

Chapter 5

A REVIEW OF LITERATURE ON THE DIPLOPODS OF THE FAMILIES HARPAGOPHORIDAE AND PARADOXOSOMATIDAE OF INDIA

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Abstract

This paper presents a review of systematic studies of the Indian Diplopods with a special reference to the two families Harpagophoridae (Order Spirostriptida) and Paradoxosomatidae (Order: Polydesnida). Among the Indian diplopods the distribution, diversity and abundance of species within these two families are very large in India and they are reported to be the endemic fauna. A total of 53 species of Harpagophorids ("stricto sensu") belonging to 11 genera and 57 species of Paradoxosomatid millipedes belonging to 24 genera have been reported in India.

Introduction

The class Diplopoda represents one of the largest classes of the animal kingdom and is the third largest class of the phylum Arthropoda (Goovatch *et al* 1995). It comprises of 80,000 species approximately (Hoffman 1980, Goovatch *et al* 1995), of which only 10-15% have been studied and described so far (Goovatch 1997). Diplopods are largely mesophyllic and hygrophyllic, hence their taxonomic richness, diversity and life forms are restricted to tropical and subtropical regions of the world. They are primarily stratobiont with a very few being cavernicolous and geobionts. Extreme habitats such as deserts and tundra are completely devoid of them (Golovatch 1987). Since these animals are very slow in their movements, cryptic in their habit, and have limited power of dispersal, every patch of land has different fauna of its own and it is so with tropical forests too. Millipedes with their long life cycles, and large number of stadia with frequent molts have limited power of dispersal. This results in high degree of speciation and endemism (Hopkin and Read 1992), which is very evident with the Indian fauna.

Diplopods are the common and conspicuous fauna of the upper soils and litter layers of the tropical, subtropical and temperate forest regions of the world. About 2500 genera are reported from all over the world, which are grouped into 160 families, 16 orders and 3 subclasses (Golovatch 1997). Most of the 10,000 described known species are known most of them are from European countries, and are probably 1/5th of the actual number of living species (Hoffman 1990). The research work on diplopods is very limited, and has received very little attention from systematists and the biologists. Perhaps their obscure nature might not have evinced interest among the zoologists and entomologists and thus there is a lack of expertise on the subject. The taxonomy of this group remains at alpha stage and the biology is at infant stage, excepting for a small group of North European fauna (Hoffman 1990). However, the investigations that have been carried out on the taxon have revealed some biological peculiarities that are restricted exclusively to this group. The synecological role of millipedes in the soil-litter milieu is comparable to that of earthworms (Hoffman 1990). These animals, as soil communities and their role in biological decomposition require attention, investigations and documentation.

Distinguishing features of Diplopoda

The class Diplopoda may be defined as a group of terrestrial, tracheate, antennate, mandibulate, progoneate, oviparous and anamorphic arthropods, bearing eight jointed antennae, a plate like fused maxillae called "gnathochilarium" the floor of the buccal cavity, a pair of mandibles functioning as cutting jaws. Diplopods are herbivorous, usually cylindrical, hard crustaceous long bodied animals, with two pairs of legs on most of the body segments that correspond to the double nature of the segments or the diplosomites. Anterior few segments bear a single pair of legs, and last somite is devoid of legs, but ends with a telson. Most of the body somites laterally carry a pair of ozopores, the openings of the ozodenes or the defence glands. Some of these peculiarities distinguish them from other Arthropods.

Review of literature

Despite their large availability, the millipedes are least explored in tropical countries and more so in India. The systematic studies of Diplopoda, which were conducted by the European investigators, date back to the late 19th and early 20th centuries. Pocock (1892) was the pioneer myriapodologist who described a few species of the order Helminthomorpha and Oniscomorpha from the collections of Government Central Museum, Madras (now Chennai), and published a monograph on the pill millipedes of India, Ceylon and Burma (1899). Subsequently, Silvestri (1916) described 4 new species of Aulocobolus from India, a few millipedes of the order Oniscomorpha from Oriental region (Silvestri, 1917), 5 new subgenera of Pyragodesminae (Silvestri, 1920), some Indian and Malayan millipedes of the family Trachyiulidae, and synonymised the genus Caimbolopsis as Tmchywius (Silvestri, 1923) and also reported and described a cavemiculous millipede from Siju caves of Assam (Silvestri, 1924). Attems (1936) was the first to give an exhaustive report on the Indian diplopods. He devised the key for their identification, and reported Indian fauna comprising of 290 species belonging 92 genera. All the species were reported to be endemic to India. Of the 92 genera, 64 are endemic and the other 28 are found to occur outside India also. He described 62 new species and 15 new genera, and stated that the reported faunistic list is far from complete, and description of zoogeographic distribution at that point would not be valid. The reported Indian fauna comprised of great number of Spheerotherida, Glomeridesmida, Spirostreptida, Spirobolida, and Polydesmida.

Review of literature on the family Harpagophoridae

Attems is the father of Myriapodology in India. His extensive work on this subject is the only reliable source of literature even to this day. Verhoeff (1936) reported a few species of this family from India. Carl (1941) brought out a monograph viz. "Nematophora and Juliformia" on the millipede fauna of South Peninsular India and Ceylon in which he reported several genera and species of this family new to science. Attems (1942) revised generic nomenclatures of some Harpagophorid millipedes proposed by himself and also by Carl. He allocated the species that were reported under the genus *Thyropygus* from



India to different genera viz *Phyllogainostreptus*, *Gnomognsithm*, *OrgMognaitus*, etc. after making careful studies of the collections. Krishnan (1968), the only Myriapodologist from India at that time, brought out a monograph on the single Genus *Thyropygus*, and described 10 species from South India, despite the fact that these species were allocated to different genera. This misrepresentation by Krishnan indicates that he could not lay his hands on the work of Attems (1941). Further, this genus has not been reported by any Myriapodologist from India. Demange (1968) and Hoffman (1975) have confirmed that the genus *Thyropygus* is an African genus, does not exist in India and has not been reported so far (Personal communication with the author), although there exists a close relationship between the Indian and African Fauna. In the wake of these findings, the earlier reports of occurrence of *Thyropygus* in India remain null and void. The extensive work of Demange (1968) included description with illustrations of several genera and species of Harpagophorid millipedes, along with key for their identification. His later works included a new species *Phyuogontofstreptus sihestris* from Sal forest, Madhya Pradesh (Demange, 1970), description of a new species *P. pocullifem* from south India, reallocation of *Thyropygus negotiosus* as *negotioms* (Demange, 1975), two new species *Cmlogonus palmatus* and *Orgsinognsithus janmdhsinam* (Demange, 1977a) and two species of *Cairlogonus*, viz. *C. chowdmeim* and *C. eicifer* from south India, a new genus *Msardonms* (Demange, 1977), description of a new species *C. auriculius* from Kamataka (Demange, 1983) and a new genus *Janardhananeptus* with a single new species *J. kannanorensis* from Kerala (Demange 1989).

All the above listed literature of different scientists being either in French or in German language, their accessibility to other scientists including Indian scientists have been very limited leading to poor study of this group of Arthropods.

Hoffman (1977) dissociated the genus *Leptostreptus* from the family Harpagophoridae and created a new family *Adiaphorostreptidae* with a type genus *Adiaphorostreptus*. To this new family he assigned *L. caudatus* and *L. fuscus* from Ceylon and *L. leviventer* from peninsular India. Hoffman and Burkhalter (1978) reported the genus *Gonoplectus* with five species from Assam and Darjeeling. Demange (1961) synonymised the genera *Thyroglutus* and *Gongylorthus* reported by Attems (1936) as *Gonoplectus*. According to Hoffman and Burkhalter (1978) Harpagophorid fauna of peninsular India is still poorly known, but it appears to have affinity with that of the South African fauna.

After a lapse of two decades, Bano (1998) presented a taxonomic review of the family Harpagophoridae with a checklist of Indian species known till then, and added a note on the emendation of the genus *Thyropygus*. A key for the identification of the Indian genera of the family Harpagophoridae, and an illustrated key for identification of the millipedes of the orders of Indian Diplopoda are under publication with Bombay Natural History Society.

Review of literature on Paradoxosomatidae

Daday (1889) proposed the family Paradoxosomatidae under the order Polydesmida. Cook (1895) created another family Strongylosomatidae. Attems (1914) erected the family



Strongylosomidae and published his work in *Das Tierreich* (1937). Under the family Strongylosomidae, Attems (1936) described a large number of species and genera along with the key for their identification. His work formed the basis of research for other diplopodologists. Hoffman (1963) in his work on this group of millipedes of south East Asia remarked that the diversity and abundance of this group of millipedes are at its zenith in peninsular India and adjoining islands. After a lapse of three decades, Jeekel (1968) studied this group of millipedes, resurrected the nomenclature Paradoxosomatidae proposed by Daday (1889) and synonymised the names Strongylosomidae and Strongylosomatidae. He revised the entire family giving morphological details of taxonomic importance, created several taxons, and provided diagnostic characters at all taxon levels. He gave a list of Indian Paradoxosomatid millipedes with their generic characters and their taxonomic positions. Jeekel (1980) allocated the names of the two species *Orthomorpha coonorensis* and *Orthomorpha dentata*. Carl (1932) to two new genera *Parchondromorpha* and *Harpagomorpha* respectively. He created a new genus *Antichirogonus* and placed the two Indian species *Sundanina laevisulcata* and *Sundanina hirta* under this new genus. In the same paper, he presented the characteristics of the genera *Polydrepanum* and *Dasypharkis*. Golovatch (1983) reported 16 species of Paradoxosomatid millipedes of 13 genera from India. Of them, eight genera were new to India and to science. In 1984, he created a new genus *Substrongylosoma* for two related species *S. distinctum* and *S. falcatum* both from Darjeeling, and simultaneously erected, a monotypic-genus *Himalomorpha* for a sympatric sp. *Strongylosoma montigena*, and these three species were placed within the tribe Strongylosomatini. In 1992 he reported *Kronopolites unicolor* from Assam and Darjeeling and assigned it to a new genus *Martensosoma*.

Golovatch and Martens (1996) reported a list of the fauna of millipedes from Himalayas including Indian species. Bano (1998) reported the distinguishing characteristics and systematics of Indian Paradoxosomatid millipedes with an updated checklist of the species of Paradoxosomatid millipedes known till then.

Review of literature as on today reveals that the Indian fauna consists of 11 orders, 19 families with 100-120 genera and about 500 species (Bano 1999). The reported number of species is definitely very much less than what must actually exist, and have remained unnoticed and undiscovered due to paucity of investigators.

With this basic knowledge on the subject, a study of diplopods was thought of. Among the 19 families reported, large species diversity was found with two families, the Harpagophoridae and Paradoxosomatidae, followed by Sphaerotheridae and Spirobolidae. To make a beginning in the study of systematics, the two families, Harpagophoridae and Paradoxosomatidae, were selected for the purpose of revision and updating. To explore the fauna brief surveys were conducted in the Western Ghats of peninsular India during the monsoon periods of 1994-1995. The millipedes collected were preserved, identified and described (1997). A baseline data on the taxonomic aspects and checklists of known species were presented (Bano 1998a,b).



From the collections made, twenty-four species of Harpagophoridae belonging to seven genera, viz. *Harpurostreptus*, *Carlogonus*, *Gnomognathus*, *Organognathus*, *Phyllogonostreptus* and *Humbertostreptus* were identified. *Humbertostreptus*, an African genus (Demange 1961), is reported for the first time from India. In addition, a millipede belonging to a new genus was also discovered, which is new to science and to India. The new genus is christened *Dharmastreptus* with a single species (Bano, report under preparation). Among the genera reported from India the genus, *Gonoplectus* is restricted to Northeast India, whereas the other genera are largely from peninsular India. The genera *Ktenostreptus* and *Fageostreptus* (Attems 1936) were lacking in the collections made by the author. This may be attributed to insufficient exploration or to incorrect identification of the earlier workers. Puttarudraiah and Shastry (1954) reported *Ktenostreptus* sp. as a pest on cotton crop from Chitradurga. In the present survey, two species of *Mardonius* (Order Spirostreptida: Family Spirostreptidae) have been collected from the same region on vegetable crops.

From the family Paradoxosomatidae, 18 species belonging to seven genera, viz. *Chondronpha*, *Anoplodesmus*, *Polydrepanum*, *Orthomorpha*, *Streptogonopus*, *Paranedyopus* and *Oxidus* were recorded. Two new genera of Paradoxosomatidae have been discovered that are yet to be named. Two new species belonging to the genera *Polydrepanum* have been discovered and are to be named. The report reflects faunal diversity, microhabitat and distributions of millipedes of these two families (Bano, 1997).

From Himalayan region more than 200 species of diplopods are reported (Golovatch and Martens 1996), of which about 50 species of 21 genera and 14 families are from North East India.

A checklist of Harpagophorid millipedes of India presented by Bano (1998) contains 60 species, out of which 20 are listed under "*Incertae sedis*". This means about 40 species are definitely Harpagophorid. This demands a revised study on identification of these millipedes.

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Plate 2



Tranantula Spider : WII AV Library



Platacanthomys lasiurus : S.U. Saravana Kumar

