



**ORIGINAL RESEARCH PAPER**

**Zoology**

**A REVIEW OF MICRO-ARTHROPODS AND ITS DEPENDENCY ON MOSSES**

**KEY WORDS:** Micro-Arthropods, bryophyte, microhabitat, diversity.

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**ABSTRACT**

The study was undertaken to assess the micro-arthropod diversity in the moss microhabitat. Microhabitat analyses are of major concern as far as modern biology and ecology is concerned. Mosses are bryophytes abundantly occurring in almost all humid environments seen attached to all substrata. They play a major in retaining the water and maintain the ecology of the entire ecosystem. Micro-arthropods are small bodied soil organisms which have a crucial role in the ecosystem as decomposers. With the objective of understanding the diversity of micro-arthropods, in the moss microhabitats a preliminary diversity and density assessment study was undertaken. The multiple samples of mosses were collected from various microhabitats to assess the density and diversity of micro-arthropods.

**INTRODUCTION**

The plant-animal interaction is an unavoidable coexistence for the food, shelter reproduction and other aspects. Some have been even co-evolved in such a way that the vanishing of one species even raises challenges on the existence of the other. Coevolution is defined as an evolutionary process, where the two organisms interact among one another very close so that they evolve by mutual benefit in response to the antagonistic selection pressure of nature (Brown and Vincent, 1987). Minute invertebrates like micro-arthropods as being considered as decomposers prefer leaf litters are generally referred as soil micro-arthropods (Moore *et al*, 1988). As the definition of micro-arthropods accounts diverse group of organisms, the ecological niche of each organism may differ from one to another. These organisms prefer "microhabitat" with limited size, but can fulfill all the physical as well as metabolic needs. The choice of microhabitat differs with species to species. One habitat may occupy with single species or of multispecies based on their ecological preferences. When the habitat preference of a micro-arthropod lies in a single floral species, it can be referred as a monotypic micro habitat (Caruso *et al*, 2013).

**Bryophytes (Moss)**

The bryophytes or "moss plants" are the monotypic micro habitat. The nonvascular cryptogams, and the most primitive terrestrial plants having the specialty of being the second largest population among the floral vegetation (Sabovljevic *et al*, 2009). Mosses have incomparable capacity to withstand vast environmental conditions and play a significant role in the ecosystem dynamics. Their adaptability helps them to grow in large extent of habitats which inturn helps to stabilize the soil and protect from erosion (Saxena, 2004). Bryophytes possess a uniqueness (of being host) as they act as host plant for diverse microorganisms in countless ways. Owing to the small size and the ability to colonize on a variety of substratum moss grow enormously results in the formation of colonies, mats and cushions without any periodical leaf fall enables the colonization for a long period (Proctor, 1990). They absorb water content available in the atmosphere and hence able to withstand extreme environmental conditions which facilitate easy microbial colonization (Dobbeler, 1997). The diversity of bryophytes is primarily linked to moisture content followed by the pH value and other aspects such as latitude, available light, nutrients etc. Their vegetation is limited to moist environment (Cogalniceanu, 2014). They lack a true root-shoot system and significantly rely on diffusion for water.

**Role of Microarthropods in Moss**

Approximately 1,00,000 micro-arthropods are there in a cubic meter of moss microenvironment (Gerson, 1982). The micro-arthropods are invertebrates, having cuticular exoskeleton and segmented body playing a very important role in the food web. The insect orders collembola, diptera, hemiptera, hymenoptera,

orthoptera and the acarine orders cryptostigmata and prostigmata are known to feed on mosses (Gerson, 1969). The microarthropods are benefited from moss (Fig 1) in many ways, such as shelter, source of water, and may derive their food from the mosses. They are tiny and their body is very thin. Due to this reason their bodily water may easily get evaporated. Hence, they prefer to live in the moss habitat to retain their moisture, because naturally the moss has the ability to hold lots of water (Wood, 1967). The microarthropods are also mediate as a sperm transfer and playing role in moss fertilization (Cronberg, 2012). The female moss emits the chemicals with the more odors than the male plants it may attract the microarthropods towards the female plants (Seaman, 2012). And also the volatile compounds influence the attraction of microarthropod and mediate fertilization of moss (Rosenstiel *et al*, 2012). The major micro-arthropods are mites, spiders, pseudoscorpions, myriapods, centipedes, millipedes, symphylans, springtails, insects and beetles. Due to the complexity in the taxonomy and the difficulty in understanding most of these organisms remain unidentified till date. Among these groups, the spring tails are a major group with unavoidable roles in ecosystem.

**Fig 1: Microarthropods collected from Moss**



**Spring tails**

The word "Collembola" is derived from the Greek word meaning "colle"= glue and "embolon"= piston or peg. Worldwide, about 8800 species of collembola have been described (Bellinger *et al* (2018). The morphological molecular and fossil evidence shows that, the Collembolas are separate class related to insects. Usually collembola between 1 and 3 millimetres in length, easily to seen with the aid of a microscope. Some species may grow to 10 millimetres in length and can be easily seen with the naked eye. Under collembola ,Arthropleona have elongated body while symphyleonans have globular body (Davies, 1927). They are found in almost every part of the earth, from the Himalayas to Antarctica. They help to control the fungal diseases of some plants and even influence the mycorrhizal growth by carrying the spores. Collembolas play a major role in degrading the organic materials; transportation of fungal spores and ensures the microbial balance. Besides their role in ecology hold as food source for many living

organisms such as ants, beetles, lizards, frogs, etc. Springtails are also considered as the indicators of soil pollution because they cannot thrive in polluted soil.

Springtails occupy a wide variety of ecological niches ranging from herbivore or carnivore to a detritivore. Fungi are important diets of many species but even some species reported to suck the extracts from plants. Sminthuridae are good examples for those species which are strictly herbivores (Chahartaghi *et al*, 2005). As collembolans are very soft and thin, their bodies dry out very easily in the environment. Their life cycle is very short and reaches its adult stage and sexual maturity within three weeks. Before attaining the sexual maturity they usually undergo molting 4-5 times. Springtails are supposed to evolve in a cool climate and they tend to increase in their numbers abundantly at low temperatures and cool conditions.

**Arachnids**

Arachnids are primitive arthropods which can be easily distinguished by the presence of eight legs and a pair of appendage for feeding, defense and perception. The body is divided into cephalothorax (formed by fusion of head and thorax) and the abdomen. In arachnids the pair of legs may vary and the abdominal section may be seen fused together. Generally, arachnids are carnivores and they feed on the predigested bodies of animals and are able to produce highly poisonous venom. They produce digestive enzymes and secrete it over the dead prey using pedipalp and chelicerae. The digested broth is sucked into the stomach with the help of sclerotised pharynx, which acts as a pump.

**Acari mites**

The major arachnids in the moss are acari (acarina) and pseudoscorpions, among which the acari includes the ticks and mites. These arthropods are capable of living in every habitat ranging from terrestrial to aquatic. They are mainly predators while some are detritivores, they are used even to control other arthropod pests. However, the mites like red spider mites are considered as pests or even can cause various diseases in vertebrates. Oribatid mites commonly called as "moss mites" are a major group of soil micro-arthropods supposed to feed mainly on decaying matter or as predators (Alberti *et al*, 1994). They are considered as beneficial organisms capable of maintaining soil health (eg: earthworm) and none of the members are considered to be parasitic. Though several thousand of species has been described worldwide still much of the species remain unidentified. They have a strong exoskeleton hardened by sclerotisation commonly seen among the litter debris, mosses and lichens. Unlike other micro-arthropods they reproduce very slowly and in cold conditions; their life cycle can extend up to two years. Interestingly they seem to be parthenogenic, without the record of males. Due to the slow metabolic rate, slow development and lower fecundity rate they are found only in relatively stable environment. However, the biology of this species remains untraceable to date. Though the adult mites are not easily preyed by other animals, the soft bodied nymphs are attacked by soil predators.

**Pseudoscorpions**

Pseudoscorpions are scorpion like small flat arachnids generally prey on other arthropods and are harmless. The colour of the body can be yellowish to dark brown with claws displayed in different colour. They are capable of stinging the prey using the venom in the mobile finger prior to digestion. They are more active in the summer days and spend the cold conditions in the silken cocoons (Annamalai *et al*, 2012).

These all microarthropods may absorb micro / macro-nutrients either from the moss plant directly or indirectly. Moreover they may depend on the fungus and bacteria which may present in the moss environment.

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