



# Biological Studies of Millipedes In Amravati Region of Maharashtra, India.

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## ABSTRACT

Our biosphere is existing brimming with life. Out of which the class insecta is most gone after wide scope of creatures including the soonest referred to land animals spineless creatures referred as millipedes. All through my whole examination work I just gathered millipedes from 2 of the 9 potential requests. This could be because of the way that the two requests I did gather are known to happen explicitly in the Maharashtra, while the other seven requests are known to happen in an increasingly wide and general zone, for example, basically being discovered 'around the world' or in the India. By a long shot the most widely recognized millipede request gathered was Polydesmia and three types of Spirostreptida were found at every one of the six areas I gathered at. This was especially astounding to me thinking about that the request Polydesmida has just a solitary family happening in the Amravati locale, Maharashtra, and Spirostreptida has two families. This might be brought about by better soil sythesis because of the numerous orange, teak plants, cotton plants and banana trees situated in the region of where the millipedes were gathered. The spoiling and rotting organic product lying on the ground could add to progressively supplement rich soil and pull in increasingly full scale arthropods like millipedes. Then again, the nearness of the diverse natural product trees could likewise be a pointer of better soil. During the current examination an endeavor has been made to consider the assortment of Millipede types of various locale of Amravati District brought to the research facility and kept up in the glass tarrerium. Recognizable proof of these species is done with their morphological and anatomical investigation, nature of gathered species. Development and support of terrarium and stages in the existence pattern of the normal millipede *Anoplodesmus tanjoricus* of the Amravati district.

**Keywords:** Millipedes, Detritivores, Diplosegment, Megadiverse, Repugnatorial glands, sexual dimorphism, Polydesmia, cosmotropic.

## INTRODUCTION

The millipede species in found every wherein the field of green grants, gardens, open ground covered with grass, Anjangaon bari, Badnera, forest of Dharni, Chikhaldhara and Semadoh and other parts of Amravati district,

Maharashtra, India. The Arthropods are the most diverse group of animals amongst invertebrates on the planet. They comprise about 80% of the 1.5 million presently described species (IUCN, 2004). Despite this overwhelming diversity, they remain among the poorest known. Current estimates predict that only one quarter of the arthropod species have been described so far. The millipede class, Diplopoda, encompasses a spectacular hidden diversity: about 8000 species have been described from a worldwide fauna estimated to be tenfold greater (Hoffman *et al.*, 2002; Marek and Shelley, 2005). The arthropod class Diplopoda, the millipedes, ranks among the most diverse groups of terrestrial organisms, with over 12,000 species described. Although they play an important ecological role in most terrestrial ecosystems, little is known about the group's diversity, morphology, and phylogeny compared with other arthropod groups. The millipede class Diplopoda is a mega diverse and ancient terrestrial group, with more than 12,000 nominated species and an estimated diversity of approximately 80,000 species (Hoffman R. L. *et al.*, 2002.). Despite their remarkable diversity and importance as detritivores in temperate and tropical forests (C'arcamo *et al.*, 2000 and Crawford, 1992), major problems persist at all taxonomic and phylogenetic levels within the Group. The number of described species lags far behind diversity estimates. There are numerous monotypic genera; ordinal, subordinal, and familial relationships as well as placement of millipedes within the Arthropoda are either unresolved or controversial. Currently, 16 orders of extant and 8 orders of extinct millipedes are recognized.

### Morphology

The millipede body, similar to that of everything being equal, is secured by an emitted exoskeleton, or fingernail skin, made out of chitin and protein. The fingernail skin is solidified, by sclerotization (= protein tanning) yet additionally by the consolidation of calcium salts. Subsequently millipede sclerites are frequently hard, rocklike, and absolutely resolute. The stretch body is isolated into two particular tagmata, the short front head and the since quite a while ago, fragmented, posterior. The undisputed analytic component for the Diplopoda is the diplo section condition. A millipede body comprises of the head and a trunk area with four basic fragments. The rest of the body rings (BR) are made out of two sections, every

one of which conveys two leg sets (LP). The first trunk portion past the head is the legless collum fragment, which is likewise found in the Paupoda, the undisputed sister gathering of the millipedes. Every one of the following three sections conveys one set of legs. They originate ventrally and comprises of seven podomeres (coxa, trochanter, prefemur, femur, postfemur, tibia, and bone structure). The gonads open on or behind the subsequent LP (third trunk ring, progoneate position). Millipedes have a solitary pair of reception apparatuses with seven articles (eight in Penicillata) and four special tactile cones (diplopod apomorphy; on the last antennomere). The sidelong fixes of ocelli, found in most however not all millipede gatherings, are viewed as compound eye subordinates (Spiess, 1981); middle eyes are missing

### MATERIALS AND METHODS

Species of millipede were collected for identification and carefully described in the laboratory. All the morphological characters of male and female were recorded and the species were identified up to order. The millipede species were preserved as per the method given by Dr. Richard L. Hoffman. During the present study (2005-2009), Arthropods-Millipede (diplopods) were collected from various places in Amravati district, such as Anjangaon Bari, Semadoh, Chikhaldara, Parathwada, Nandgaon-khandedwar, Pohara, campus of Shivaji Agriculture College Amravati, Melghat, Badnera, Achalpur, Chandur, Dhamangaon etc. Specimens were brought to the laboratory and maintained in the glass terrarium filled with the soil brought from the collection site. The soil of the collection site shows the presence of 2.7% mg/kg total nitrogen, 2.3% mg/kg total phosphorus, 1.5% mg/kg total potassium, Sodium 0.81% mg/kg, Magnesium 32.32% mg/kg and Calcium 85.2% mg/kg. The pH of the soil is slightly alkaline (7.5) and Ec is 0.21. Some small pieces of bricks were kept in the terrarium and water was poured on these pieces of bricks to keep the soil of the terrarium moist. In laboratory, these millipedes were provided with leaf litter, banana testa, some green leaves and cucumber slices under laboratory conditions. It was observed that these millipedes preferred mainly cucumber slices and banana testa only. Before the study millipedes were separated from the stock. These studies were conducted with magnification, preferably with the help of a dissecting microscope to observe the specimen.



**Figure 1:** Photograph of *Anoplodesmus tanjoricus* in culture box.

Total eight different species of Millipede were collected and sent to Prof. Hoffman, Curator museum of natural history U.S.A. for identification, this study revealed that in the district, millipedes of two orders (Polydesmida and Spirostreptida) are found. These are as follows.

1. *Anoplodesmus tanjoricus* (Pocock, 1892), order Polydesmida.
2. *Mordoniusimportatus* (Demanage, 1977), order Spirostreptida.
3. *Phyllogonostreptusamballae* (Chamberlin, 1923), order Spirostreptida.
4. *Chondromorphamammifera* (Attems, 1936), order Polydesmida.
5. *Chondromorphakelaarti* (Humbert), order Polydesmida.
6. May be new genus and species (Hoffman), order Polydesmida.
7. Scientifically undescribed (Hoffman), order Polydesmida.
8. Undescribed, order Spirostreptida.

Out of these eight species one species (no. 6) is reported for the first time from this region and two species (no. 7 & 8) are under the process of description. The eight millipede's species are discussed in the light of systematics, ecology and evolutionary relationship. Detailed morphology of two millipede species namely, *Anoplodesmus tanjoricus* and *Mordoniusimportatus* has been studied. The life cycle of species *Anoplodesmus tanjoricus* is studied in laboratory. An exhaustive literature survey has been done to describe the millipedes collected from the district. *Anoplodesmus tanjoricus* (no. 1) species is found distributed throughout the district. This species is found in large number in village Anjangaon Bari about 15 km. away from Amaravati, probably because this soil is rich in Calcium 85.2% mg/kg, Magnesium 32.32% mg/kg and the pH of the soil is slightly alkaline (7.5). This species is easy to culture in laboratory as it feeds on

decaying leaves normally on cucumber slices, banana tasta. This species constructs housings (chambers) in the soil of the glass terrarium in the laboratory.

This species breeds in the soil of glass terraria and all stages in the life cycle of this millipede could be studied. This species has a peculiar smell due to the secretion of repugnatorial gland. Their secretion causes irritating sensation to the eyes when observed from short distance. The finding regarding identification and taxonomic status of the millipede species of Amravati district are in agreement with earlier studies. The work of identification of the undescribed species will be done during the continuation of the studies on millipedes in near future. Some conclusions regarding sexual dimorphism in millipede species are as follows.

1. The population of females is more than males.
2. The legs of males are slightly longer than those of the females of same size.
3. Females are thicker dorso ventrally than that of males.
4. Females are slightly longer than males.
5. Chestnut color of females is often darker than that of males.
6. The longitudinal yellow ridges (*A. tanjoricus*) along the keels of the males appear to be more prominent than on the females.
7. Females have thirty one pairs of leg in Polydesmida (except undescribed species no. 6 in which there are twenty nine pairs of leg) and males in Polydesmida have thirty pairs of legs.

## RESULTS AND OBSERVATION:

### 1: Sexual dimorphism (Figure 2 A & B):

The millipede *A. tanjoricus*, exhibits distinct sexual dimorphism. The females are always longer and

broader than males. A fully grown specimen of both the sexes is shiny black in colour with a pair of yellow ridges per segment on lateral sides. Adult male specimen measures about 3.5 to 4 cm in length , 0.3 to 0.5 cm in width and female is measures about 4 .5 to 5 cm in length , 0.4 to 0.6 cm in width , body weight is about 450 mg. and 550 mg. in male and female respectively.

**2: Antennae (Fig. 3 A and B):**

The anterior most head appendages are the two filiform antennae which are creamish brown in colour, each consisting of 7 cylindrical articles. The antennae articulate with the anterior and dorsal surface of the head capsule. The tip of the distal antennal article has four tiny chemoreceptive cones (Cone sensillae) characteristic of diplopods, as well as numerous mechanoreceptive setae. A walking millipede

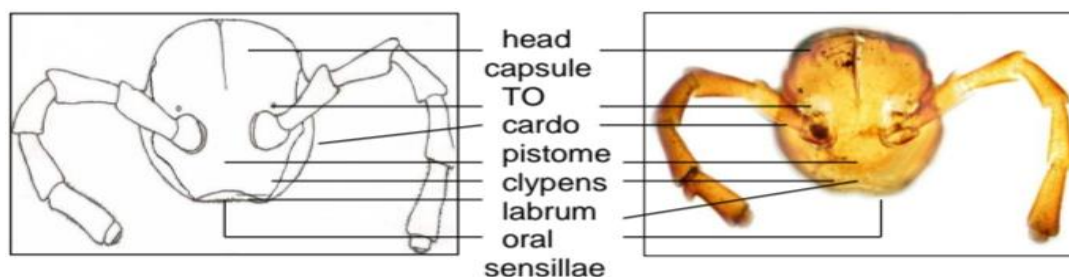
continuously taps the ground with the tips of its antennae.

**3. Mandible (Fig. 4A and 4b):**

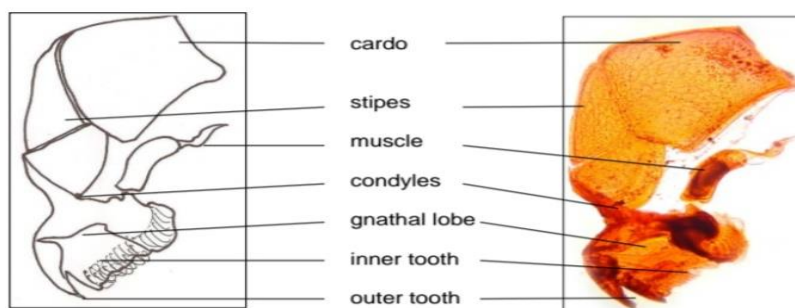
The mandibles are the second pair of head appendages and first pair of mouthparts, mandibles are large, powerful and heavy, making up most of the side of the head. Each consists of a heavy, immovable, biarticulate mandibular base and a toothed, movable, distal gnathal lobe. It consists of a proximal basal article, the mandibular cardo, and a distal basal article, the mandibular stipes. The gnathal lobe has two sclerotized movable teeth, the outer tooth and the inner tooth, a rasp-like molar plate, and a set of pectinate lamellae. The gnathal lobes articulate with the stipes of the base , bears many small teeth which are minute, curved and sickle shaped. All the teeth are directed inwards. The mandibles are sclerotized and bears a single condyle.



**Figure 2A :** Photograph of Female *Anoplodesmus tanjoricus* (ventral view). **B)** Photograph of Male *Anoplodesmus tanjoricus* in ventral view showing gonopods (ventral view).



**Figure 3A & 3B:** Diagrammatic representation and Photograph of Head of *A. tanjoricus* (Dorsal view) showing pair of Antennae & Labrum.



**Figure 4A and 4B:** Diagrammatic representation and Photograph of Mandible of *A. tanjoricus*.

**4) Gnathochilarium (Fig. 5A and 5B)**

The labium-like gnathochilarium (= lower lip) is the third pair of head appendages and is posterior to the mandibles. It is a specialized feeding structure, almost completely covers and hides the jaws of the mandibles from view. Like the insect labium, the gnathochilarium is a single piece formed in development by the median fusion of two lateral appendages. It is a broad, flat plate ventral on the millipede head. The gnathochilarium consists of two large lateral stipes, a median triangular promentum, a small mentum, submentum and two medial lingual plates (= lamellae linguales). Each stipes has two distal sensory pegs bearing contact chemoreceptor's (taste).

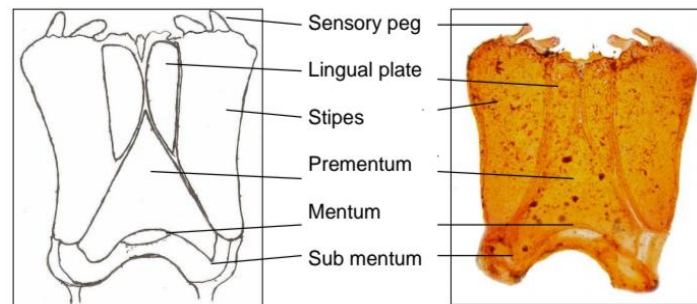
**5) Leg (Fig. 6A and 6B):**

Legs are present on all trunk segments except 1,19 and 20 and are creamish brown in colour. The legs are strongly homonomous in size and morphology, with no regional specialization. The only exception being the extreme modification of 8th pair of legs on VII segment, which become the intromittent organs called

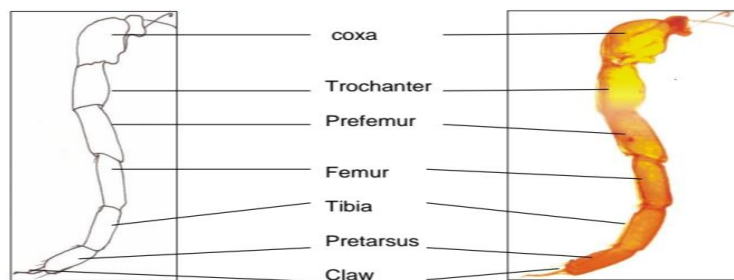
gonopods. The legs extend laterally and then ventrally to support the body rather like the legs of reptiles. In *A. tanjoricus* the male has 30 pairs and female 31 pairs of leg. Each leg consists of seven articles. These articles are (in order from proximal to distal): coxa, trochanter, prefemur, femur, tibia, tarsus and the claw like pretarsus. Only the tips of the pretarsi contact the substratum when walking.

**6) Gonopods: (Fig.6 and 6.1):**

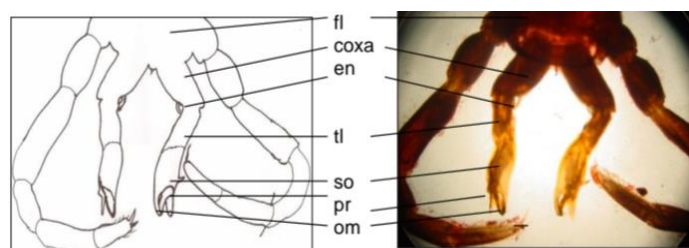
Male millipedes transfer spermtophores with the help of a pair of gonopods present on the seventh segment. Sperm transfer is indirect and employs the gonopods to move spermatophores from the male gonopores on the genital segment (segment 3 of male) to the female vulvae on her genital segment (segment 3 of female). The complicated morphology of the gonopods is species specific and serves as a mechanical species isolating mechanism and is also important in species level taxonomy and consequently is useful in species identification.



**Figure 5A and 5B:** Diagrammatic representation and Photograph of Gnathochilarium of *A. tanjoricus*.



**Figure 6A and 6B:** Diagrammatic representation and Photograph of Leg of *A. tanjoricus*



**Figure. 7A and 7B:** Diagrammatic representation and Photograph of Gonopods of *A. tanjoricus*.

## SUMMARY AND CONCLUSION

The findings on identification and taxonomic status on the millipede species of the Amravati district are in agreement with the earlier studies. The finding of present studies indicated that the millipedes of order Polydesmida and Spirostreptida could be diffracted (Key for identification) from the following characters.

- 1) Tomosvary organ is always present in Polydesmida and present or absent in Spirostreptida.
  - 2) Ocelli are absent in Polydesmida and always present in Spirostreptida.
  - 3) Stipes of gnathochilarium of Polydesmida are close to each other while in Spirostreptidastipes of gnathochilarium are widely separated by large promentum.
  - 4) In Polydesmida only anterior pairs of leg on seventh body segment is modified in to gonopod while in Spirostreptida both the leg pairs on seventh segment are modified in to gonopods and gonopods are more complex in Spirostreptida as compared to the Polydesmida.
  - 5) The fourth segment is with single pair of leg In Polidesmida while in Spirostreptida fourth body segmens without legs.
  - 6) In exoskeleton sternal region is smaller in Polydesmida and larger in Spirostreptida.
  - 7) Body segment are 19 or 20 in Polydesmida while in Spirostreptida there is greater no. of body segments are 50, 57 or 67.
  - 8) Anal spine is short, downwardly directed in Polydesmida while in Spirostreptida it is sharp, pointed and straight.
  - 9) Paranota of the exoskeleton is either present or absent in Polydesmida while always absent in Spirostreptida.
  - 10) The speed of movement is greater in Polydesmida as compared to Spirostreptida.
  - 11) Polydesmids are smaller in size while Spirostreptida are larger to giant.
  - 12) Head capsule has occipital suture in Spirostreptida while in Polydesmida it is absent.
1. These studies are of academic and economic importance. The study of millipedes of Amravati district requires further attention and in future, the work of identification of unidentified and undescribed species will be continued.

### Conflict of Interest

The author declares that there is no conflict of interest.

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