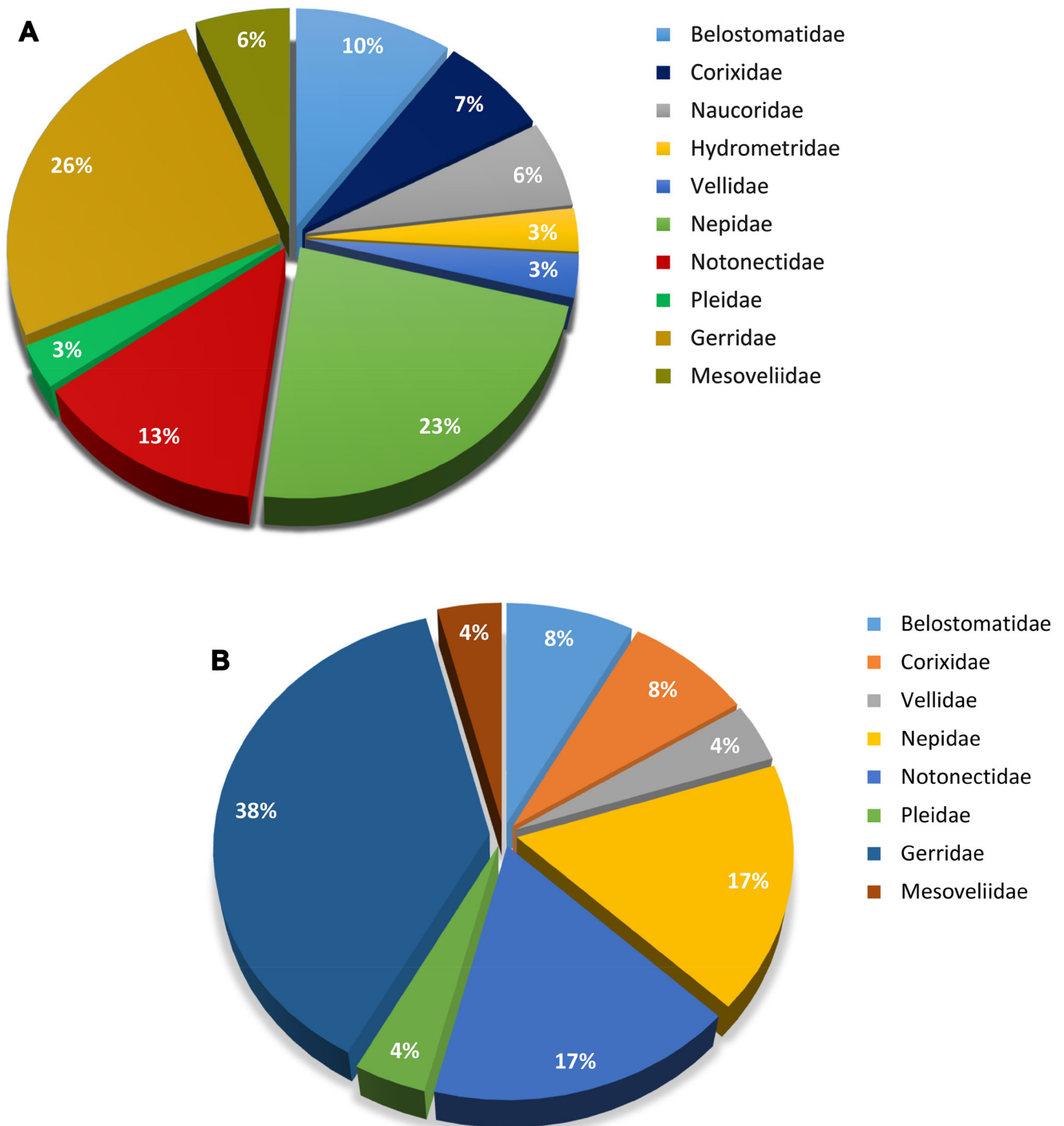
**Distribution. India:** Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu (Chandra et al., 2020); Telangana (**New record**) and Uttar Pradesh (Chandra et al., 2020). **Elsewhere:** Afghanistan, Iran, Iraq, and Oman (Chandra et al., 2020).

***Metrocoris communoides* Chen & Nieser, 1993**

*Metrocoris communoides* Chen & Nieser, 1993, 19 (2): 51, Holotype ♂. – Tamil Nadu, India.

**Material examined.** 1♂, 20.xii.2021, Umamaheshwaram; 1♀, Gandipochama temple; 1♀, 28.xii.2021, Stream near Gangapur; 1♂, 25.xii.2021, Kunthala waterfalls, J. Deepa & party, leg.

**Distribution. India:** Madhya Pradesh, Odisha, Tamil Nadu (Chandra et al., 2020) and Telangana (Chandra et al., 2021).



**Figure 2.** Family-wise species composition chart. **A.** Kawal Tiger Reserve; **B.** Amrabad Tiger Reserve.



## DISCUSSION

Telangana has received limited attention in faunistic research, with most studies concentrating on a small number of lakes and reservoirs. These studies have led to the identification of 14 aquatic and semi-aquatic hemipteran species in the region. (Deepa & Rao, 2007; Deepa, 2013). However, a recent study by Chandra et al. (2021) revealed 28 species from Telangana, which is still relatively low compared to the overall diversity of aquatic and semi-aquatic hemipterans in India. Throughout three years, in-depth research was conducted in the Amrabad and Kawal Tiger reserves. Among the 38 species of aquatic Hemipterans, infraorder Nepomorpha showed higher diversity, with 22 species belonging to 10 genera and six families. In comparison, infraorder Geromorpha is represented by 16 species and 12 genera belonging to 4 families. *Cercotmetus brevipes*, *R. libera*, *R. varipes atropaha*, *C. affinis*, *H. bengalensis bengalensis*, *H. indicus*, *E. fusca*, *A. breddini*, *A. kuroiwae* and *P. frontalis* under the infraorder Nepomorpha, and *A. kumari*, *M. communis*, *R. kraepelini*, *N. parvulus*, *O. rhexenor*, *H. greeni*, *M. horvathi*, *M. vittigera*, *R. ceylanica* and *R. sumatrensis* under infra order Gerromoprha are the additional species for the state fauna of Telangana. *Ranatra libera* is being reported for the first time from peninsular India, which was collected from both the Tiger reserves (Fig. 1E). This species was originally described by Zettel from Burma's Bago division in Myanmar in 1999, and it was later further documented from Thailand (Tran & Nguyen, 2016). Later, Jehamalar and Chandra (2020) reported from Meghalaya, India. It is quite easily understandable that the preferable habitats of this species are mainly the hilly streams with aquatic bushes (Zettel, 1999; Tran & Nguyen, 2016; Jehamalar & Chandra, 2020). All of these previous studies, along with this present work, suggest that *Ranatra libera* is a high-altitude species that prefers hilly lentic or lotic waters as its preferable habitat. *Rhagovelia sumatrensis* earlier reported exclusively from Chhattisgarh and Madhya Pradesh in central and Sikkim and West Bengal in eastern India and Andaman and Nicobar Islands (Chandra et al., 2020). We are reporting this species from both of these Tiger reserves, which is an additional distributional record from peninsular India (Figs 1D, 1F). This species was also collected from hilly streams, where the water current was moderate to slow in both the Tiger reserves.

Among the ten families documented from the two Tiger reserves, Gerridae, Nepidae, and Notonectidae showed the highest species composition of average 31%, 19.5% and 14.5%, respectively (Figs 2A, 2B). According to the previous study (Chandra et al., 2021), the diversity of aquatic and semi-aquatic Hemiptera in Telangana is less than 1% compared to the diversity throughout India. Therefore, extensive surveys should be taken in various parts of Telangana to acquire true aquatic and semi-aquatic Hemiptera diversity. Knowledge of their biology, feeding habits, and prey-predator relationship is essential to studying fish biology (Thirumalai, 1999). They also serve as zoogeographical indicators (Jordon, 1951; Hungerford & Matsuda, 1958a, 1958b) and play their role as bio-indicators of long-term environmental changes (Moir & Brennan, 2007). It is abundantly evident that comprehensive documenting of the fauna is required, focusing on this group to highlight the genuine diversity of aquatic Hemipterans in Telangana.

## AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: J. Deepa: Confirmed the species identification and revised the manuscript; S. Banerjee: Collected the specimens, did preservation, identified and photographed the specimens, and wrote and revised the manuscript. Both authors read and approved the final version of the manuscript.

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## AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the National Zoological Collection of Zoological Survey of India, Freshwater Biology Regional Centre and are available from the curator upon request.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## CONSENT FOR PUBLICATION

Not applicable.

## CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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## بررسی فونستیک سن‌های آبی و نیمه‌آبی (Hemiptera, Heteroptera) مناطق حفاظت شده ببر تلانگانا، هند

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مرکز منطقه‌ای مطالعات زیستی آب‌گیرها، بخش مطالعات جانورشناسی هند، حیدرآباد، هند

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**چکیده:** تنوع و پراکنش سن‌های آبی و نیمه‌آبی مناطق حفاظت شده ببر کاوال و امرآباد ایالت تلانگانا بررسی شد. در این گزارش، ۳۸ گونه از سن‌های آبی و نیمه‌آبی متعلق به ۲۲ جنس و ۱۰ خانواده از مناطق حفاظت شده ببر کاوال و امرآباد ثبت شد. حضور ۲۰ گونه به آمار گونه‌های ایالت تلانگانا اضافه شد. دو گونه *Ranatra libera* Zettel, 1999 و *Rhagovelia sumatrensis* Lundblad, 1933 نیز مشاهده و به عنوان گزارش جدید برای هند ثبت شدند. در منطقه حفاظت شده ببر کاوال تنوع گونه‌ای بیشتری نسبت به منطقه حفاظت شده امرآباد ثبت شد. این تحقیق اولین مستندات مطالعاتی روی سن‌های آبی و نیمه‌آبی در هر دو منطقه حفاظت شده ایالت تلانگانا محسوب می‌شوند.

**واژگان کلیدی:** تنوع، آبی، گزارش انتشار، آب‌پیماریختان، سوزنی‌ریختان