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Temjenmongla

Zoological Survey of India,
Arunachal Pradesh Regional
Centre, Itanagar, Arunachal
Pradesh, India

Tinku Pegu

Zoological Survey of India,
Arunachal Pradesh Regional
Centre, Itanagar, Arunachal
Pradesh, India

First record of *Asiomorpha coarctata* (De Saussure, 1860) from Arunachal Pradesh, North East India

Temjenmongla and Tinku Pegu

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Abstract

Millipede belonging to the species *Asiomorpha coarctata* (De Saussure, 1860) is identified and reported here in this paper through this study; this represents the first report of *A. coarctata* not only from Arunachal Pradesh but from the North Eastern region of India as well.

Keywords: Millipede, first record, *Asiomorpha coarctata*, Arunachal Pradesh, biodiversity, hot spot

Introduction

Arunachal Pradesh is the largest state of the North East region of India in terms of geographical area with an area of 83,743 Sq. Km out of which 68,009 km² is under forest cover. The state is situated between longitude 91°30' to 97°30' E and latitude 26°28' to 29°31' N and it has a long international border with Bhutan to the west (160 km), China to the north and northeast (1,080 km) and Myanmar to the east (440 km). It stretches from snow-capped mountains in the north to the plains of Brahmaputra valley in the south. Arunachal Pradesh is a part of the Eastern Himalayan region hotspot, in fact, roughly, the entire state encompasses the eastern most part of the country (Myers *et al.* 2000) ^[30]. The State is home to myriad biodiversity, which has been documented and yet still, yielding species new to science. Conservation biologists warn that 25% of total life forms could become extinct during the next twenty to thirty years. There is gradual loss of fauna species and the causes for the loss of species are numerous, such as fragmentation of natural habitats, deforestation, Jhum cultivation, timber felling, hunting, soil erosion, encroachment problem and urbanization. Each community exercises control over the natural resources within their inhabited area and uses the resources for shelter, cultivation, food, daily multifarious uses and other human activities. In an era of human activities, global environmental changes, habitat loss and species extinction, conservation strategies are a crucial step toward minimizing biodiversity loss. The need and urgency to research and document the faunal species specially the least studied or even rarely studied as in the case of millipedes in the context of Arunachal Pradesh, a north eastern state of India is highly felt essential.

First appearing in the Silurian period, the arthropod class Diplopoda is one of the fourth largest class of Arthropoda and oldest as they belonged to the Devonian period and the largest among terrestrial arthropods after Chelicerata, Crustacea and Hexapoda (Bueno-Villegas *et al.* 2003; Sierwald and Bond 2007; Shear and Edgecombe 2010) ^[13, 37, 34]. They are found distributed in most parts of the world on all continents except Antarctica. This class, Diplopoda with a total of about 12,000 described species is the third most species-rich group of land arthropods on earth and contributes substantially to invertebrate biodiversity (Golovatch *et al.* 1995; Hoffman *et al.* 1996, 2002; Shelley 2007; Sierwald and Bond 2007; Brewer *et al.* 2012; Enghoff *et al.* 2015) ^[19, 22, 23, 36, 37, 12,17].

The name millipede derives from Latin roots, 'milli' meaning 'thousand' and 'ped' meaning foot. However, despite their name, these creatures do not have thousands of legs. They are omnivorous animals, but primarily feed on dead plant material and decaying matter on the forest floor. Millipedes are most commonly found in the cooler, damper and darker places within their environment and they inhabit areas under rocks, in the leaf litter, in rotting logs and occasionally in burrows which are all known as micro-habitats. They have a long-distinguished history on our planet, spanning over 400 million years. Millipedes are designated as 'ecological engineers' and play significant role in the breakdown of plant detritus and augment soil nutrient recycling in forests, their ecological importance is immense: the health

Corresponding Author:

Temjenmongla

Zoological Survey of India,
Arunachal Pradesh Regional
Centre, Itanagar, Arunachal
Pradesh, India

and survival of every deciduous forest depends on them, since they are one of the prime mechanical decomposers of wood and leaf litter, especially in the tropics. However, in spite of its large diversity and their significant contribution, they are poorly known and are often simply overlooked, certainly understudied and have long been neglected in all areas of biological research (Enghoff 2016; Kadamannaya *et al.* 2012; Ambarish and Sridhar 2013) [18, 27, 2].

The millipede fauna of India, one of the largest countries of the world, is diverse but still little is known. There is very limited work on millipedes from India, which makes even basic identification a challenging task. From India, a total of about 270 species in at least 90 genera, 25 families and 11 orders have been reported so far (Rajulu, 1970; Golovatch and Wesener, 2016) [33, 21]. In India, the feeding activity, habitats and food preference of millipedes has been studied (Bano *et al.* 1976; Bai 1997b) [11, 10]. Four species of millipedes belonging to four genera under three families have been reported from Delhi and for the first time from the South Arcot district, Tamil Nadu, there has been reports of 4 millipede species (Bai, 1997a; Bai and Indra, 1997) [9, 8]. In the Western Ghats and West Coast of India few workers have assessed on the distribution and moulting behaviour of pill millipedes (*Arthrosphaera*) (Ashwini and Sridhar 2008; Ambarish and Sridhar 2014) [7, 4]. There is even a study of the antioxidant activity of *A. fumosa* and *A. magna* (Ambarish and Sridhar, 2015) [5]. Likewise, studies on various other parameters like seasonal occurrence and activity, diurnal periodicity, morphology, distribution and diversity with respect to millipedes has been studied and widely reported (Ashwini and Sridhar 2006; Kadamannaya and Sridhar 2009; Kadamannaya *et al.* 2012; Alagesan and Ramanathan 2013; Ambarish and Sridhar 2013, 2015, 2016; Choudhuri *et al.* 2014; Sridhar 2016; Chezian and Prabakaran 2016) [6, 26, 27, 1, 2, 5, 3, 15, 38, 14].

However, studies with respect to taxonomy are scanty and the latest taxonomy work on millipede from India is a report on three millipede species of the family Paradoxosomatidae from Gujarat (Dash and Priyadarsini 2016) [16]. A study on the occurrence of Spirobolida and Sphaerotheriida has been recently reported from Arunachal Pradesh, North East India (Temjenmongla 2020) [39] for the first time. Apart from this report from Arunachal Pradesh and despite the fact that the state is considered to be one of the richest bio-geographical provinces of the Eastern Himalayan zone, there is rarely any other report or documentation on this fauna and as such this study was carried out in this region.

Materials and Methods

The millipede specimens were collected in June, 2018 and in March and September, 2019 from the Lower Subansiri district and from June, 2018 to August, 2021 from the Papum Pare district, Arunachal Pradesh, India. On the basis of gathering traditional knowledge, information from the local people about the locations where millipedes were likely to occur, the survey locations were so selected. Millipede collection was performed during day time from forest habitats, leaf litter was turned over with a garden rake or a small three-pronged garden cultivator, and rotting wood, logs, rocks and various drift wood remains were flipped to uncover and visually spot the millipedes which were then handpicked from the forest floor or the uppermost soil strata. With the aid of a GPS (Garmin Oregon 550) the collection sites were recorded.

Photographs of live specimens (Fig. 1) were taken using a Nikon D3400 DSLR camera and they were preserved in labeled vials containing 70% ethanol (Fig. 2). An Olympus SZ61 zoom stereo microscope was used for the observation study of the millipedes. The millipedes were identified based on morphological and taxonomical characteristics using systematic taxonomic keys (McCormack 2007; Likhitrakarn *et al.* 2011; Dash and Priyadarsini 2016) [29, 28, 16]. The identified voucher specimen was assigned a registration number and it is deposited in the collections of the National Zoological Collection of Arunachal Pradesh Regional Centre, Zoological Survey of India, Itanagar.



Fig 1: Dorsal view of *A. coarctata* (De Saussure, 1860)



Fig 2: Lateral view of *A. coarctata* (De Saussure, 1860)

Results & discussions

The millipede belonging to the species *Asiomorphaco Arctata* (De Saussure 1860) (Fig 1 & 2) was identified and is reported here in this paper. This study represents the first report of the

genus *A. coarctata* not only from Arunachal Pradesh but from the North Eastern region of India as well. *A. coarctata* is the synonym of *Orthomorpha coarctata*. It is a flat-backed, relatively small, long-flange millipede that is widely introduced species of Polydesmidan millipede. These flat-backed millipedes scavenge on plant material, usually in the leaf-litter, but some also feed on living plants or are arboreal and they prefer wet forest leaf-litter habitats.

A. coarctata belong to the family Paradoxosomatidae, which is one of the largest and most dominant family in terms of described genera and species among the 145 millipede families of the 16 diplopod orders (Nguyen and Sierwald 2013; Chaudhury *et al.* 2014) ^[31, 15].

Adult males range from 14.5–20.5 mm in length and 1.5 to 2.7 mm wide while adult females are somewhat larger ranging from 16.5–27.5 mm long, and 1.6–3.2 mm wide (Likhitrakarn *et al.* 2011) ^[28]. *A. coarctata* have proportionally longer and pointier Paranota (lateral keels) on mid-body segments (segments 8-9) and is yellow in colour. The male gonopod is long and slender and can be found on the 7th segment of the body and it reaches the posterior legs of the 5th segment (McCormack 2007) ^[29]. The gonopods have a single, simple tip, whereas in other species two or three lobes are present (Hoffman 1999; Likhitrakam *et al.* 2011) ^[24, 28]. *A. coarctata* is probably of East Asian origin and it became widespread in tropical and subtropical areas throughout the world, including the Hawaiian Islands, the West Indies, Gulf Coast of North America, and the Galápagos Islands (Jeekel 1963; Peck 1998; Shelly and Lehtinen 1998; Hoffman 1999; McCormack 2007) ^[25, 32, 35, 24, 29].

Conclusion

There are some few reports on other millipede species (Golovatch and Martens 2018) ^[20], however, with respect to *A. coarctata*, there is only a lone report till date (Dash and Priyadarsini 2016) ^[16]. India has received little attention as regards the millipede fauna, in spite of its uniqueness and extreme diversity. Research on charismatic animal species, mostly birds and mammals are important, but researchers should be particularly encouraged to take up studies of non-charismatic species like millipedes which make up the bulk of biodiversity that Arunachal Pradesh is famous for. Millipede is a neglected group of fauna and further study needs to be carried out by this group. The present study region provides a unique profusion of habitats with diverse biota and high level of endemism, it is very likely that more species of the class may be found in this remote location of the country, apart from the possibility of discovery of new species of this organism from this rarely studied area. Hence, further studies and documentation on this group of fauna is felt essential to be carried out.

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