

**TAXONOMY AND SPECIES DIVERSITY OF URBAN FOREST MYRIAPODS  
IN KATHMANDU VALLEY, NEPAL**



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Entry 68

M.Sc. Zoo Dept. Entomology

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Date: 2080-01-21

04-05-2023

T.U. Registration No.: 5-2-1156-62-2015

T.U. Examination Roll No.: Zoo 828/076

Batch: 2076

A thesis submitted

In the partial fulfilment of the requirements for the award of the degree of Master of  
Science in Zoology with special paper Entomology

Submitted to  
Central Department of Zoology  
Institute of Science and Technology  
Tribhuvan University  
Kirtipur, Kathmandu  
Nepal  
May 2023

## DECLARATION

I hereby declare that the work presented in this thesis has been done myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged with references to the author(s) or institution(s).

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**RECOMMENDATION**

This is to recommend that the thesis entitled "**TAXONOMY AND SPECIES DIVERSITY OF URBAN FOREST MYRIAPODS IN KATHMANDU VALLEY, NEPAL**" has been carried out by Mr. Lokendra Chand for the partial fulfillment of the Master's degree in Science in Zoology with species paper entomology. This is his original work, which has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree at any other institution.

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**LETTER OF APPROVAL**

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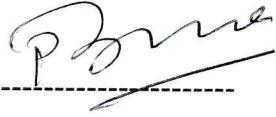
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**CERTIFICATE OF ACCEPTANCE**

This dissertation submitted by Mr. Lokendra Chand, entitled "TAXONOMY AND SPECIES DIVERSITY OF URBAN FOREST MYRIAPODS IN KATHMANDU VALLEY, NEPAL" has been accepted for the partial examination in partial fulfilment of the requirements for a Master's degree in Science in Zoology with species paper entomology.

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## **ACKNOWLEDGEMENTS**

At first I would like to express my sincere thanks to Professor Dr. Prem Bahadur Budha for his continuous supervision and encouragement from the beginning to the completion of the work.

I am grateful to the former head of the department Professor Dr. Tej Bahadur Thapa and Professor Dr. Kumar Sapkota, the current head of the Central Department of Zoology, Tribhuvan University for providing such an opportunity to carry out this dissertation work.

I am thankful to Lab. Officer Mrs. Kamala Mishra, Office Assistant Mr. Basanta Kumar Khanal, and Technical Assistant Mr. Ganesh Lama for providing laboratory equipments to conduct laboratory work.

I want to thank Thomas Wesener (Research Museum Alexander Koenig, Germany), Henrik Enghoff (Professor at University of Copenhagen, Denmark), S.I. Golovatch (Russian Academy of Sciences, Russia), William Shear (Hampden-Sydney College, USA), and Carles Domenech Perez (University of Alicante, Spain) for helping me for the identification confirmation of my collected samples as well as providing me with needed articles.

I am grateful to the Department of Forest, Babarmahal, for providing me permission to conduct my research in three urban forest patches inside the Kathmandu Valley.

I am thankful to my brothers Hemant Oli, Kishor D.C, Bijan Basnet, Suman Sharma, Thakur Bhandari, Dambar Hamal, and my friends Ayuba Senchury, Gunja Kaucha and Saru Thapa Pandey, who accompanied me in the field work.

Finally, I would like to acknowledge my family and friends for providing priceless support and continued encouragement throughout my entire study.

**Lokendra Chand**

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## LIST OF ABBREVIATIONS

<b>Abbreviated form</b>	<b>Details of Abbreviation</b>
CDZ	Central Department of Zoology
CDZMTU	Central Department of Zoology Museum, Tribhuvan University
CGTU	Coronation Garden of Tribhuvan University
RCF	Ranibari Community Forest
NCF	Nilbarahi Community Forest
TU	Tribhuvan University

## ABSTRACT

This study aimed to identify the Myriapoda fauna of urban forest patches inside the Kathmandu Valley. Samples were collected from May to December 2022 at three urban forest patches: Coronation Garden of Tribhuvan University, Ranibari Community Forest, and Nilbarahi Community Forest. Direct search and hand collection of myriapod samples was done during pre-monsoon (May–June), monsoon (July–August), and post-monsoon (December), in the 2 m x 2 m size plots within two parallel transects at 10 m distance. A total of 10 species of Myriapoda belonging to two classes (Diplopoda and Chilopoda), seven families, and eight genera were reported. Two species of the class Diplopoda *Gonoplectus ranibariensis* sp. nov. and *Gonoplectus nilbarahiensis* sp. nov. were described new to science. Three new records to Nepal were reported *Trigoniulus corralinus* (Eydoux and Souleyet, 1842), *Rhysidatrispinosa* Jangi & Dass, 1984, and *Scutigera coleoptera* (Linnaeus, 1758). New distribution records were made for *Delarthrum elegans* (Golovatch, 1992), *Oxidus gracilis* (C.L. Koch, 1847), *Koponenius biramus* Golovatch and Vandenspiegel, 2014, *Rhysida afra* (Peters, 1855) and *Cryptops dora* Pocock, 1891. None of the common species recorded from three forest patches. Most species are unique to each forest. *G. ranibariensis* sp. nov., *T. corallinus*, *R. trispinosa*, and *C. dora* are unique for Ranibari Community Forest, *K. biramus* for Nilbarahi Community Forest, and *O. gracilis* for Coronation Garden of Tribhuvan University. *G. nilbarahiensis* sp. nov., *D. elegans*, *R. afra* are common for Ranibari Community Forest and Nilbarahi Community Forest. *S. coleoptera* was a common species distributed in the Ranibari Community Forest and Coronation Garden of Tribhuvan University.

The Diplopoda (n=344, six species) was most abundant and diverse class followed by Chilopoda (n=73, four species). The abundance of Myriapoda is approximately similar in Ranibari Community Forest (n=211) and Nilbarahi Community Forest (n=203) and but lower in Coronation Garden of Tribhuvan University (n=3). Species diversity in Ranibari Community Forest ( $H' = 1.71$ ) is higher than other two forest patches: Nilbarahi Community Forest ( $H' = 0.35$ ) and Coronation Garden of Tribhuvan University ( $H' = 0.64$ ). The abundance of Myriapod is higher in pre-monsoon (n=330) but species diversity is similar in premonsoon and monsoon (eight species). Higher abundance of Diplopoda was recorded during pre-monsoon while Chilopoda during monsoon. The abundance and species diversity of Myriapoda was affected by forest type, human activities, and season which altered the percentage and size of the litter layer.

# 1. INTRODUCTION

## 1.1 Background of Study

Myriapoda is the sub-phylum of wingless arthropods with many segmented slender body, having one or two pairs of legs in each segment. It is divided into four classes: Paupoda, Symphyla, Chilopoda, and Diplopoda (Adis & Harvey 2000). Globally, there are more than 16,000 species of Myriapoda including 13,611 species of Diplopoda (3005 genera, 146 families and 16 orders) and 3300 species of Chilopoda (333 genera, 24 families and five orders) (Adis & Harvey 2000; Shear & Krejca 2019; Sierwald & Spelda 2023).

Diplopoda have cylindrical trunks with two pairs of legs per segment which are distributed in temperate, sub-tropical, or tropical forests. They are found in variety of habitats: marine littoral, freshwater habitat, deserts, zonal tundra, high mountains, caves, deeper soil, epiphytes, bark of trees, tree canopies, and nests of ants, termites, and birds (Golovatch & Kime 2009). Their body size ranges from a few mm to 35 cm (e.g. *Eumillipes persephone* contains 1,306 legs (Marek et al. 2021). They play an important ecological role in terrestrial ecosystems due to various feeding modes- detritivores, carnivores, omnivores as well as coprophagous (Hoffman & Payne 1969; Crawford 1992; Minelli & Golovatch 2001). But little is known about their diversity, morphology, and phylogeny (Sierwald & Bond 2007). Chilopoda, commonly known as centipedes, are terrestrial predatory nocturnal arthropods with a single pair of legs in each segment. Body size ranges from few mm to 30 cm, containing 15–191 pairs of legs, with venomous first pair, the forcipules (Edgecombe & Giribet 2007; Shear & Krejca 2019). They are also distributed worldwide in tropics and temperate regions and found leaf litter, soil, under stones, bark, or wood, grassland, desert, caves, and also in the littoral zone (Edgecombe & Giribet 2007; Bonato & Zapparoli 2011).

In Nepal, a total 187 nominal species of Diplopoda and 32 species of Chilopoda are recorded including 169 and 12 species endemic to Nepal respectively (Korsos et al. 2009; Thapa 2019; Golovatch 2022; Golovatch 2023). Seventeen species of Diplopoda and six species of Chilopoda have been recorded from the Kathmandu Valley and surrounding hills (Korsos et al. 2009; Thapa 2019). Most of the species were recorded from the forest of surrounding hills while their status inside the forest patches of urbanized area are still unknown. This study was focused on finding the diversity and distribution of Myriapoda fauna in urban forest patches in the Kathmandu Valley. This work identified the myriapod species diversity that will help for the conservation of leaf litter fauna of urban forest.

## **1.2 Objectives**

The main objective of the study was to study Myriapoda species from selected urban forest patches in the Kathmandu Valley, Nepal. The specific objectives are as follows:

- i. To identify Myriapoda species of urban forests of the Kathmandu valley with taxonomic descriptions,
- ii. To compare the species diversity, abundance and seasonal variations of Myriapoda fauna in the selected urban forest patches within Kathmandu Valley.

## **1.3 Significance of the Study**

Diplopods play an important ecological role in terrestrial ecosystems by decomposing vegetation and cycling nutrients because of their detritivorous nature. Chilopods predate on small arthropods; other invertebrates. There is little known about their diversity, morphology, and phylogeny (Edgecombe & Giribet 2007; Sierwald & Bond 2007), particularly urban forest patches which are important refugia for variety of animals. The most of the myriapod fauna of the Kathmandu valley is limited to surrounding hills. This study will provide the status of Myriapods of the urban forest patches of the Kathmandu Valley. This data is the first hand information for future reference and conservation effort.

## **1.4 Limitation of the Study**

The study was limited in three forest patches: Coronation Garden of Tribhuvan University, Ranibari Community Forest and Nilbarahi Community Forest. Myriapods were searched directly only in the litter on rotten logs other microhabitats such as tree bark, human habitation, agricultural fields are excluded. Other systematic traps such as pitfall trap sampling was avoided due to possible damage by humans, monkeys and other animals.

## 2 LITERATURE REVIEW

### 2.1 Global Diversity of Myriapoda

Myriapods are terrestrial wingless arthropods that have at least nine pairs of walking legs and a trunk that is not clearly split into a thorax and an abdomen (Minelli & Golovatch 2001). Myriapoda is a diverse and ancient group of Myriapods: millipedes, centipedes, and other related organism divided into four classes: Diplopoda, Chilopoda, Symphyla and Pauropoda (Adis & Harvey 2000). Globally, more than 16,000 species of Myriapoda recorded within four classes in which Diplopoda is the most diverse class with 13,611 species followed by Chilopoda (3,300 species), Pauropoda (835 species) and Symphyla (200 species) (Adis & Harvey 2000; Shear & Krejca 2019; Sierwald & Spelda 2023). More than 85,000 species of Myriapoda are await for naming (Chapman 2005). Myriapods are world widely distributed except Antarctica, mostly found in temperate countries (Minelli & Golovatch 2001). They are inhabits from the lush tropical rainforest of South America to the arid desert of Africa, dense forest of Asia as well as island (Golovatch & Kime 2009; Wesener 2011). The can be found various microhabitats leaf litter, soil, bark of trees, tree canopies as well as caves (Golovatch & Kime 2009).

Diplopoda is the class of Myriapods with long, cylindrical bodies with numerous segments, each bearing two pairs of legs except first three segments (Shear & Krejca 2019). Diplopoda is divided into 16 orders in which Polydesmida is the largest millipede order in numbers of species while Siphoniulida is smaller consisting only two species (Shear 2011; Brewer et al. 2012; Shear & Krejca 2019). They are distributed worldwide except Antarctica, major groups of soil and litter fauna in temperate and tropical environments (Golovatch & Kime 2009; Alagesan 2016). The distribution patterns of Diplopods are influenced by various factors: presence of leaf litter, climate, moisture level and soil composition (Santos-Silva et al. 2018). This is the reason for the higher diversity of Diplopods in tropical rainforest and lower in arid grasslands and deserts (Kime & Golovatch 2007). Most of the Diplopods are endemic to certain area while four species: *Oxidus gracilis*, *Asiomorpha coarctata*, *Leptoniulus soronus* and *Trigoniulus corallinus* are widespread species throughout the world (Shelly & Lehtinen 1999).

Chilopoda is a group of elongated predatory myriapods characterized by more than 15 pairs of legs, each body segments bearing one pair of legs. Diplopoda is divided into five orders: Craterostigmomorpha, Scutigermomorpha, Lithobiomorpha, Scolopendromorpha and Geophilomorpha (Minelli 2011; Edgecombe & Giribet 2007). The species of Chilopoda

are recorded from all the continents except Antarctica with the greatest diversity occurring in the tropics and warm temperate regions inhabit leaf litter, soil, under stones, bark, or wood in forests, although grassland, desert, caves, and the littoral zone (Edgecombe & Giribet 2007). Craterostigmomorpha comprised one family, one genus and two species: *Craterostigmus tasmanianus* Pocock, 1902 and *C. crabilli* Edgecombe & Giribet, 2008 endemic to Tasmania and South Island of New Zealand (Edgecombe & Giribet 2008; Minelli 2011). Scutigermomorpha is the order of centipede with compound eyes comprised three families, 20 genera and approximately 96 valid species (Stoev & Geoffroy 2004; Minelli 2011). The three families of Scutigermomorpha have non-overlapping distribution while Scutigeraeidae is common in temperate and tropical Asia (Edgecombe & Giribet 2006). Lithobiomorpha is the order with two families, approximately 63 genera comprising more than 1,100 species (Edgecombe & Giribet 2008; Minelli 2011). Scolopendromorpha is the order centipedes with 21 or 23 trunk segments with the same number of paired legs, except *Scolopendropsis duplicate*, having more than 800 valid species (Fusco 2005; Chagas-Junior et al. 2008; Edgecombe & Giribet 2008; Minelli 2020). Geophilomorpha most diverse order at familial level with 13 families having approximately 1,300 valid species (Edgecombe & Giribet 2008; Minelli 2011).

## **2.2 Diversity of Myriapoda in Nepal**

Nepal is rich in Myriapoda fauna. Most of the species of Myriapoda were recorded from mid to Eastern Nepal while Myriapods of western and terai region are undiscovered. Most of the species of Diplopoda are endemic to Nepal while some of them are invasive also but Chilopoda have less number of endemic species. Carl (1935) started a taxonomic work on millipedes while of Nepal with description of two species: *Hingstonia eremita* and *Orthomorpha simulans* from Rongshar Valley. Attems (1936) reported *Kophosphaera excavata* (Butler, 1874). Demange (1961) described two species of *Gonoplectus* Chamberlin, 1921 from Nepal: *G. brôlemanni* and *G. hyatti*. Shear (1979) described new genus *Nepalella* with two species and three species of *Tianella* Attems, 1904. Mauriès (1983a) described 2 species *Trachyiulus wilsonae* and *Podoglyphiulus elegans*. Mauriès (1983b) described *Nepalomatoilus* as subgenus of *Chromatoiulus* with description of 3 species: *Chromatoiulus (Nepalomatoilus) loebli*, *C. smetanai* and *C. deahrvengi*. Golovatch (1986) reported Polydesmidae first time from Nepal with description of four species of *Usbekodesmus* and two species of *Himalodesmus* as well as described two species of *Hingstonia* and four species of *Sholaphilus* within Fuhrmannodesmidae.

Golovatch (1987a) reported family Opisthotretidae first in Nepal, in which he described genus: *Martensodesmus* with description of three species, also described one species of *Usbekodesmus*, five species of *Himalodesmus* and two species of *Hingstonia*. Golovatch (1987b) reported Glomeridae first time with description of five species of *Hyleoglomeris* Verhoeff, 1910. Shear (1987) described four species of *Tianella*, two species of *Nepalella* and one species of *Kashmireuma*. Enghoff (1987) upgraded *Nepalomatoilus* from subgenus to genus with description of 10 species. Mauriès (1988) described 11 new species from Nepal: four species of *Tianella*, one species of *Kashmireuma* and six species of *Nepalella*. Golovatch (1990a) reported 3 species: *Orthomorpha coarctata* Sussure, 1860, *Oxidus gracilis* (C.L. Koch, 1847) and *Paranedyopus cylindricus* (Carl, 1935) first time from Nepal with description of four species of *Paranedyopus* and one species of *Orophosoma*. Golovatch (1990b) described one species of *Himalodesmus*, one species of *Usbekodesmus*, four species of *Hingstonia* and two species of *Sholaphilus*. Golovatch (1992) again recorded *O. coarctata* with description of genus *Martensosoma* with six species and two species of *Armolites*. Golovatch (1993) described one species of *Substrongylosoma*. Golovatch (1994a) described one species of *Armolites*, one species of *Martensosoma* with description of two genus: *Nepalomorpha* and *Parorthomorpha* with description of three and eight species respectively. Golovatch (1994b) described one species of *Touranella* and also described new genus: *Hirtodrepanum* with description one species. Golovatch (1996) described 14 species of *Orophosoma* Jeekel, 1980. Shelly (1996) described genus: *Nepalozonium* with description of one species which was the first record of Polyzooniida; Hirudisomatidae from Central Asia. Golovatch (2000) synonymized *Paranedyopus* Carl, 1932 into *Anoplodesmus* Pocock, 1895 which synonymized six species of Golovatch (1990a).

Korsos (2001) described three species of *Anaulaciulus* and Korsos et al. (2009) described *Hirudicryptus quintumelementum*. Golovatch et al. (2011) transferred *Usbekodesmus* Lohmander, 1933 into *Epanerchodus* Attems, 1901. Golovatch 2013 synonymized Fuhrmannodesmidae into Trichopolydesmidae. Golovatch (2014) synonymized *Nepalomorpha* Golovatch, 1994; *Parorthomorpha* Golovatch, 1994; *Martensosoma* Golovatch, 1992; *Armolites* Golovatch, 1984; *Orophosoma* Jeekel, 1980 into *Delarthrum* Attems, 1936 with description of seven species. Golovatch (2014) also renamed *D. spiniger* (Golovatch, 1992) into *D. spinigerum* (Golovatch 1992) because of homonymy and described genus *Beronodesmus* with description of one species. Golovatch &

VandenSpiengel (2014) described genus *Koponenius* with description of one species from Nepal. Golovatch and VandenSpiengel (2016) again described another species of *Koponenius* Golovatch, 2014. Golovatch (2015) described genus: *Beronodesmoides* close to *Beronodesmus* Golovatch, 2014 with description of three species as well as one species of *Anoplodesmus*, one species of *Kronopolites*, seven species of *Beronodesmus*, and four species of *Delarthrum*. Wesener (2015) re-described *Kophosphaera excavata* (Butler, 1874) with description of two species of *Kophosphaera* and one species of *Zephronia*. Golovatch (2016a) described two species of *Substrongylosoma*, one species of *Pocockina*, one species of *Beronodesmoides*, one species of *Anoplodesmus*. Golovatch (2016b) described two species: *Delarthrumquadridentatum* and *Touranellapilosa* from Nepal. Golovatch (2016c) described three species of *Beronodesmoides* and one species of *Beronodesmus*. Golovatch et al. (2016) described *Beronodesmus martensi* and *B. serratus*. Golovatch (2022) described *Epanerchodus telnovi*. Golovatch 2023 described two species of Dilopoda: *Chondromorpha greke* and *Delarthrum telnovi*.

Shinohara (1965) started the taxonomic work of Chilopoda in the Nepal with description of *Tygarrup nepalensis*. Dobroruka (1979) described a species *Allothereua wilsoni* from Nepal. Eason (1989) described 10 species of Chilopoda: nine of *Lithobius* Leach, 1814 and one of *Australobius* Chamberlin, 1920 of Lithobiidae and new record of one species of *Lithobius*. Lewis (1992) described *Otostigmus martesi* and *Ethmostigmus trigonopodus pygomasoides* with record of another five species of Scolopendridae. Lewis (1999) recorded *Cryptops dora* and described *C. nepalensis*. *Cormocephalus pygmaeus* Lewis, 1992 synonymized to *C. dentipes* Pocock, 1891 and *Otostigmus (O.) glaber* Lewis, 1992 was described as new species: *O. beroni* in Lewis (2001). Khanna (2003) mentioned the presence of *Rhysida longipes longipes* (Newport, 1845) in Nepal. Bonato and Minelli (2004) described *Mecistocephalus silvestrii* from Nepal while describing other species from Indian Peninsula.

### **2.3 Endemism in Myriapoda**

Endemism refers to the ecological phenomenon where a species is native and restricted to a particular geographic region. Endemic species are typically adapted to specific local environmental conditions. Endemism is common in Diplopoda because of their very slow movement, cryptic in their habit, long life cycles and large number of stadia with frequent moults also seen in Chilopoda (Edgecombe & Giribet 2007; Alagesan 2016). Diplopods are endemic to single cave, mountain, valley, island as well as some mountain chains

(Minelli & Golovatch 2001; Golovatch & Kime 2009). One of the example of endemism of Diplopoda in island is *Zehntnerobolus* Wesener, 2009; genus endemic to Madagascar (Wesener 2011). Some of the families of Chilopoda are also endemic to certain continent (Edgecombe & Giribet 2007). Endemism also common in the context of Diplopoda of Nepal because out of 187 nominal species of Diplopoda and 32 species of Chilopoda, 169 and 12 species endemic to Nepal respectively (Korsos et al. 2009; Thapa 2019; Golovatch 2022; Golovatch 2023). The invasive species which are worldwide distribution: *Oxidus gracilis* are transported through human activities, such as transportation of nursery stock and soil (Sierwald & Bond 2007).

### 3. MATERIALS AND METHODS

#### 3.1 Study Area

The Kathmandu Valley occupies an area of 642 km<sup>2</sup> and lies between the latitudes of 27°38'32" N to 27°45'7" N and 85°16'5" E to 85°22'32" E with an average elevation of 1,350 m above sea level. The valley has a sub-tropical climate. It consists of three districts: Kathmandu, Lalitpur, and Bhaktapur, with human settlements, roads, parks, and forest patches. Three forest patches, Nilbarahi Community Forest from Bhaktapur district and Coronation Garden of Tribhuvan University and Ranibari Community Forest from the Kathmandu district were selected for this study (Figure 1).

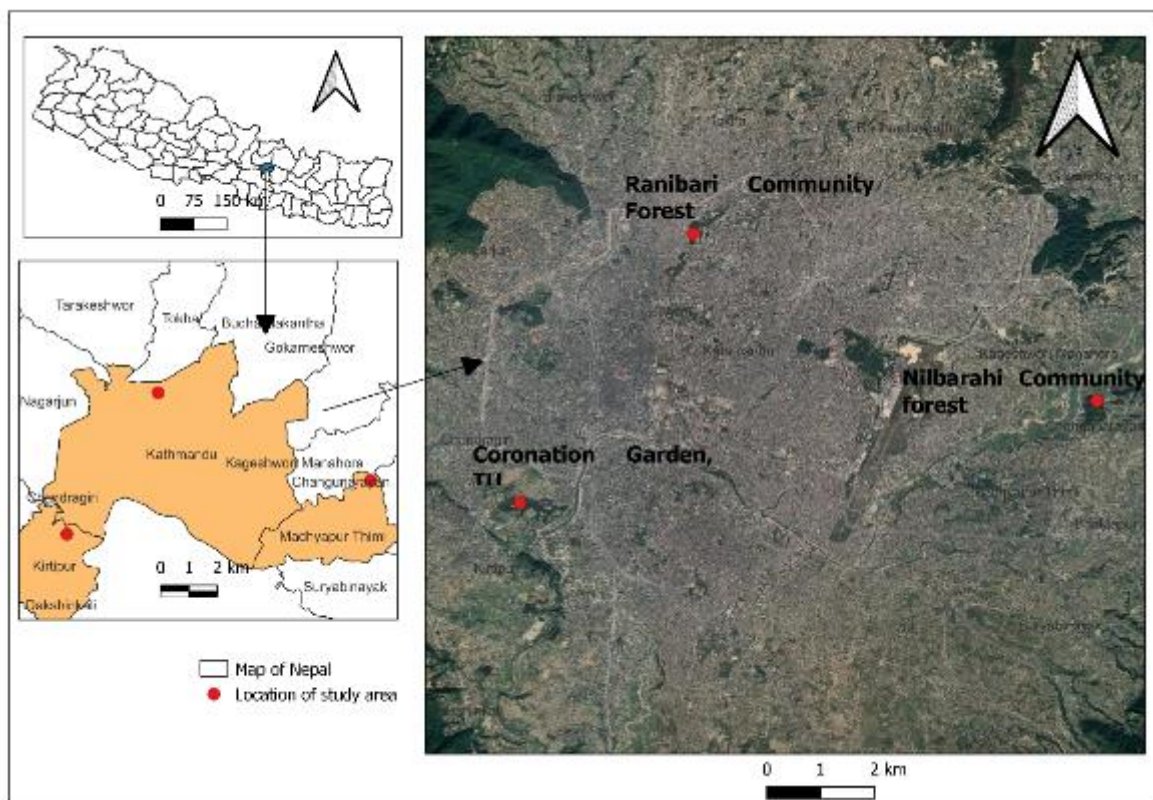


Figure 1. Study Area

**Nilbarahi Community Forest (NCF):** It is a natural forest located East of the Valley in Bhaktapur district situated between latitudes 27°41'43" N to 27°42'01" N and longitudes 85°23'38" E to 85°23'54" E at 1,350–1,400 m altitude with a 217,396 m<sup>2</sup> area. It consists of a mixed type of vegetation dominated by *Pinus species*, *Engelhardia spicata*, *Schima wallichii* and *Myrsina species*. This area is surrounded by human settlements and agricultural land.

**Coronation Garden, Tribhuvan University, Kirtipur (CGTU):** It is afforested land with a semi-natural landscape inside the Tribhuvan University Campus, Kirtipur, located at

between latitudes 27°40'43"N to 27°40'52"N and longitudes 85°17'3"E to 85°17'49"E with a 1,300–1,350 m altitudinal range. The area of 186,100 m<sup>2</sup> have afforested trees: *Eucalyptus camaldulensis*, *Cinnamomum camphora* along with invasive plants *Lantana camera*, *Ageratinum adenophorum*etc.

**Ranibari Park Community Forest (RCF):** It is a natural forest located in the NW part of Kathmandu Metropolitan City between latitudes 27°43'43" N to 27°43'59" N and longitudes 85°19'12" E to 85°19'18" E with a 1,320–1,350 m altitude and a 69,500 m<sup>2</sup> area. This forest consists of mixed types of vegetation with bamboo and trees: *Homaium nepaulense*, *Schima walichii*, *Pinus roxburghii*, *Engelhardia spicata*, *Ziziphus incurve*etc. Surrounded by urban areas.

### 3.2 Sampling Design

There are different sampling techniques for Myriapoda collection: pitfall traps, Berlese-Funnel traps, hand collection, litter sifting, drive transects, nested quadrats (Mesibov et al. 1995; Druce et al. 2004; Snyder et al. 2006; Domingo-Quero & Alonso-Zarazaga 2010). The direct search in the leaf litter was applied to collect myriapod specimens in this study. Two parallel transect of 110 m were set aside at the distance of 10 m. Ten quadrats with 2m × 2m were made in each transect followed by Mbenoun Masse et al. 2018 (Figure 2).

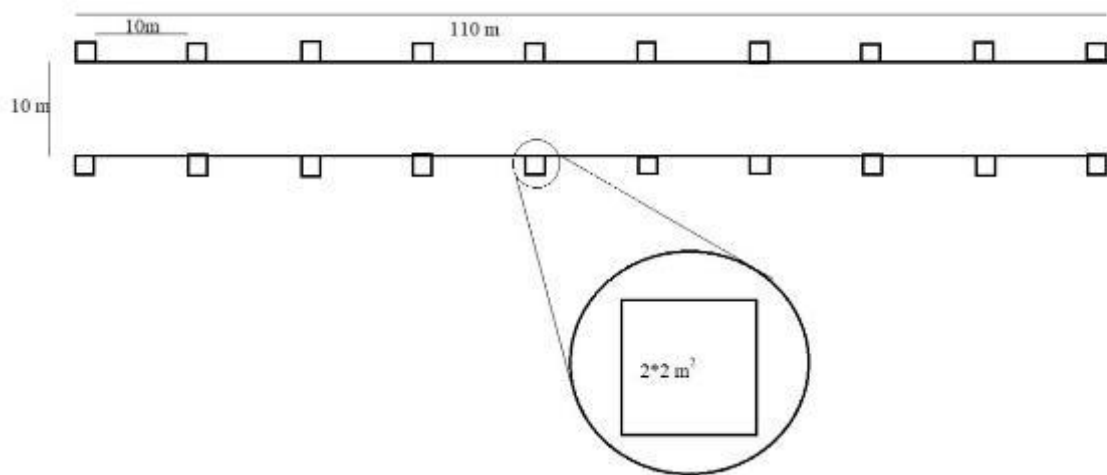


Figure 2. Sampling Design

### 3.3 Sampling Method

Samples were collected by active searching for 10 minutes in each quadrat by three persons from May to December 2022. The litter shifting, search under fallen trunks and branches were applied and visible myriapod individuals were picked up by hand using forceps. All

plot samples collected from each quadrat were kept in separate vial in 90% ethanol with labelling.

### 3.4 Preservation

Collected samples from the field were brought to laboratory of the Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal. The diluted ethanol in the collection was replaced by fresh ethanol within a week of the first collection. After identification all specimens were preserved in 90% ethanol and deposited at Central Department Zoology Museum of Tribhuvan University (CDZMTU), Kathmandu Nepal.

### 3.5 Sorting of Specimens and Identification

Morphospecimens of Diplopoda and Chilopoda were sorted based on the size and morphological characters. Gonopod of Diplopoda was dissected on stereoscope with 45× magnification for the species level identification. Extracted gonopod were photographed by mobile camera (SAMSUNG S5KJN1SQ03) and the image was illustrated by Fino-Camera Lucida. Measurements were done by digital slide callipers. Identification of collected Diplopoda samples was done with the help of Voges (1878), Pocock (1894), Saussure & Zehnter (1901), Chamberlin (1921), Attems (1936), Demange (1961), Hoffman and Burkhalter (1978), Blower (1985), Demange (1986), Golovatch (1992), Shelley & Lehtinen (1999), Pitz & Sierwald (2010), Golovatch (2014), Golovatch and VandenSpiegel (2014), Nguyen et al. (2017). Chilopods were identified by using Peters (1855), Wood (1862), Kraepelin (1903), Lewis (1999), Fusco (2005), Edgecombe & Giribet (2006), Barber (2011), Cupul-Magaña & Flores-Guerrero (2016), Dyachkov (2020), Joshi et al. (2020), Minelli (2020), and Schileyko et al. (2020). Terminologies were followed by Bonato et al. (2010). The gonopod terminologies used in this work are (Attems 1936; Demange 1961; Demange 1986; Pimvichai et al. 2009) (Table 1).

Table 1. Terminologies to describe *Gonoplectus*

ac = anterior coxal fold: the main part of gonopod in anterior view	ap = additional process
alp = lateral process of anterior coxal fold, distolateral part	as = additional spine
amp = mesal process of anterior coxal fold: projection of ac, protruding from its mesal margin	pc = posterior coxal fold

rl = rounded lappet	plp = lateral process of posterior coxal fold
rlb = rounded lobe	pmp = mesal process of posterior coxal fold
ub = unmodified blepharochaete	px = paracoxite, basal part of posterior coxal fold
fe = femoral spine	st = sternite
pb = prostatic branch	sb = seminal branch
sg = seminal groove	

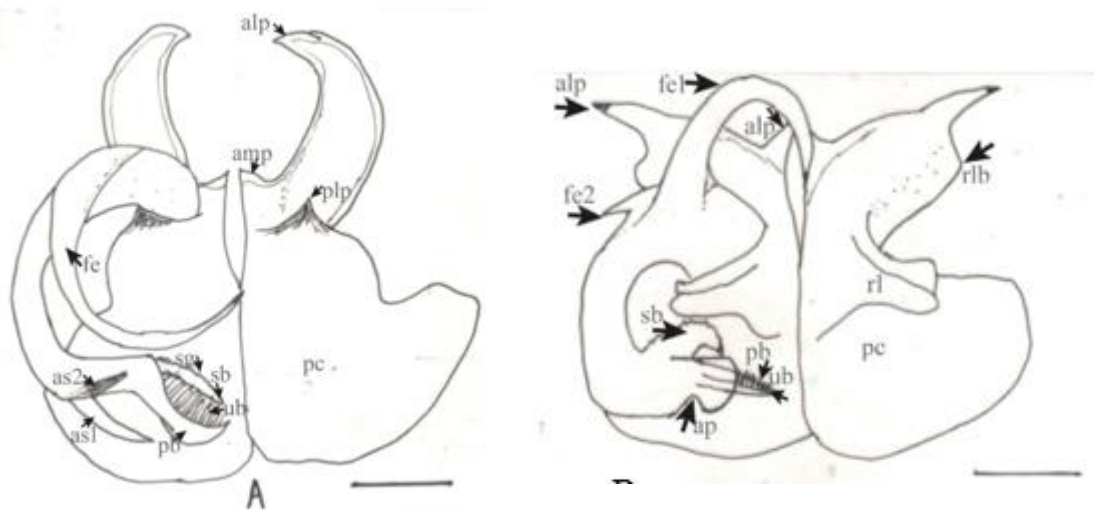


Figure 3. Anal view of gonopod showing terminologies. A. *Gonoplectus ranibariensis* sp. nov. B. *Gonoplectus nibarahiensis* sp. nov.

### 3.6 Data Analysis

Data of all sites were tabulated in Microsoft Excel. Shannon-Weiner Diversity Index and Shannon-Weiner Evenness Index were calculated. Taxonomic descriptions of the new species as well as diagnostic characters of all identified millipedes and centipedes were done. Distribution range for all species was provided.

## 4. RESULTS

### 4.1 Systematics and Taxonomic description

Order: Spirobolida

Suborder: Trigoniulidea Attems, 1910

Family: Pachybolidae Cook, 1897

Subfamily: Trigoniulinae Attems, 1909

Genus: *Trigoniulus* Pocock, 1894

Type species: *Spirobolus goesi* Porat, 1876 = *Trigoniulus corralinus* (Eydoux and Souleyet, 1842)

Type Locality: St. Bartholomew (England, United Kingdom) (Pocock 1894, Porat 1894)

Diagnosis: uniform or brick-red colour, laterally narrowed collum, and network of crescentic or sub-circular striae (Pocock 1894; Shelley & Lehtinen 1999).

*Trigoniulus corralinus* (Eydoux and Souleyet, 1842)

Figure. 4, 5

Material Examined: 2 ♂, CDMTZU-DipL105, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal, leaf litter, June 1, 2022; leg. Lokendra Chand.

Diagnostic features: Male with 50mm long and mid-body segment 3.22 mm wide. podous rings 50, apodous ring absent, and legs 93 pairs, head, antenna, legs, and anal portion greyish. Eyes black, 40 ocelli in each eye, collum pointed, metazonite reddish brown, and prozonite light black, metazonite smooth dorsally and prozonite punctate and striated, 6-8 ring segments expanded in males, ozopore begins from the 6<sup>th</sup> segment. Preanal segment (epiproct) blunt and leathery, anal segment with black margin. Gonopod: Anterior gonopod with coxae, separated by V-shaped subtriangular sternite. Coxae wider anteriorly, coxae of the posterior gonopod joined by sternite; tip curved mesad.

Remarks: There is no cut at median sternite projection (Saussure & Zehnter 1901) and indented (Shelley & Lehtinen 1999).

Distribution: *T. corallinus* is native to Southeast Asia that was later introduced to Africa, Central and South America, and tropical islands throughout the world (Shelley & Lehtinen 1999). This species was reported from India as *Trigoniulus goesi*, *T. lumbricinus* (Golovatch & Wesener 2016). It is the first report from Nepal.



Figure 4. A. *Trigoniulus corralinus* (Eydoux and Souleyet, 1842), ♂, paratype. B. anterior body, lateral view. C. anal segments, ventral view. Scale=1 mm

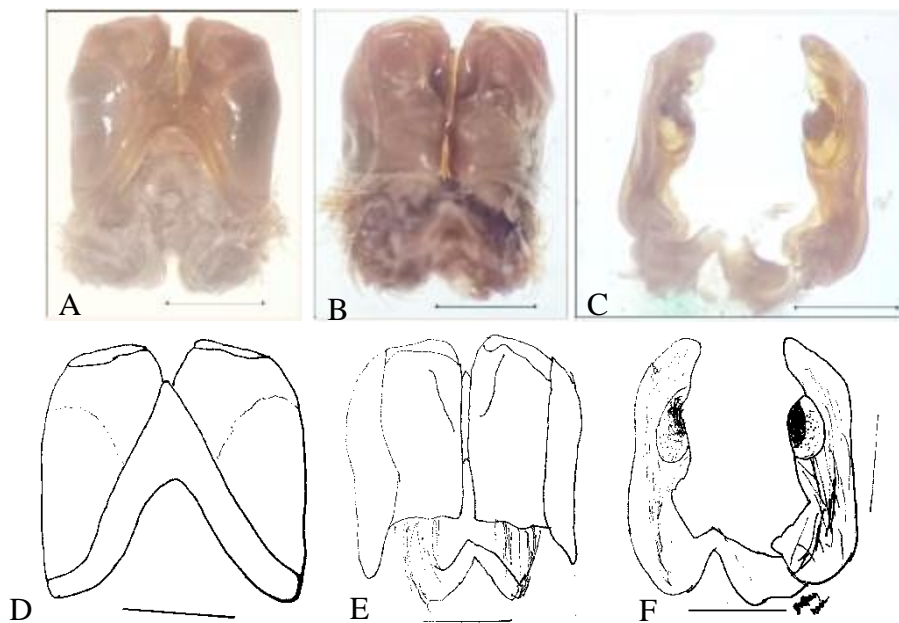


Figure 5. *Trigoniulus corralinus* (Eydoux and Souleyet, 1842), ♂ gonopod; A and D. gonopod, oral view B & E. gonopod, anal view; C & E. teleopodite, anal view, scale =1mm

Order: Polydesmida

Suborder: Strongylosomatidea

Family: Paradoxosomatidae Daddy, 1889

Subfamily: Alogolykinae Hoffman, 1962

Tribe: Polydrepani Jeekel, 1968

Genus: *Delarthrum* Attems, 1936

Type species: *Delarthrum obscurum* Attems, 1936

Type Locality: Chhangla Gali, Abbotabad district, Punjab, Pakistan (Attems 1936)

Diagnosis: 20 segments, paraterga weak to strong, setose in metaterga is rare, gonopod coxa sub cylindrical and longer as femorite, coxa possess setose distolaterally, short prefemural portion with setose, slender femorite, two processes, twisted solenophore and free solenomere (Attems 1936; Golovatch 2014).

*Delarthrum elegans* (Golovatch, 1992)

Figure.6

Materials Examined: 2 ♂, CDMTZU-DipL105, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal, leaf litter, June 1 2022; leg. Lokendra Chand.



Figure 6. A. *Delarthrum elegans* (Golovatch, 1992), ♂ (no scale). B. left gonopod, lateral view. C & D. left gonopod, mesal view. E. mid-body metazonite, lateral view. F. lamina between coxae. G. leg of first pair. Scale=1 mm

Diagnostic features: 23–25 mm, colour pale brown, metazonite with a darker brown margin; antenna clavate, long and slender, reaching to the 3<sup>rd</sup> segment, 1/3 of the 6<sup>th</sup> and 7<sup>th</sup> antennomere blackish brown, and the tip of the 7<sup>th</sup> antennomere is creamy, collum narrowed laterally, with a few long and thin hair-like structures; the width of the collum = segment after the 4<sup>th</sup>, the width of the head = 1<sup>st</sup> to 3<sup>rd</sup> segment, deep suture between prozonite and metazonite, transverse sulcus on metatergite starts from the 5<sup>th</sup> segment, epiproct from a tail-like structure with a few long, thin hairs directed posteriorly, and paraproct with a convex margin also has 2-3 pairs of hair, slender and long legs. Sternite of 1<sup>st</sup> pair of legs with lamina with small hairs. 2<sup>nd</sup> to 4<sup>th</sup> segments with one pair of leg, 7<sup>th</sup> with one pair of gonopod and legs, 5<sup>th</sup>, 6<sup>th</sup> and after 8<sup>th</sup> segments with two pairs of legs. Gonopod with long and slender with typical coxite and prefumer, coxite sub-cylindrical, setose at the distal end, directed backwards, prefumeral portion with setose, femorite slender directed to the oral side of the body, distal part enlarged, tibiotarsus separated by transverse sulcus, solenophore is bigger than solenomerite, apically tooth shaped, solenomerite simple.

Distribution: *D. elegans* is the endemic species to Nepal, was described from Kathmandu city and its surrounding hills (Golovatch 1992).

Genus: *Oxidus* Cook, 1911

Type species: *Fontaria gracilis* Koch C.L., 1847

Type locality: Vaterland, Puloloz \*locality in former Czechoslovakia or in Ostindien

Diagnosis: Well-developed paratergite, 1 or 2 rows of setae on metazonite, legs without tarsal brushes, and a 5<sup>th</sup> sternum with no modifications (Bolwer 1985; Nguyen et al. 2017).

*Oxidus gracilis* (C.L. Koch, 1847)

Figure. 7

Material Examined: 2 ♀, CDMTZU-DipL106, Coronation Garden, Tribhuvan University (27°40'48"N 85°17'18"E), Kathmandu, Bagmati, Nepal, shifted litter, May 31, 2022; Lokendra Chand.

Diagnostic features: length 25mm, tergite of metazonite dark brown without setae, lateral margin (paranota) of metazonite yellow, sternite, prozonite, antenna and legs yellowish, antenna reaching to the 2<sup>nd</sup> segment, transverse sulcus present after the 5<sup>th</sup> segment.



Figure 7. *Oxidus gracilis*, ♀. No scale

Remarks: Only two ♀ specimens were collected from the study area. Based on the external morphology, this specimen is identified as *Oxidus gracilis* (Bolwer 1985; Nguyen et al. 2017).

Distribution: *Oxidus gracilis* is found all over the world, primarily in warm temperate regions (Nguyen et al. 2017). In Nepal, Golovatch (1990b) reported this specimen from Ganabahal, Kathmandu Valley, Pokhara of Kaski district, and Trisuli Village of Rasuwa district.

Family: Haplodesmidae Golovatch et al. 2009

Genus: *Koponenius* Golovatch & Vandenspiegel, 2014

Type species: *Koponenius unicornis* Golovatch and Vandenspiegel, 2014

Type Locality: India, West Bengal, Darjeeling District, Kalimpong (Gandhi Ashram) (Golovatch & Vandenspiegel, 2015)

Diagnosis: sub-cylindrical body segment, dorsum convex with 19 segments in the body, and a special ozopore formula (5, 7–18) (Golovatch & Vandenspiegel 2014).

*Koponenius biramus* Golovatch and Vandenspiegel, 2014

Figure. 8

Material Examined: 1 ♂, CDMTZU-DipL107, Nilbarahi Community Forest (27°41'57"N, 85°23'48"E), Bhaktpur, Bagmati, Nepal, shifted litter, June 2, 2022; leg. Lokendra Chand. Diagnostic features: length 11 mm, width 2mm. 19 segments and ozopores in 5<sup>th</sup> and 7<sup>th</sup> to 18<sup>th</sup> segments, collum and metaterga with dense, dull and microvillose ceratogenous crusts, collum cover head from above, antenna clavate, placed into a deep C-shaped groove.

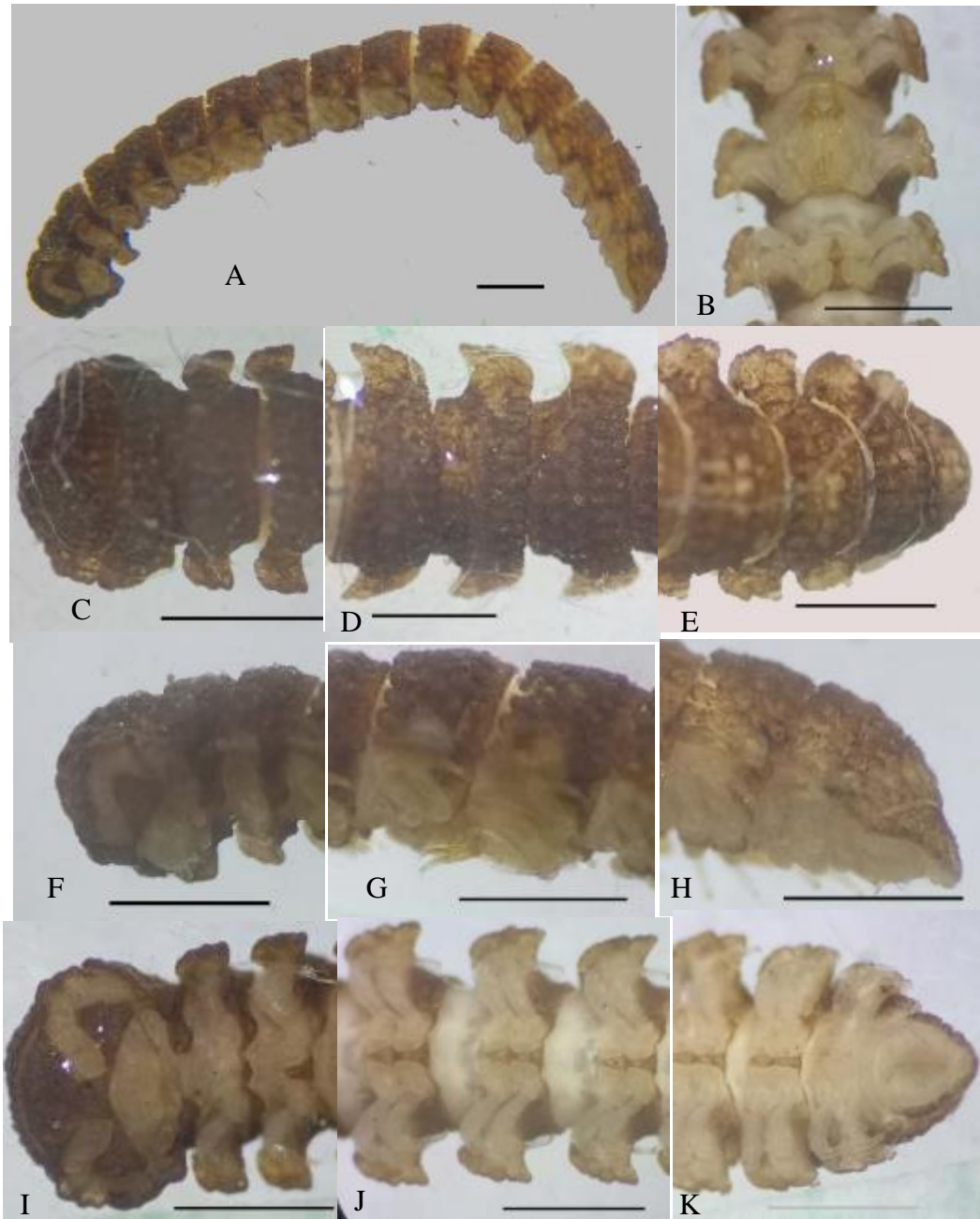


Figure 8. A. *Koponenius biramus*, ♂. B. body segments with gonopod, ventral view. C, F & I. anterior body part, dorsal, lateral, ventral and ventral views respectively. D, G & J: mid-body segments, dorsal, lateral and ventral views respectively. E, H & K. posterior body part, dorsal, lateral and ventral views respectively. Scale = 1 mm

Collum wider than head, 3<sup>rd</sup> and 4<sup>th</sup> segments are equal in width while 2<sup>nd</sup> is equal to the after 4<sup>th</sup> to 16<sup>th</sup> and after that tapering to the end. Short and stout Legs with dense setose, gonopod with large and subcylindrical coxae, teleopodite elongated, acropodite with subflagellum solenomere, and a slender and long process.

Distribution: This species is endemic to Nepal, reported and described from Godawari, Lalitpur district, inside the Kathmandu Valley (Golovatch & VandenSpiegel 2014).

Class: Chilopoda

Subclass: Pleurostigmophora Pocock, 1902

Family: Scolopendridae Leach, 1814

Subfamily: Otostigminae Kraepelin, 1903

Genus: *Rhysida* Wood, 1862

Type species: *Rhysida lithobioides* (Newport, 1845) = *Branchiostoma lithobioides* Newport, 1845

Type locality: China (Newport, 1845)

Diagnosis: 10 pairs of spiracles (segments 3, 5, 7, 8, 10, 12, 14, 16, 18, 20), spiracle in the 7<sup>th</sup> segment, 17–21 antennal articles with 3 basal articles glabrous (Joshi et al. 2020; Kraepelin 1903).

*Rhysida afra* (Peters, 1855)

Figure. 9

Material examined: 1 ♂, CDMTZU-ChiL101, Nilbarahi Community Forest (27°41'57"N, 85°23'48"E), Bhaktpur, Bagmati, Nepal, shifted litter, September 31, 2022; 1 ♂, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal, shifted litter, June 1, 2022; leg. Lokendra Chand.

Diagnostic features: Length 44 mm, 18 antennal articles, basal three articles are glabrous dorsally, cephalic plate is dark brown and T1-T21 smooth; colour bluish green ; sternite creamy colour, antennae bluish green; coxa and terminal segments of legs creamy but the middle parts are bluish green. Longitudinal median furrow on 10% of the anterior cephalic plate, each forpicular coxosternal tooth plate longer than wider with four main teeth. Base of the tooth plate forming 120° angle sutures. T21 is marginated. Tergite of the ultimate leg-bearing segment wider than longer, and coxopleuron 1.2 times longer than sternite of the ultimate leg-bearing segment, coxopleural process has 2 apical and 1 subapical spine, ultimate leg contains prefemur, femur, tibia, tarsus and pretarsus. Prefemural spinal

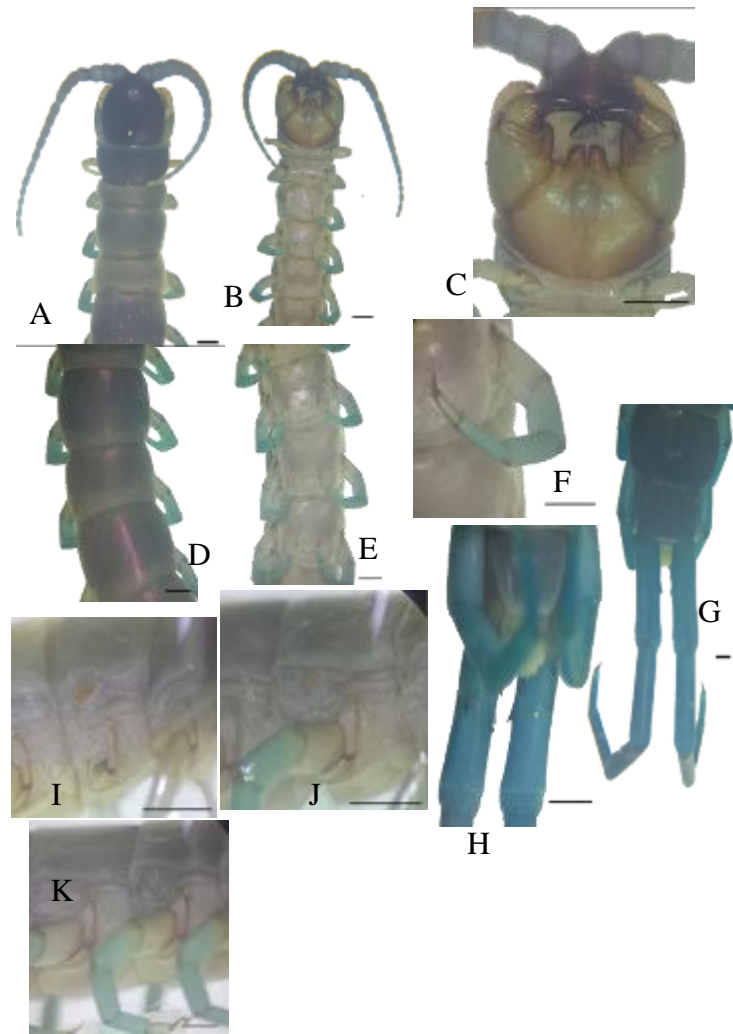


Figure 9. *Rhysida afra* (Peters, 1855), ♂. A. anterior body, dorsal view. B. anterior body, ventral view. C. mouthparts. D. middle body segments, dorsal view. E. middle body segments, ventral view. F. leg at middle segment. G. anal region, posterior view. H. anal region, ventral view. I. spiracle at 3rd segment. J. spiracle at 5th segment. K. spiracle at 7th and 8th segment. Scale=1 mm

formula: VL2, VM1 DM1, two tarsal spur from 1<sup>st</sup> to last segment, two tibial spur from 1<sup>st</sup> to 19<sup>th</sup> and 1 in 20<sup>th</sup> and 21<sup>th</sup>. 1 spur in post femur from 1<sup>st</sup> to 7<sup>th</sup> and femoral spur in 1<sup>st</sup> pair of leg. Among 10 spiracles, the 1<sup>st</sup> on the third segment was mu-shaped and the rest were rounded or oval.

Distribution: This species is distributed in Africa and tropical Asia (Peters 1855, Kraepelin 1903, Lewis 2001). Lewis (1992) and Lewis (2001) reported *R. afra* from Nepal.

*Rhysida trispinosa* Jangi & Dass, 1984

Figure. 10

Material examined: 1 ♂, CDMTZU-ChiL102, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal, on bark of log, September 31, 2022; L. Chand. Diagnostic features: length 62mm, 20 antennal articles, basal three articles are glabrous dorsally, two completely ventrally; 75% of the 3rd ventral segment smooth; and remaining with setae, cephalic plate, and T1 are smooth, red-brown, and T2 to T21 are brown, legs light yellow. Longitudinal median furrow on 10% of the anterior cephalic plate. Forpicular coxosternal tooth plate wider than longer with four main teeth, base of the tooth plate

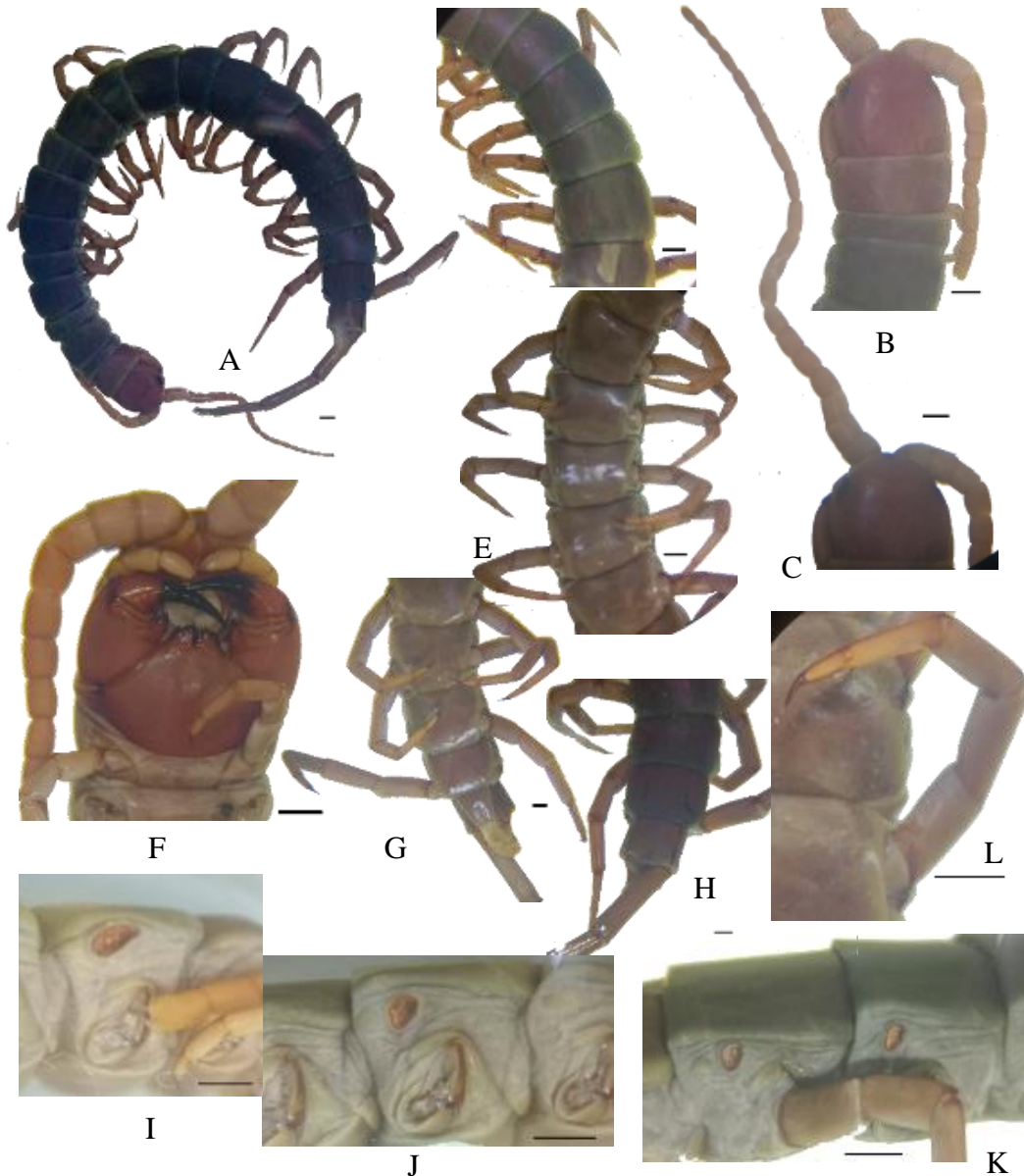


Figure 10. A. *Rhyssida trispinosa* Jangi & Dass, 1984, ♂. B. head, dorsal view. C. left antenna. D. mid-body segments, dorsal view. E. middle body segments, ventral view. F. mouthparts. G. anal region, ventral view. H. anal region, posterior view. I. spiracles at 3<sup>rd</sup> segment. J. spiracle at 5<sup>th</sup> segment. K. spiracles at 7<sup>th</sup> and 8<sup>th</sup> segments. L. Leg at mid-body segment. Scale =1mm

forming a 120 degree suture. T21 marginated. The tergite of the ultimate leg-bearing segment wider than long a little bit. Sternite of the ultimate leg-bearing segment with convex lateral, coxopleuron 1.7 times of longer than sternite of ultimate leg bearing segment, coxopleural process with 2 apical and 1 subapical spine. The ultimate leg contains the pre-femur, femur, tibia, tarsus, and pretarsus. Prefemoral spinal formula: VL0, VM1, and DM0. 2 tarsal spurs: 1<sup>st</sup> to 18<sup>th</sup> pair, and 1 tarsal spur for the 19<sup>th</sup> and 20<sup>th</sup> pairs of legs.

Distribution: Joshi et al. (2020) mentioned that this species was described from Pune, Maharashtra which is widely distributed in peninsular India.

Remarks: All characters are compared to *Rhysida trispinosa* Jangi & Dass, 1984 described in Joshi et al. (2020) seems to similar except the pre-femoral spinal formula.

Family: Cryptopidae Kohlrausch, 1881

Subfamily: Cryptopinae

Genus: *Cryptops* Leach 1814

Type species: *Scolopendra hortensis* Donovan, 1810 = *Cryptops hortensis* (Donovan, 1810)

Type Locality: Exeter (United Kingdom) (Leach, 1816).

Diagnosis: 21 body segments, conical setaceous antenna with 17 antennomere, absence of eyes, toothy lip, basal leg articles are unarmed, lateral anal appendages obtuse (Leach 1816, Wood 1862, Lewis 1999, Lewis 2009).

*Cryptops doriae* Pocock 1891

Figure.11

Material examined: 1 ♂, CDMTZU-ChiL103 Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal, on log, 31.Sep.2022; leg. Lokendra Chand.

Diagnostic features: length 16 mm, 21 pairs of legs, brownish yellow colour, 17 articles on left antenna and 16 articles on right antenna, articles 1<sup>st</sup> and 2<sup>nd</sup> with long setae 3<sup>rd</sup> with long and short setae and all other articles with short setae. Head plate covered by T1 at posterior, anterior margin of forpicular coxosternite with setae, 1 setae at clypeal plate, T1 to T2 without suture, T3 to T6 with incomplete suture posteriorly, T7 to T21 complete suture, Legs with setae, tarsi of leg not divided.



Figure 12. A & B. *Cryptops doriae* Pocock 1891, ♂, dorsal and ventral view respectively. C. Anterior body, ventral view. D. Anterior body parts, dorsal view. E. anal parts, ventral view. Scale =1mm. E =no scale

Distribution: Seychelles, Cambodia, Nepal, Myanmar, India, Laos, Indonesia (Java), Vietnam, Malasiya and Papua New Guinea, Introduced to Great Britain (Lewis 1999, Schileyko et al. 2020, Dyachkov 2020).



Figure 11. *Scutigera coleptra* (Linnaeus, 1758), ♂

Subclass: Notostigmophora

Order: Scutigermorpha Pocock, 1895

Family: Scutigerae Leach, 1814

Subfamily: Scutigerae Leach, 1814

Genus: *Scutigera* Lamarck, 1801

Type species: *Scutigera coleoptrata* (Linnaeus, 1758)

Type specimen: Hifpania (Portugal and Spain)

Diagnosis: Antennae setaceous, multi-articulated, often very long. Two grating eyes. Four palps, Body elongated and scaly.

*Scutigera coleoptara* (Linnaeus, 1758)

Figure. 12

Material examined: 1 ♀, CDMTZU-ChiL104, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal, shifted litter, 31.Sep.2022; Lokendra Chand.

Diagnostic features: body length 25mm, width 5mm. Antenna with many segments, antennomere are wider than longer, suture is present between eye and antenna, Transverse suture is deep. 7 tergites fusing 15 body segments, coxa with a ventral spine, prefemur, femur and tibia with longitudinal row of teeth with 3 long spines at end, two tarsal segments with multiple joints, a pair of spine-bristle at the end of first tarsal segment.

Distribution: *Scutigera coleoptera* is the common house centipede, found throughout the world: Europe, Asia, Africa, North America, and South America, mostly near human settlements (Stoev and Geoffroy 2004).

Order: Spirostreptida Brandt, 1833

Suborder: Spirostreptidea Brandt, 1833

Family: Harpagophoridae Attems, 1909

Subfamily: Harpagophorinae Attems, 1909

Tribe: Gonoplectini Hoffman, 1980

Genus: *Gonoplectus* Chamberlin, 1921

Type species: *Gonoplectus carteloni* Chamberlin, 1921= *Gonoplectus malayus* (Carl, 1909)

Type locality: Northern India (Chamberlin, 1921)

**Diagnosis:** The genus *Gonoplectus* was diagnosed based on the absence of setae on the distal plate of the posterior gonopod, gonocoel open laterally, posterior gonopod curving ectad and then promixad. Ozopores starts from the 6<sup>th</sup> segment near the suture. Prozonites

with transverse striations, metazonite smooth dorsally, longitudinal striae below the ozopore, spiracle pits 2 times longer than wider, 4<sup>th</sup> and 5<sup>th</sup> joints of legs with pads, tail pointed either straight or upcurled (Chamberlin 1921). Free sternite and gonopod with a spineless seminal branch, completely separated from a second pectinate branch (Demange 1961).

*Gonoplectus ranibariensis* sp. nov.

Figure. 13-15

Material examined: Holotype: 1 ♂, CDZMTU-DipL101, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal; leaf litter; June 1 2022; leg. Lokendra Chand.

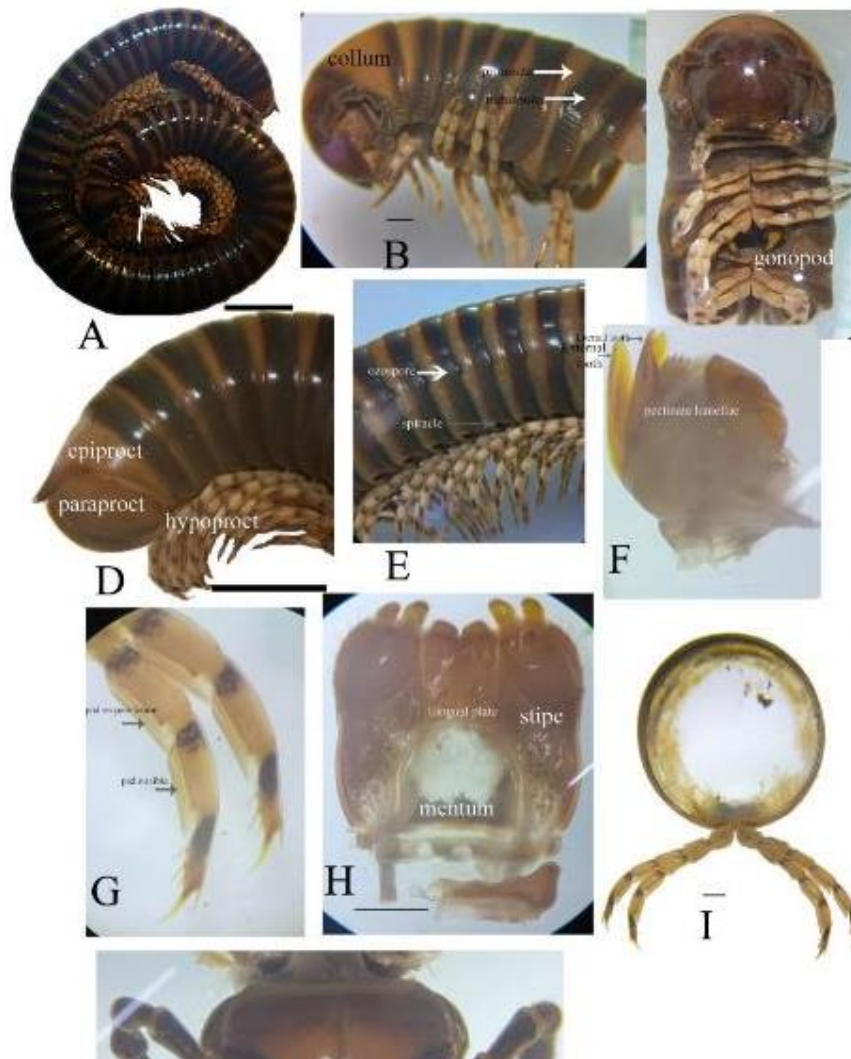


Figure 13. A. *Gonoplectus ranibariensis* sp. nov., ♂, holotype, B-J=paratype, ♂, B. lateral view of anterior body. C. ventral view of anterior body. D. lateral view of anal segments. E. mid-body segments with leg pairs. F. mandible. G. last 3 segments of legs with tarsal spur. H. Gnathochilarium. I. Mid-body segments with leg pair. J: head, frontal view. Scale=1 mm.

Paratypes: 2 ♂, CDZMTU-DipL102, same as the type locality.

Description: Adult males with 56–58 segments, legs 105–109 pairs, length 121–132 mm, diameter 7.3–7.8 mm, apodous ring absent. Head brown, antenna brown black, collum yellowish with black band anterior and posterior side at side and yellow at middle with red brown margin, metazonite black brown with red brown margin, and prozonite yellow. Legs are creamy white segments with black proximal ends. epiprocts, paraprocts, and hypoprocts are yellowish brown.

Head surface smooth; No setae. Ocelli, seven rows. 13-12-11-9-7-6-2 (right ocelli). The length between eyes greater than length of the eye. Occipital furrow visible. Antenna with seven antennomers, comparative length 2>3>4>5>6>1>7, setae present.

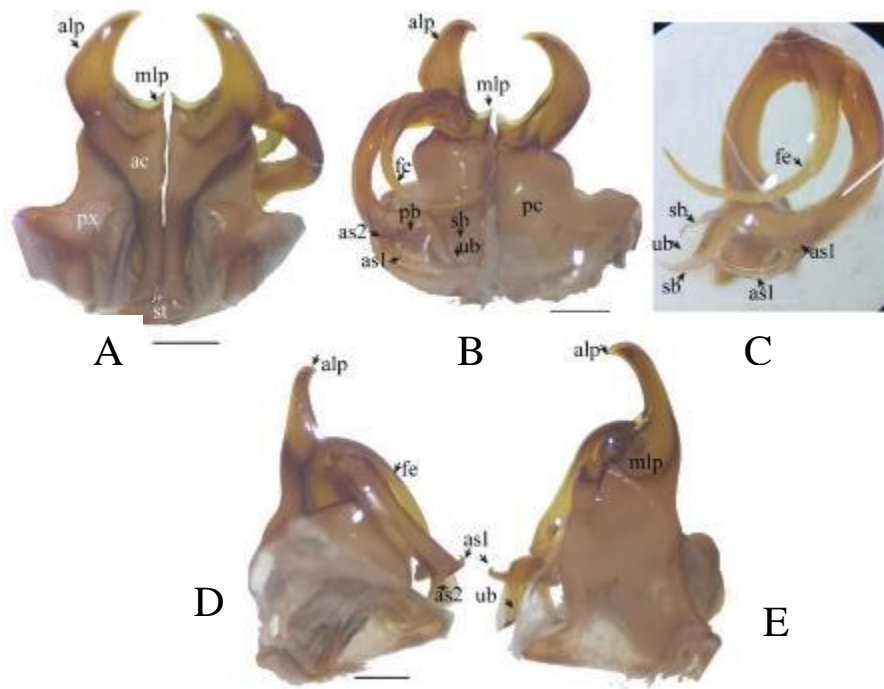


Figure 14. *Gonoplectus ranibariensis* sp. nov., ♂, paratype, gonopod. A. gonopod, oral view; B. gonopod, anal view. C: left teleopodite. D. gonopod, mesal view. E. gonopod, lateral view. Scale = 1 mm

Gnathochilarium: anterior part of stipes swollen containing a distinct seta with a swollen rounded socket (peg-like structure) with 5-8 spines distolaterally. The posterior part of the stipes consists of nearly 20 setae, comparatively smaller than the seta present on the anterior lobe. Two rounded protruberance present distally at the stipes. The lingual plate consists of

2 long setae at the distal part, 1 spine nearly in the middle, and 7-8 spines at the posterior part. Mentum smooth.

Mandible: external tooth comparatively longer than internal tooth, 8 rows of pectinate lamellae.

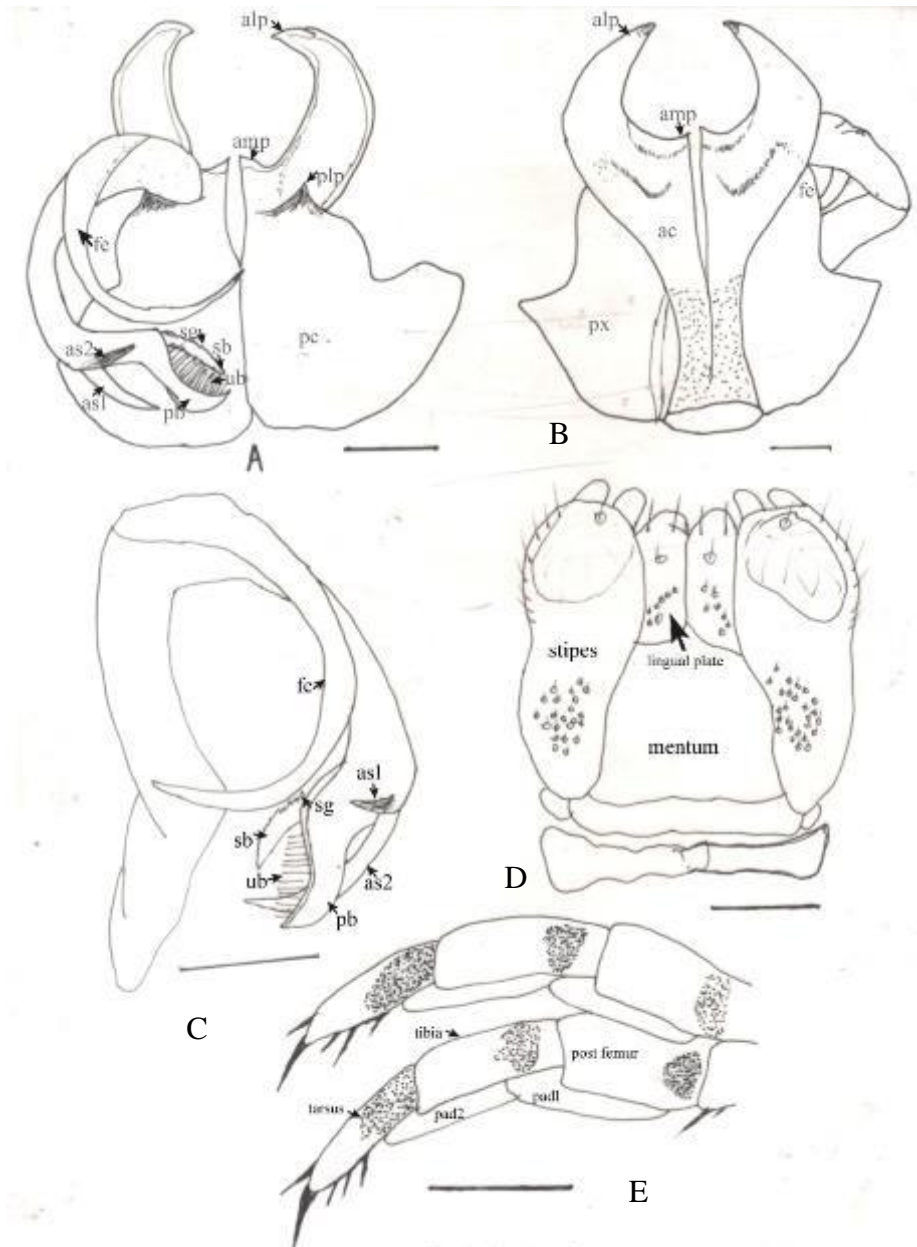


Figure 15. *Gonoplectus ranibariensis* sp. nov., ♂, paratype, gonopod. A. gonopod, anal view. B. gonopod, oral view: C: left teleopodite. D. gnathochilarium. E. last 3 segments of legs of mid-body. Scale=1 mm

Collum: broad at middle, narrowing towards ends; dorsally shiny and punctate; anterior end is acute; posterior angle is obtuse; marginal swelling at anterior. Five longitudinal furrows on the lateral side (ending parts of the collum).

Body rings: segments 56–58, the first collum, 2<sup>nd</sup>–4<sup>th</sup> segment with 1 pair of legs; gonopod at 7<sup>th</sup> segment, others segments with 2 pairs of legs; apodous ring absent. Ozopore starts from 6<sup>th</sup> segment, prozonite smooth and shiny, metazonite smooth posteriorly, longitudinally striate below the ozospore. Epiproct (anal segment) tapering with a straight tail, convex paraproct with swollen lips, and triangular hypoproct

Legs: Creamy yellow segments with black patches proximally. More than 50 % of tarsus with black patches. After the third pair of legs, the pad is present in the post femur and tibia until the last pair of legs. Tarsus with five setae; at the end of the coxa, pre-femur, and femur with one seta.

Gonopod: (Figure. 14, 15) sternite oval, Anterior coxal fold: lateral process curved, base broad, tapering towards end, mesal process comparatively smaller than lateral process, directed mesad. Posterior coxal fold: basally with paracoxite, small lateral process present, directed distad, mesal process not seen; Teleopodite: long, with a great curvature in the right angle, femoral spine at knee, curved semicircle, downwards to paracoxite mesad, regular pointed to the tip, seminal branch with seminal groove, prostatic groove with >15 unmodified blepharocheate, 2 spine like processes are present, smaller one is blackish, and another is similar to teleopodite colour but larger.

**Etymology:** The species name is given after the type locality Ranibari.

**Comparison:** The morphology of gonopod of *Gonoplectus ranibariensis* sp. nov. is compared with *Gonoplectus hyatti* Demange, 1961 reported from Tilhar, SW of Pokhara, Nepal. The lateral process of the anterior coxal fold has a paddle-like structure and the mesal process contains denticulation in *G. hyatti*, while in *G. ranibariensis* sp. nov., the lateral process is sickle-shaped and the mesal process is pointed (Figure. 10, 11). Both species have pads in the post-femur and tibia after the 3<sup>rd</sup> pair of legs, but in *G. hyatti*, the last 8–10 leg pairs have only one pad, while in *G. ranibariensis* sp. nov., all the legs after the 3<sup>rd</sup> pair contain pads in the post-femur and tibia to the last.

*Gonoplectus nibarahiensis* sp. nov.

Figure.16-18

Holotype: 1 ♂, CDZMTU-DipL103, Nilbarahi Community Forest (27°41'57"N, 85°23'48"E), Bhaktapur, Bagmati, Nepal; shifted litter; June 2, 2022; leg. L. Chand.

Paratype: 2 ♂; CDMTZU-DipL104, same as the type locality; 1. June 2022, Ranibari Community Forest (27°43'51"N, 85°19'15"E), Kathmandu, Bagmati, Nepal; leg. Lokendra Chand.

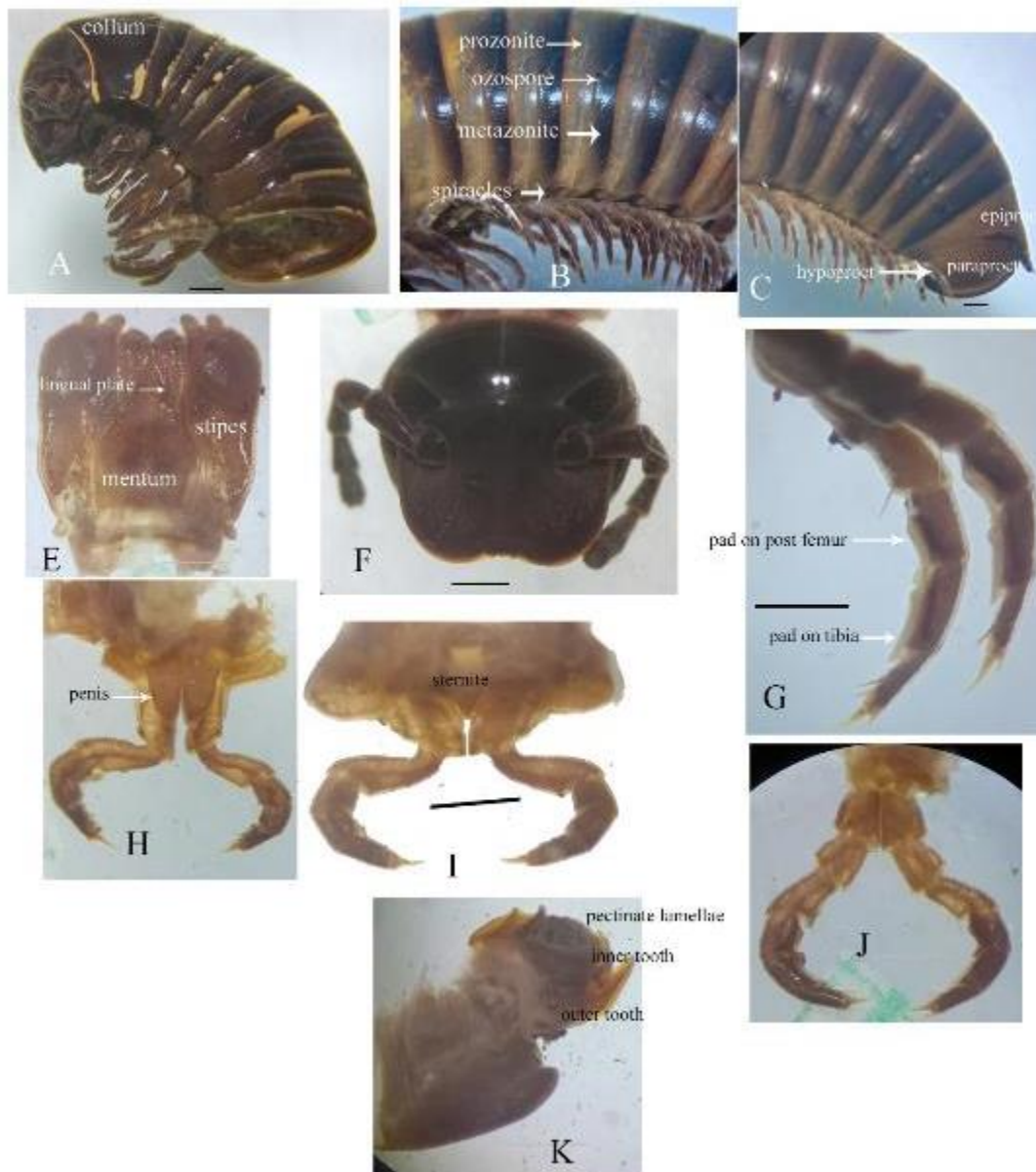


Figure 16. *Gonoplectus nilbarahiensis* sp. nov., ♂, paratype. A. lateral view of anterior body. B. mid-body segments with leg pairs. C. lateral view of anal segments. E. Gnathochilarium. F. head, frontal view. G. legs from mid-body with pad. H. 2<sup>nd</sup> pair of legs. I. 1<sup>st</sup> pair of legs. J. 3<sup>rd</sup> pair of legs. K. mandible. Scale-1 mm

Description: Adult males with 60 segments, 113 pairs of legs, length 91–113 mm, diameter 6.49–6.77 mm, absence of apodous rings, gonopod at the 7<sup>th</sup> body rings of the male.

Colour: head, antenna brown, collum brown black, metazonote black brown with red brown margin, prozonite yellow, legs brown, epiproct, paraproct, and hypoproct yellowish brown, edge of paraproct brown black.

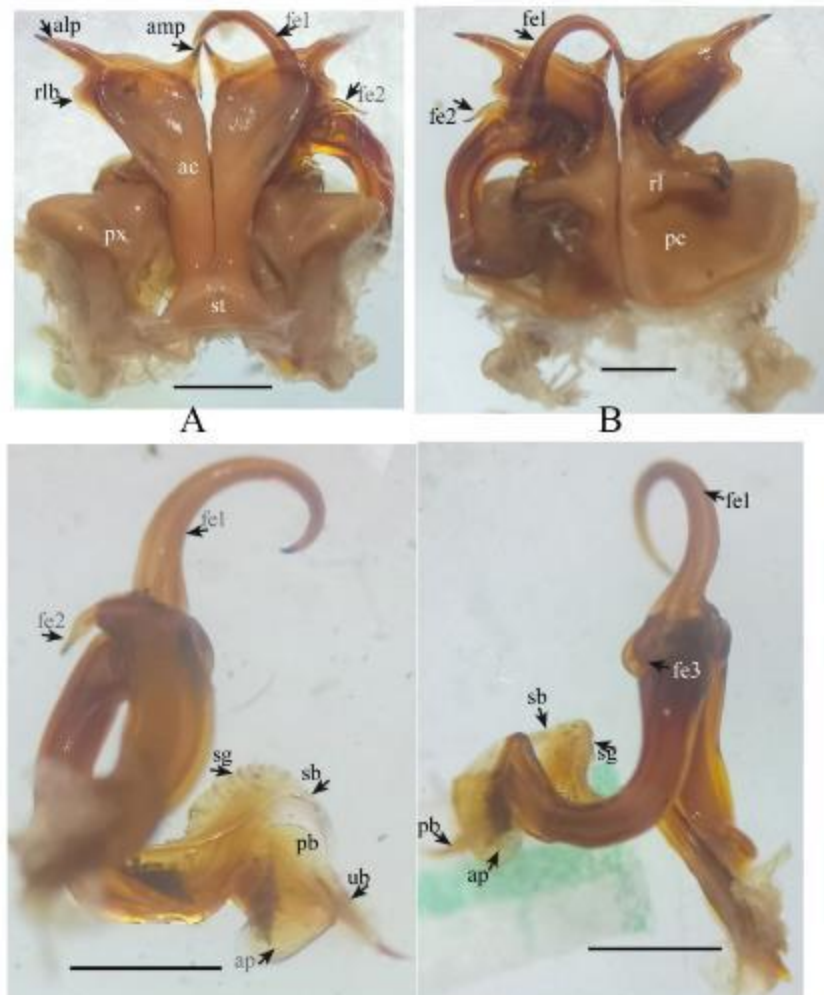


Figure 17. *Gonoplectus nibarahinensis* sp. nov. A. gonopod, oral view: B: gonopod, anal view. C and D. teleopodite, anterolateral and lateral view. Scale-1mm

Head: smooth surface, occipital furrow visible, the surface covered by the collum has a longitudinal furrow differentiated by suture. Ocelli: 7 rows. 13-12-11-9-9-8-2(left eye).

Antenna: 7 antennomers, comparative length 2>3>4>5>6>1>7. Setae present.

Gnathochilarium: anterior part of stipes with a swollen lobe containing a distinct seta with a swollen rounded socket (peg-like structure) with 5-8 spines present distolaterally. The posterior part of the stipes consists of nearly 25 setae, comparatively smaller than the seta present on the swollen anterior lobe. Two rounded protruberance present distally at the

stipes. The lingual plate consists of two long setae at the distal part, two setae at the side of the median axis, and 7-8 spines at the posterior part. Mentum with spines anteriorly but posteriorly smooth.

Mandible: external tooth comparatively longer than internal tooth,  $\leq 10$  rows of pectinate lamellae; molar plate furrowed. .

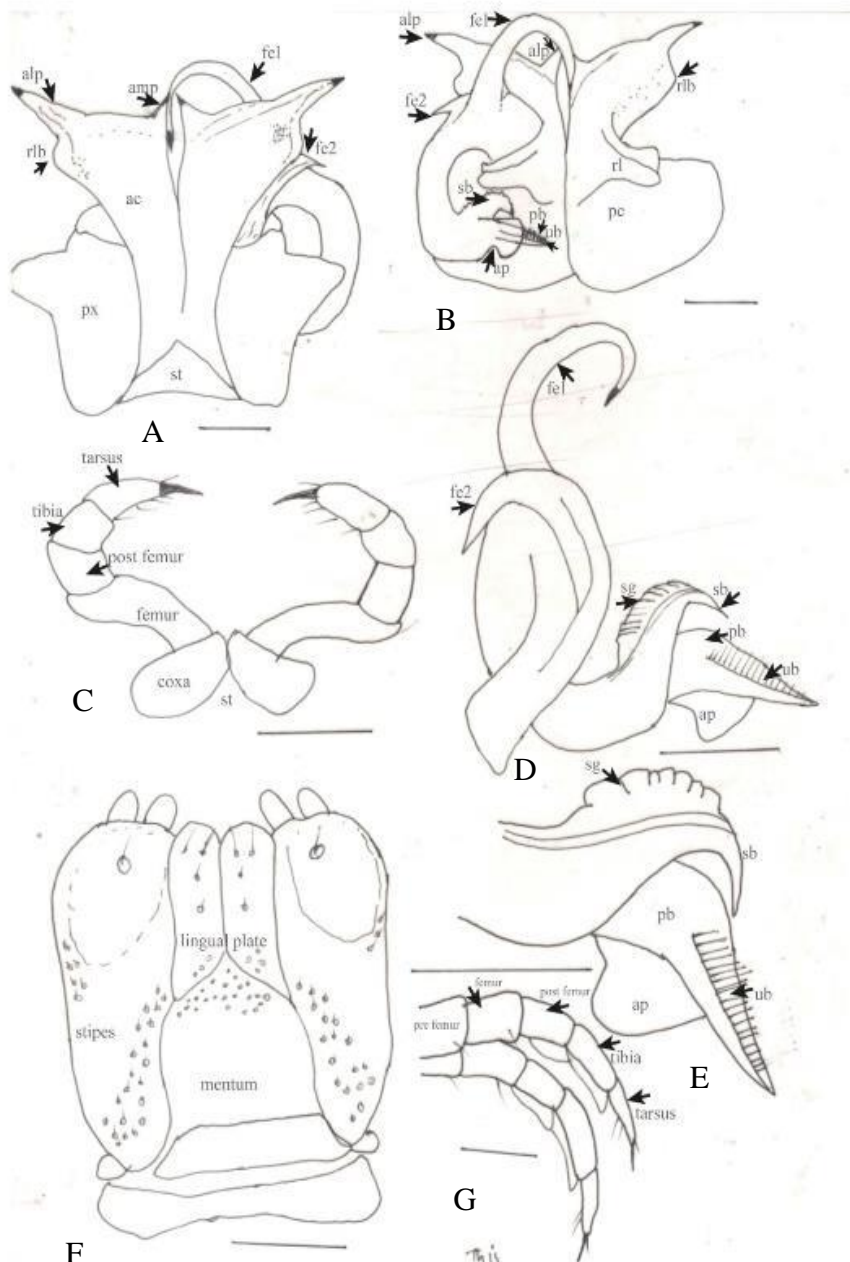


Figure 18. *Gonoplectus nilbarahiensis* sp. nov. A. gonopod, oral view: B: gonopod, anal view. C. First pair of leg. D. teleopodite, anterolateral view. E. distal part of teleopodite. F. Gnathochilarium. G. last 5 segments of leg from mid- body. Scale=1 mm

Collum: broad at middle, narrowing towards ends; dorsally shiny and punctate; anterior end is acute and circle; posterior angle obtuse; marginal swelling at latero-anterior.

Body rings: 60 segments; first is collum; 2<sup>nd</sup>– 4<sup>th</sup> segment with 1 pair of legs; all others with 2 pairs of legs except 7<sup>th</sup> with gonopod, absence of apodous rings. Ozopore starts in the 6<sup>th</sup> segment. Shiny prozonite and metazonite are differentiated by sutures. Prozonites are punctate with a transverse striate, metazonites are dorsally smooth, below the ozopores longitudinally striate. The stigmal groove reaching to the end of the prefemur. Anal segment tapering with straight tail, paraproct convex, triangular hypoproct.

Legs: After the 3<sup>rd</sup> pair of legs, the pad is present in the post femur and tibia until the last pair of legs, except for the last 8 to 10 pairs only in the tibia, tip of the pad acute and directed ventrally, the tarsus with 4 setae and the pretarsus.

Gonopod (Figure. 17-18) : on the 7<sup>th</sup> segment, triangular sternite, Anterior coxal fold: lateral process, straight spine-like, directed distad, connected with a rounded lobe on the aboral side of the coxal fold, mesal process also spine-like structure, shorter than lateral process, directed mesad; the space between coxal processes is convex. Posterior coxal fold: normal, rounded lappet present, processes not visible. Teleopodite: with two femoral spine at the knee, one spine larger, curved medially in a semicircle, and the second spine directed distally. Teleopodite with two branches, the first branch divided into two arms: one is a curved seminal branch with a seminal groove with a pointed tip, and the second is a prostatic branch, straight, ended to tip, with  $\geq 20$  unmodified blepharochaete generated from mid-line in the branch also consisting of a flat paddle-like structure, covering half the prostatic branch posteriorly.

Etymology: The species name is given after the type locality Nilbarahi.

Comparison: The morphological characters of *Gonoplectus nilbarahiensis* sp. nov. is compared with *Gonoplectus repertus* Attems, 1936, reported from Bengal, the Eastern Himalayas, Pashok, Darjeeling District. The space between anterior processes (lateral and mesal) was with rounded creek in *G. repertus* but convex in *G. nilbarahiensis* sp. nov.. The smaller femoral spine was directed basally in *G. repertus* while *G. nilbarahiensis* sp. nov. was directed distally (Figure. 13–14). The arm (process) of the first branch is sickle-like like in *G. repertus* and in *G. nilbarahiensis* sp. nov. , it looks like a flat paddle (Figs. 13–14).

#### 4.2 Community composition, diversity and distribution

A total of 417 individuals belonging to two classes were reported from three urban forest patches of Kathmandu Valley. Six species of Diplopoda (n=344) belonging to three orders, four families and five genera whereas four species of Chilopoda (n=73) belonging to two orders, three families and three genera were recorded in which Diplopoda were more abundant and rich in taxa than Chilopoda.

Table 2: Faunal diversity of Myriapods in three urban forest patches

	CGTU	RCF	NCF	Total	R. A.
<b>Diplopoda</b>					
<b>Spirodtreptida, Harpagophoridae, Gonoplectini</b>					
<i>Gonopectus ranibariensis</i> sp. nov.	-	6	-	6	1.44
<i>Gonopectus nilbarahiensis</i> sp. nov.	-	27	<b>193</b>	220	52.8
<b>Spirobolida, Pachybolidae, Trigoniulinae</b>					
<i>Trigoniulus corallinus</i> (Eydoux and Souleyet, 1842)	-	<b>64</b>	-	64	15.3
<b>Polydesmida, Paradoxosomatidae</b>					
<i>Delarthrum elegans</i> (Golovatch, 1992)	-	48	3	51	12.2
<i>Oxidus gracilis</i> (C.L. Koch, 1847)	2	-	-	2	0.48
<b>Polydesmida, Haplodesmidae</b>					
<i>Koponenius biramus</i> Golovatch and Vandenspiegel, 2014	-	-	1	1	0.24
<b>Chilopoda</b>					
<b>Scolopendromorpha, Scolopendridae, Otostigminae</b>					
<i>Rhysida afra</i> (Peters, 1855)	-	30	14	44	10.6
<i>Rhysida trispinosa</i> Jangi & Dass, 1984	-	2	-	2	0.48
<b>Scolopendromorpha, Cryptidae</b>					
<i>Cryptops doriae</i> Pocock, 1891	-	3	-	3	0.72
<b>Scutigermorpha, Scutigeridae</b>					
<i>Scutigera coleoptera</i> (Linnaeus, 1758)	1	23	-	24	5.76
R. A.= Relative Abundance					

*G. ranibariensis* sp. nov. was the most abundant species from the forest patches, followed by *T. corralinus*, *D. elegans*, *R. afra*, *S. coleopteran*, *G. ranibariensis* sp. nov., *C. dora*, *O. gracilis*, *R. trispinosa* while *K. biramusis* was the least abundant species in the forest patches inside the Kathmandu Valley. Most species are unique to each forest; none of the species recorded from all three forest patches *G. ranibariensis* sp. nov., *T. corallinus*, *R. trispinosa*, and *C. dora* are unique for RCF, *K. biramus* for NCF, and *O. gracilis* for CGTU. *G. nilbarahiensis* sp. nov., *D. elegans*, *R. afra* are common for RCF and NCF. *S. coleoptera* was a common species distributed in the RCF and CGTU.

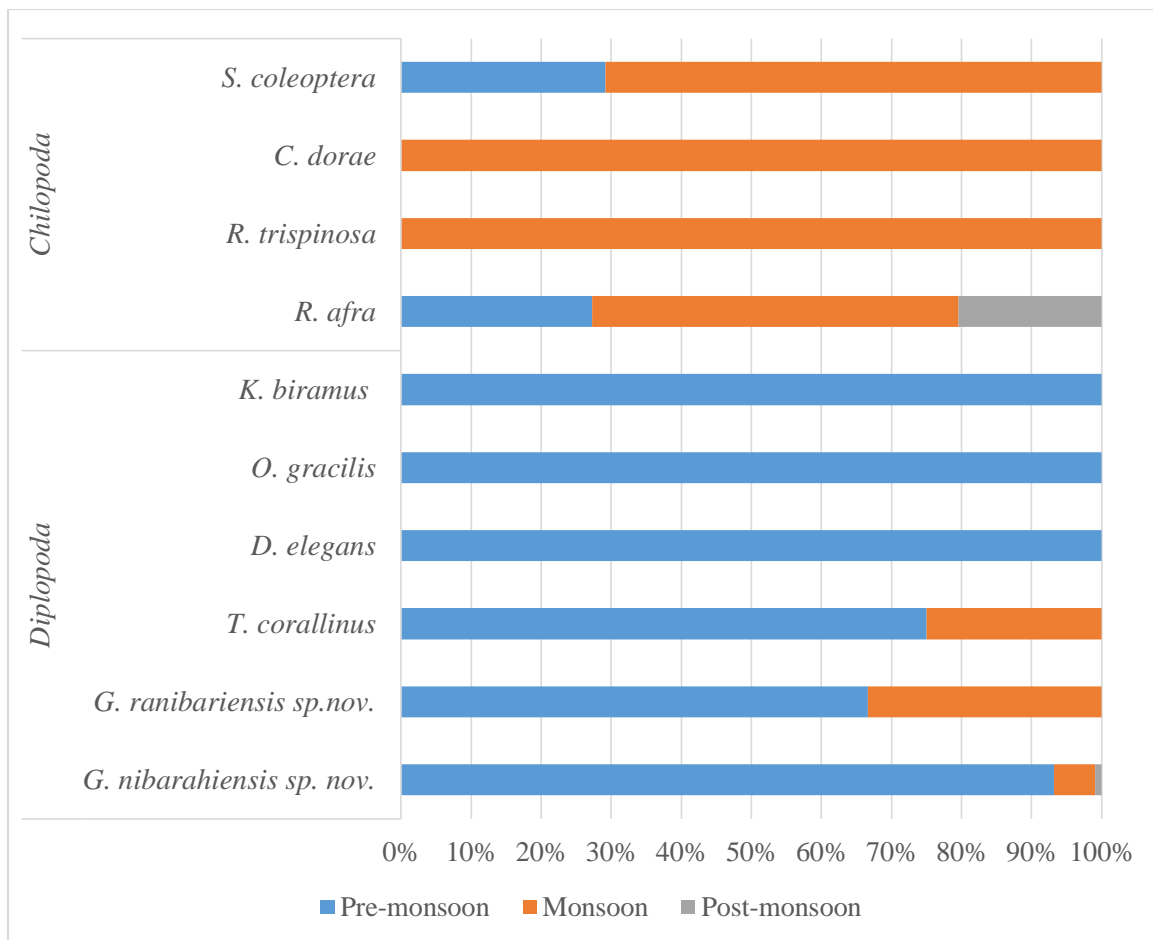
Table 3: Diversity of Myriapoda in three forest patches

Parameters	Sites		
	CGTU	RCF	NCF
Individuals	3	203	211
Species richness	2	8	4
Shannon-Weiner Diversity Index ( $H'$ )	0.64	1.71	0.35
Shannon-Weiner Evenness Index (E)	1.33	0.74	0.15

The abundance of Myriapoda was higher in NCF (n = 211) than in CGTU (n = 3), but still similar to RCF (n = 203). The higher species richness in RCF followed by NCF and CGTU. RCF ( $H' = 1.71$ ) had the highest species diversity, while NCF ( $H' = 0.35$ ) had the lowest. CGTU ( $H' = 0.64$ ) fell somewhere between the other two forest patches but still had relatively low species diversity. CGTU (E = 1.33) means that the species in this community are relatively evenly distributed in terms of their abundance. RCF (E = 0.74), lower than the other two sites, indicated the presence of some species in this community that are more abundant than others. NCF (E = 0.15), the lowest of the three sites, suggested that there were large variations in the abundance of species in this community.

### 4.3 Seasonal Variation

Eight species of Myriapoda were reported during the pre-monsoon as well as the eight species during the monsoon but only two were recorded during post monsoon. The abundance of Myriapoda was high during the pre-monsoon, which is decreased during the monsoon and post-monsoon. The abundance of Diplopoda species was high during the pre-monsoon (n = 311; six species), while that of Chilopoda species was high during the monsoon (n = 45; four species).



## 5. DISCUSSION

A total of 10 species of Myriapoda, in which six species of Diplopoda and four species of Chilopoda were identified during this study. Morphological characters and gonopod structure were used for identification of Diplopoda up to species level while only morphological characters are sufficient for Chilopoda identification (Mwabvuet al. 2013; Enghoff et al. 2015; Edgecombe & Giribet 2006; Edgecombe & Koch 2008).

The *Gonoplectus* is the most common species which is widely distributed from Uttarakhand, India and Thailand (Hoffman & Burkhalter 1978; Enghoff et al. 2015) and its occurrence is also common in Kathmandu Valley. Gonopod structure is sufficient for the identification of *Gonoplectus* species as well as other species (Demange 1961). *Gonoplectus ranibariensis* sp. nov., *Gonoplectus nilbarahiensis* sp. nov. were identified and described as new species because of their unique gonopod structure (Demange 1961). *Delarthrum elegans* (Golovatch, 1992) and *Koponenius biramus* Golovatch and Vandenspiegel, 2014 are endemic to Nepal (Golovatch, 1992, Golovatch and Vandenspiegel 2014) because of slow movement, long life cycles and large number of moulting (Alagesan 2016). *Trigoniulus corralinus* (Eydoux and Souleyet, 1842) and *Oxidus gracilis* (C.L. Koch, 1847) well-known invasive species with a high adaptive potential are worldwide distribution because of international commerce mostly found in urban zones and greenhouses (Blower 1985, Shelly & Lehtinen 1999, Shelly et al. 2006, Iniesta et al. 2020). *Rhysida afra* (Peters 1855), *R. trispinosa* Jangi & Dass, 1984, *Cryptops dora*e Pocock, 1891 and *Scutigera coleoptera* (Linnaeus, 1758) have wide distributions (Kraepelin 1903, Lewis 1992, Lewis 1999, Lewis 2001, Stoev and Geoffroy 2004, Joshi et al. 2020).

Diplopoda were recorded as most common species from urban forest patches as they are mostly found in forest (Battitola et al. 2017; Nkoh et al. 2022). *G. nilbarahiensis* sp. nov. is the dominant species of Nilbarahi Community Forest and *T. corralinus* is the dominant species of Ranibari Community Forest followed by *D. elegans* which showed the availability of favourable environment and condition for them.

This study showed that Myriapods diversity and abundance were highly influenced by humans as well as climatic factors. The Mixed forest with higher percentage of litter layer and thicker litter layer were responsible for the higher diversity and abundance of the Diplopods as well as the Chilopods in Ranibari Community Forest followed by Nilbarahi Community Forest (Bogyó et al. 2015; Poloczec et al. 2016). The abundance and species

diversity in Coronation Garden of Tribhuvan University was lower, which might be due to the monodominant type of forest, pollution that affects their habitat, less availability of leaf litters and food items needed for soil macro-fauna (Battirola et al. 2018; Szabó et al. 2023).

This study showed higher abundance of Myriapoda during pre-monsoon followed by monsoon and post-monsoon because of early rain for perfect moisture as well as a thicker litter layer needed for the habitat during pre-monsoon which was washed during monsoon (Bogyó et al. 2015; Poloczek et al. 2016). The abundance of Diplopoda species were high during pre-monsoon because of the presence of litter but Chilopoda were abundant during monsoon because of less severe rainfall, suitable humidity and reproductive active time for Scolopendromorph centipede (Lewis 1972; Joshi & Dahanukar 2012).

## 6. CONCLUSION AND RECOMMENDATIONS

### 6.1 Conclusion

A total of 417 individuals of 10 species belonging to two classes of Myriapoda were recorded. Six species of Diplopoda belonging to three orders, four families, five genera, and four species of Chilopoda belonging to two orders, three families, and three genera were reported. This study described two species of Diplopoda: *Gonoplectus ranibariensis* sp. nov. and *G.nilbarahiensis* sp. nov., the first record of *Trigoniulus corralinus* (Eydoux and Souleyet, 1842), *Rhysida trispinosa* Jangi & Dass, 1984, and *Scutigera coleoptera* (Linnaeus, 1758) to Nepal, and re-report of *Delarthrum elegans* (Golovatch, 1992), *Oxidus gracilis* (C.L. Koch, 1847), *Koponenius biramus* Golovatch and Vandenspiegel, 2014, *R. afra* (Peters, 1855), and *Cryptops dora* Pocock, 1891. Most of the species were unique for each forest while some species were common for two forest. The abundance of Myriapoda was similar in Nilbarahi Community Forest and Ranibari Community Forest but higher than Coronation Garden of Tribhuvan University. Myriapoda in Ranibari Community Forest was more diverse, followed by Coronation Garden of Tribhuvan University and Nilbarahi Community Forest. This study showed that the abundance and species diversity of Myriapoda was affected by forest type, human activities, and season, which alter the percentage and size of the litter layer.

### 6.2 Recommendations

Some recommendations made by this study are given below;

- i. The fauna of Myriapoda of agriculture lands and settlement areas.
- ii. Myriapoda fauna of other micro habitats: bark of trees and under stone, should also be inspected from surrounding hill forests as well as forests inside the urban area.
- iii. Other sampling techniques: pitfall traps, Berlese-Tullgren funnels, etc., should be used for the collection of Myriapoda.
- iv. Use ethanol with >90% concentration for preservation of Chilopoda.

## REFERENCES

- Adis, J. and Harvey, M. S. 2000. Short Communication How many Arachnida and Myriapoda are there world-wide and in Amazonia? *Studies on Neotropical Fauna and Environment* **35**(2):139–141.
- Alagesan, P. 2016. Millipedes: Diversity, distribution and ecology. *Arthropod Diversity and Conservation in the Tropics and Sub-tropics* 119–137.
- Attems, C. 1936. Diplopoda of India. *Memoirs of the Indian Museum*, **XI**(4):133-323.
- Barber, A. D. 2011. *Thereuonema tuberculata*, a Scutigermorph centipede from China, found in a warehouse at Swindon. *Bulletin of the British Myriapod and Isopod Group* **25**:49–50.
- Battirola, L. D., Golovatch, S. I., Pinheiro, T. G., Batistella, D. A., Rosado-Neto, G. H., Chagas Jr, A., et al. 2018. Myriapod (Arthropoda, Myriapoda) diversity and distribution in a floodplain forest of the Brazilian Pantanal. *Studies on Neotropical Fauna Environment* **53**(1):62–74. <https://doi.org/10.1080/01650521.2017.1397978>
- Blower, J. G. 1985. *Millipedes: Keys and Notes for the Identification of the Species*. Brill Archive **36**:1–240
- Bogyó, D., Magura, T., Nagy, D. D. and Tóthmérész, B. 2015. Distribution of millipedes (Myriapoda, Diplopoda) along a forest interior–forest edge–grassland habitat complex. *ZooKeys* **510**:181–195. <https://doi.org/10.3897/zookeys.510.8657>
- Bonato, L. and Zapparoli, M. 2011. 16 Chilopoda–Geographical distribution. In *Treatise on Zoology-Anatomy, Taxonomy, Biology. The Myriapoda* **1**:327–337. [https://doi.org/10.1163/9789004188266\\_017](https://doi.org/10.1163/9789004188266_017)
- Bonato, L. and Minelli, A. 2004. The centipede genus *Mecistocephalus* Newport 1843 in the indian peninsula (Chilopoda Geophilomorpha Mecistocephalidae). *Tropical Zoology* **17**(1):15–63.
- Bonato, L., Chagas, J. A., Edgecombe, G. D., Lewis, J. G. E., Minelli, A., et al. 2016. ChiloBase 2.0 - A World Catalogue of Centipedes (Chilopoda).
- Bonato, L., Edgecombe, G. D., Lewis, J. G., Minelli, A., Pereira, L. A., Shelley, R. M., et al. 2010. A common terminology for the external anatomy of centipedes (Chilopoda). *ZooKeys* **69**:17–51. <https://doi.org/10.3897/zookeys.69.737>

- Brewer, M. S., Sierwald, P. and Bond, J. E. 2012. Millipede taxonomy after 250 years: classification and taxonomic practices in a mega-diverse yet understudied arthropod group. *PLoS ONE* **7**(5):1–12. <https://doi.org/10.1371/journal.pone.0037240>
- Carl J. 1935. Polydesmiden gesammelt von Major R.W. Hingstonia auf der III. Everest Expedition 1924, *Revue Suisse de Zoologie* **42**(10):325–340.
- Chagas-Junior, A., Edgecombe, G. D. and Minelli, A. 2008. Variability in trunk segmentation in the centipede order Scolopendromorpha: a remarkable new species of *Scolopendropsis* Brandt (Chilopoda: Scolopendridae) from Brazil. *Zootaxa* **1888**(1):36–46. <https://doi.org/10.11646/zootaxa.1888.1.2>
- Chamberlin, R. V. 1921. V.—New Chilopoda and Diplopoda from the East Indian region. *Journal of Natural History* **7**(37):50–87.
- Chapman, A. D. 2009. Numbers of living species in Australia and the world. pp.60
- Crawford, C. S. 1992. Millipedes as model detritivores. *Berichte des Naturwissenschaftlich-medizinischen Vereins in Innsbruck* **10**:277–288.
- Cupul-Magaña, F. G. and Flores-Guerrero, U. S. 2016. Guide for the identification centipedes families (Myriapoda: Chilopoda) from Mexico: An update Guía para la identificación de las familias de ciempiés (Myriapoda: Chilopoda) de México: una actualización. *Revista Bio Ciencias* **4**(1):40–51. <http://dx.doi.org/10.15741/revbio.03.01.07>
- Demange, J. M. 1961. Matériaux pour servir à une révision des Harpagophoridae (Myriapodes-Diplopodes). *Mémoires du Muséum national d'histoire naturelle* **24**:1–274.
- Demange, J. M. 1986. Harpagophoridae de Thaïlande et de Malaisie (Myriapoda, Diplopoda, Spirostreptida). *Bulletin du Muséum National d'Histoire Naturelle* **8**:851–865.
- Dobroruka, L. J. 1979. *Allothereura wilsonae* sp. n., A new centipede from Nepal (Chilopoda: Scutigermorpha: Thereuoneminae). *Věstník Československé společnosti zoologické* **43**(2):101–103.
- Domingo-Quero, T. and Alonso-Zarazaga, M. Á. 2010. Chapter-9, Soil and litter sampling, including MSS. *Abc taxa* **8**(1):173–212.
- Druce, D., Hamer, M. and Slotow, R. 2004. Sampling strategies for millipedes (Diplopoda), centipedes (Chilopoda) and scorpions (Scorpionida) in savanna habitats. *African Zoology* **39**(2):293–304. <https://doi.org/10.1080/15627020.2004.11657225>

- Dyachkov, Y. V. 2020. New data on the scutigermorph and scolopendromorph centipedes (Chilopoda: Scutigermorpha: Scutigeridae; Scolopendromorpha: Scolopendridae, Cryptopidae) from Kazakhstan. *Arthropoda Selecta* **29**(2):173–184. <http://dx.doi.org/10.15298/arthsel.29.2.02>
- Eason, E. H. 1989. Lithobiidae from the Nepal Himalayas with descriptions of ten new species of *Lithobius* and *Australobius* (Chilopoda:Lithobiomorpha). *Zoologische Jahrbücher, Abteilung für Systematik* **116**:335–372.
- Edgecombe, G. D. and Giribet, G. 2006. A century later—a total evidence re-evaluation of the phylogeny of scutigermorph centipedes (Myriapoda: Chilopoda). *Invertebrate Systematics* **20**(5):503–525. <https://doi.org/10.1071/IS05044>
- Edgecombe, G. D. and Giribet, G. 2007. Evolutionary biology of centipedes (Myriapoda: Chilopoda). *Annual Review of Entomology* **52**:151–170. <https://doi.org/10.1146/annurev.ento.52.110405.091326>
- Edgecombe, G. D. and Koch, M. 2008. Phylogeny of scolopendromorph centipedes (Chilopoda): morphological analysis featuring characters from the peristomatic area. *Cladistics* **24**(6):872–901. <https://doi.org/10.1111/j.1096-0031.2008.00220.x>
- Edgecombe, G. D. and Giribet, G. 2008. A New Zealand species of the trans-Tasman centipede order Craterostigmomorpha (Arthropoda: Chilopoda) corroborated by molecular evidence. *Invertebrate Systematics* **22**(1):1–15.
- Enghoff, H. 1987. Revision of *Nepalmatoiulus* Mauries 1983 - a Southeast Asiatic genus of millipedes (Diplopoda: Julida: Julidae). *Courier Forschungsinstitut Senckenberg* **93**:241–331.
- Enghoff, H., Golovatch, S., Short, M., Stoev, P. and Wesener, T. 2015. Diplopoda—taxonomic overview, *Treatise on Zoology-Anatomy, Taxonomy, Biology. The Myriapoda, Volume 2. Biodiversity Data Journal* **2**:363–453. [https://doi.org/10.1163/9789004188273\\_017](https://doi.org/10.1163/9789004188273_017)
- Fusco, G. 2005. Trunk segment numbers and sequential segmentation in myriapods. *Evolution and Development* **7**(6):608–617. <https://doi.org/10.1111/j.1525-142X.2005.05064.x>
- Golovatch S. I. 1986. Diplopoda from the Nepal Himalayas: Polydesmidae, Fuhrmannodesmidae. *Senckenbergiana biologica* **66**(4/6):345–369.

- Golovatch S. I. 1987a. Diplopoda from the Nepal Himalayas. Opisetretidae, additional Polydesmidae and Fuhrmannodesmidae. Courier Forschungsinstitut Senckenberg **93**:203–217.
- Golovatch S. I. 1987b. Diplopoda from the Nepal Himalayas. Glomeridae, additional Opisetretidae. Courier Forschungsinstitut Senckenberg **93**:219–228.
- Golovatch S. I. 1990a. Diplopoda from the Nepal Himalayas. The first Paradoxosomatidae (Polydesmida). Spixiana **13**(1):9–24.
- Golovatch S. I. 1990b. Diplopoda from the Nepal Himalayas. Several additional Polydesmidae, and Fuhrmannodesmidae (Polydesmida). Spixiana **13**(3):237–252.
- Golovatch S. I. 1992. Diplopoda from the Nepal Himalayas. Some additional Paradoxosomatidae. Senckenbergiana biologica **72**(1–3):183–203.
- Golovatch S. I. 1993. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda Polydesmida). Arthropoda Selecta **2**(1):3–14.
- Golovatch S. I. 1994a. Diplopoda from the Nepal Himalayas. Further Paradoxosomatidae (Polydesmida). Senckenbergiana biologica **73**(1–2):163–182.
- Golovatch S. I. 1994b. Diplopoda from the Himalayas. Two new Alogolykini (Polydesmida: Paradoxosomatidae). Senckenbergiana biologica **73**(1–2):183–187.
- Golovatch S. I. 1996. Diplopoda from the Nepal Himalayas. Review of the genus *Orophosoma* Jeekel 1980 (Polydesmida: Paradoxosomatidae). Senckenbergiana biologica **76**(1–2):163–184.
- Golovatch S. I. 2014. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XVI. Arthropoda Selecta **23**(3):227–251.
- Golovatch S. I. 2015a. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XVII. Arthropoda Selecta **24**(2):127–168.
- Golovatch S. I. 2016a. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XVIII. Arthropoda Selecta **25**(1):1–18.
- Golovatch S. I. 2016b. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XIX. Arthropoda Selecta **25**(2):131–152.

- Golovatch S. I. 2016c. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XX. *Arthropoda Selecta* **25**(3):219–240.
- Golovatch S. I., VandenSpiegel D, Semenyuk II. 2016. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XXI. *Arthropoda Selecta* **25**(4):335–354.
- Golovatch, S. I. 2000. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), VII. *Arthropoda Selecta* **8**(4):215–220.
- Golovatch, S. I. 2022. A new species of the millipede genus *Epanerchodus* from western Nepal (Diplopoda: Polydesmida: Polydesmidae) *Íâúé âèä äëïëñä ðïää Epanerchodus èç Çàïääñâ Ìãàèä* (Diplopoda: Polydesmida: Polydesmidae). *Russian Entomological Journal* **31**(4):432–435.
- Golovatch, S. I. 2023. On several new or poorly-known Oriental Paradoxosomatidae (Diplopoda: Polydesmida), XXXI *Arthropoda Selecta* **32**(1):1–14.
- Golovatch, S. I. and Kime, R. D. 2009. Millipede (Diplopoda) distributions: A review. *Soil organisms* **81**(3):565–565.
- Golovatch, S. I. and VandenSpiegel, D. 2014. *Koponenius* gen. nov., a new genus of the millipede family Haplodesmidae from the Himalayas of India and Nepal (Diplopoda: Polydesmida). *Zootaxa* **3894**(1):141–151. <http://dx.doi.org/10.11646/zootaxa.3894.1.11>
- Golovatch, S. I. and VandenSpiegel, D. 2016. A new species of the millipede genus *Koponenius* Golovatch et VandenSpiegel, 2014, from Nepal (Diplopoda: Polydesmida: Haplodesmidae). *Russian Entomological Journal* **25**(2):219–223. <http://dx.doi.org/10.15298/rusentj.25.2.10>
- Golovatch, S. I. and Wesener, T. 2016. A species checklist of the millipedes (Myriapoda, Diplopoda) of India. *Zootaxa* **4129**(1):1–75. <https://doi.org/10.11646/zootaxa.4129.1.1>
- Golovatch, S. I., Mikhaljova, E. V. and Chang, H. W. 2011. The millipede family Polydesmidae in Taiwan, with descriptions of five new species (Polydesmida, Diplopoda). *ZooKeys* **93**:9–42.
- Hoffman, R. L. and Burkhalter, E. A. 1978. Studies on spirostreptoid millipedes XIV. A new species of *Gonoplectus* from Thailand, with notes on the status and distribution of the genus (Spirostreptida: Harpagophoridae). *Journal of Natural History* **12**(4):413–422.
- Hoffman, R. L. and Payne, J. A. 1969. Diplopods as carnivores. *Ecology* **50**(6):1096–1098.

- Iniesta, L. F., Bouzan, R. S., Rodrigues, P. E., Almeida, T. M., Ott, R., and Brescovit, A. D. 2020. Ecological niche modeling predicting the potential invasion of the non-native millipede *Oxidus gracilis* (CL Koch, 1847) (Polydesmida: Paradoxosomatidae) in Brazilian Atlantic Forest. In *Annales de la Société entomologique de France* (NS) **56**(5):387–394. DOI: 10.1080/00379271.2020.1834873
- Joshi, J. and Dahanukar, N. 2012. Ecology, diversity and distribution of centipedes (Scolopendromorpha: Chilo-poda) in the Northern Western Ghats, India.
- Joshi, J., Karanth, P. K. and Edgecombe, G. D. 2020. The out-of-India hypothesis: evidence from an ancient centipede genus, *Rhysida* (Chilopoda: Scolopendromorpha) from the Oriental Region, and systematics of Indian species. *Zoological Journal of the Linnean Society* **189**(3):828–861. <https://doi.org/10.1093/zoolinnean/zlz138>
- Khanna, V. 2003. Diversity of Scolopendrid Centipedes (Chilopoda: Scolopendromorpha) in Himalayan Ecosystem and Adjacent Areas-A Review.. *Records of the Zoological Survey of India* **101**(3-4):207–223.
- Korsós, Z. 2001. Diplopoda from the Nepal Himalaya: towards the clarification of the genus *Anaulaciulus* Pocock 1895 (Diplopoda, Julida, Julidae, Brachyiulini). *Senckenbergiana Biologica* **81**(1-2):61–86
- Korsos, Z., Geoffroy, J. J. and Mauriès, J. P. 2009. The fifth element: reconnection of the disjunct distribution of the members of Siphonocryptida (Diplopoda) with the description of a new species from Nepal. *Journal of Natural History* **43**(7-8):435–445.
- Kraepelin, K. 1903. *Revision der Scolopendriden: Mit 160 Abbildungen im Text* (Vol. 2): L. Gräfe & Sillem.
- Lewis, J. G. E. 1992. Scolopendrid centipedes from Nepal and Kashmir (Chilopoda: Scolopendromorpha). *Senckenbergiana biologica* **72**(4/6):435–456.
- Lewis, J. G. E. 1999. On the genus *Cryptops* LEACH in Nepal with redescrptions of *Cryptops australis* NEWPORT and *C. doriae* POCOCK (Chilopoda, Scolopendromorpha, Cryptopidae). *Senckenbergiana biologica* **79**:19–38.
- Lewis, J. G. E. 2001. The scolopendrid centipedes in the collection of the National Museum of Natural History in Sofia (Chilopoda: Scolopendromorpha: Scolopendridae). *Historia Naturalis Bulgarica* **13**:5–51.

- Lewis, J. G. E. 2009. A review of some characters used in the taxonomy of *Cryptops* (subgenus *Cryptops*)(Chilopoda: Scolopendromorpha: Cryptopidae). *Soil organisms* **81**(3):505–505.
- Lewis, J. G. E. 1972. The population density and biomass of the centipede *Scolopendra amazonica* (Bücherl) (Scolopendromorpha: Scolopendridae) in Sahel savannah Nigeria. *Entomologists Monthly Magazine* **108**:16–18
- Marek, P. E., Buzatto, B. A., Shear, W. A., Means, J. C., Black, D. G., Harvey, M. S., et al. 2021. The first true millipede—1306 legs long. **11**(1):23126. <https://www.nature.com/articles/s41598-021-02447-0>
- Mauriès, J. P. 1983a. Une famille nouvelle et deux genres nouveaux de Cleidogonoidea, avec notes sur la classification de la superfamille (Diplopoda, Craspedosomida). *Steenstrupia* **8**(6):165–187.
- Mauriès, J. P. 1983b. Myriapodes du Nepal (Mission I. Löbl et A. Smetana 1981) I. Diplopodes Iuliformes (Iulida, Cambalida et Spirostreptida - Nepalmatoiuulus nov. subgen. *Revue suisse de zoologie* **90**(1):127–138.
- Mbenoun Masse, P. S., Nzoko Fiemapong, A. R., VandenSpiegel, D. and Golovatch, S. I. 2018. Diversity and distribution of millipedes (Diplopoda) in the Campo Ma'an National Park, southern Cameroon. *African Journal of Ecology* **56**(1):73–80. <https://doi.org/10.1111/aje.12418>
- Mesibov, R., Taylor, R. J. and Brereton, R. N. 1995. Relative efficiency of pitfall trapping and hand-collecting from plots for sampling of millipedes. *Biodiversity Conservation* **4**:429–439.
- Minelli, A. 2011. Class Chilopoda, Class Symphyla and Class Pauropoda. In: Zhang, Z.-Q.(Ed.) *Animal biodiversity: An outline of higher-level classification and survey of taxonomic richness*. *Zootaxa* **3148**(1):157–158. <https://doi.org/10.11646/zootaxa.3148.1.31>
- Minelli, A. 2020. Arthropod segments and segmentation—lessons from myriapods, and open questions. *Opuscula Zoologica* **51**(S2):7–21. <http://dx.doi.org/10.18348/opzool.2020.S2.7>
- Minelli, S. and Golovatch, S. I. 2001. Myriapods.-In: LEVIN, SA (ed.): *Encyclopedia of Biodiversity*. In: Academic Press, San Diego.

- Mwabvu, T., Lamb, J., Slotow, R., Hamer, M. and Barraclough, D. 2013. Is millipede taxonomy based on gonopod morphology too inclusive? Observations on genetic variation and cryptic speciation in *Bicoxidens flavicollis* (Diplopoda: Spirostreptida: Spirostreptidae): Myriapoda. African Invertebrates **54**(2):349–356. <http://dx.doi.org/10.5733/afin.054.0203>
- Nguyen, A. D., Korsós, Z., Jang, K. H. and Hwang, U. W. 2017. A revision and phylogenetic analysis of the millipede genus *Oxidus* Cook, 1911 (Polydesmida, Paradoxosomatidae). European Journal of Taxonomy **293**:1–22. <https://doi.org/10.5852/ejt.2017.293>
- Nkoh, P. B. T., Mbenoun Masse, P. S., Tonga, C., Tsila, H. G., Kekeunou, S., Makon, S. D., et al. 2022. Diversity and spatio-temporal distribution of the myriapodofauna in four habitat types along an urban-rural gradient in Douala (Littoral, Cameroon). African Journal of Ecology **00**:1–11. <https://doi.org/10.1111/aje.13069>
- Peters, W. K. H. 1855. Über die Myriapoden im allgemeinen und insbesondere über die in Mossambique beobachteten Arten dieser Familie, p.82
- Pimvichai, P., Enghoff, H. and Panha, S. 2009. A revision of the *Thyropygus allevatus* group. Part 1: the *T. opinatus* subgroup (Diplopoda: Spirostreptida: Harpagophoridae). Zootaxa **2016**(1):17–50. <https://doi.org/10.11646/zootaxa.2016.1.2>
- Pitz, K. M. and Sierwald, P. 2010. Phylogeny of the millipede order Spirobolida (Arthropoda: Diplopoda: Helminthomorpha). Cladistics **26**(5):497–525. <https://doi.org/10.1111/j.1096-0031.2009.00303.x>
- Pocock, R. I. 1894. Contributions to our Knowledge of the Arthropod Fauna of the West Indies. Part III. Diplopoda and Malacopoda, with a Supplement on the Arachnida of the Class Pedipalpi. Journal of the Linnean Society of London **24**(157):473–519.
- Poloczek, A., Pfeiffer, M., Schneider, R. and Mühlenberg, M. 2016. The Chilopoda (Myriapoda) of the Khentey-Mountain Range, Northern Mongolia. Communities of different forest-types under a varying fire regime. European Journal of Soil Biology **74**:114–120. <https://doi.org/10.1016/j.ejsobi.2016.04.004>
- Santos-Silva, L., Pinheiro, T. G., Chagas-Jr, A., Marques, M. I. and Battirola, L. D. 2018. Temporal and spatial variation of Myriapoda (Diplopoda and Chilopoda) assemblages in a Neotropical floodplain. Biota Neotropica, 18.

- Saussure, H. D. and Zehnter, L. 1901. Myriopoden aus Madagaskar und Zanzibar, gesammelt von Dr. A. Voeltzkow. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft **26**(4):429–460.
- Schileyko, A. A., Vahtera, V. and Edgecombe, G. D. 2020. An overview of the extant genera and subgenera of the order Scolopendromorpha (Chilopoda): a new identification key and updated diagnoses. Zootaxa **4825**(1):1–64. <https://doi.org/10.11646/zootaxa.4825.1.1>
- Shear, W. 2011. Class Diplopoda de Blainville in Gervais, 1844. In: Zhang, Z.-Q.(Ed.) Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness. Zootaxa **3148**(1):159–164. <http://dx.doi.org/10.11646/zootaxa.3148.1.32>
- Shear, W. A. 1979. Diplopoda from the Nepal Himalayas. Chordeumida with comments on the Asian chordeumid fauna. Senckenbergiana biologica **60**(1-2):115–130.
- Shear, W. A. 1987. Chordeumatid Diplopoda from the Nepal Himalayas, II. Courier Forschungsinstitut Senckenberg **93**:229–240.
- Shear, W. A. and Krejca, J. K. 2019. Myriapods. In Encyclopedia of Caves, Academic Press pp. 739–745. <https://doi.org/10.1016/B978-0-12-814124-3.00089-3>
- Shelley R. M. 1996. *Nepalozonium trimaculatum*, n. gen., n. sp. (Diplopoda: Polyzoziida: Hirudisomatidae): first record of the order and family from Central Asia. Proceedings of the Entomological Society of Washington **98**(4):677–680..
- Shelley, R. M. and Lehtinen, P. T. 1999. Diagnoses, synonymies and occurrences of the pantropical millipeds, *Leptogoniulus sorornus* (Butler) and *Trigoniulus corallinus* (Gervais)(Spirobolida: Pachybolidae: Trigoniulinae). Journal of Natural History **33**(9):1379–1401.
- Shelley, R. M., Carmany, R. M. and Burgess, J. 2006. Introduction of the millipede, *Trigoniulus corallinus* (Gervais, 1847) (Spirobolida: Trigoniulidae), in Florida, USA. Entomological news **117**(2):239–241. [http://dx.doi.org/10.3157/0013-872X\(2006\)117\[239:IOTMTC\]2.0.CO;2](http://dx.doi.org/10.3157/0013-872X(2006)117[239:IOTMTC]2.0.CO;2)
- Shinohara, K. 1965. A new species of Chilopoda from Himalaya. Journal of the college of Arts and Science, Chiba University, Natural Science **4**:303–306.

- Sierwald, P. and Bond, J. E. 2007. Current status of the myriapod class Diplopoda (millipedes): taxonomic diversity and phylogeny. *Annual Review of Entomology* **52**:401–420. <https://doi.org/10.1146/annurev.ento.52.111805.090210>
- Sierwald, P. and Spelda, J. 2023. Millibase. doi:doi:10.14284/370
- Snyder, B. A., Draney, M. and Sierwald, P. 2006. Development of an optimal sampling protocol for millipedes (Diplopoda). *Journal of Insect Conservation* **10**:277–288. <http://dx.doi.org/10.1007/s10841-006-6699-z>
- Stoev, P. and Geoffroy, J. J. 2004. An annotated catalogue of the scutigermorph centipedes in the collection of the Muséum National d’Histoire Naturelle, Paris (France)(Chilopoda: Scutigermorpha). *Zootaxa* **635**(1):1-12.
- Szabó, B., Korányi, D., Gallé, R., Lövei, G. L., Bakonyi, G., and Batáry, P. 2023. Urbanization decreases species richness, and increases abundance in dry climates whereas decreases in wet climates: A global meta-analysis. *Science of The Total Environment* **859**:160145. [doi.org/10.1016/j.scitotenv.2022.160145](https://doi.org/10.1016/j.scitotenv.2022.160145)
- Thapa, V. K. 2019. Invertebrates Fauna of Nepal (Excluding insect), pp. 350.
- Voges, E. 1878. Beiträge zur Kenntnis der Juliden. *Zeitschrift für wissenschaftliche Zoologie* **31**:127–194.
- Wesener, T. 2011. Re-discovery after more than a century: a redefinition of the Malagasy endemic millipede genus *Zehntnerobolus*, with a description of a new species (Diplopoda, Spirobolida, Pachybolidae). *Zootaxa* **3018**(1):21–26.
- Wesener, T. 2015. The Giant Pill-Millipedes of Nepal (Diplopoda, Sphaerotheriida, Zephroniidae). *Zootaxa*, **3964**(3):1–20. <https://doi.org/10.11646/zootaxa.3964.3.1>
- Wood, H. C. 1862. On the Chilopoda of North America, with a catalogue of all the specimens in the collection of the Smithsonian Institution.