(3)

ICV 2016: 88.13
SJIF Impact Factor 8.883

ISSN:2320-7817(p)
ISSN : 2320964X(o)

International Journal of

Life Sciences

An International Peer Reviewed Open Access Journal

Volume 10 Issue 2 June 2022

SFRI

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International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2022; 10 (2): 161-166
ISSN:2320-7817(p) | 2320-964X(o)

Research Article | Open Access

Faunal composition of humus soil in Melghat forest of India

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Manuscript details:
Received: 20.03.2022
Revised 16.04.2022
Accepted: 15.05.2022
Published: 29.05.2022

Cite this article as:
Mangle Vijay S (2022) Faunal composition of humus soil in Melghat forest of India., *Int. J. of Life Sciences*, 10 (2): 161-166.

Available online on http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

A good soil consists of minerals and bioorganic substances. Biogenic part consists of soil animals ranging from microscopic animals to large animals and organized in to complex food web. Among the soil fauna, soil invertebrates are important component of tropical forest ecosystem. The Melghat forest is mixed dry deciduous type and soils are bouldry to gritty loam. The forest generates large volume of litter as they grow, but all the litter is converted to soil organic matter, the job is done by a complex community of bacteria, fungi and diverse invertebrate animals. The animal members of the soil biota are numerous and diverse. The most invertebrates were group of hexapods, myripods, arachnids and oligochits. The soil fauna characterized by the degree of presence in the soil or micro habitat utilization by different life forms. The present attempt was made to study the faunal composition of litter and humus soil.

Keywords: biogenic, fauna, forest, humus soil, invertebrates, litter.

INTRODUCTION

Soil moves continually in a nature cycle aided by oxygen, water, minerals, decomposing animals and plants matter. These elements create life in the soil, which is ongoing if not disturbed. Good soil consists of 93 % minerals, 7 % bio-organic substances, in the bio-organic part, 85 % humus, 10 % roots, 5 % edaphon. Edaphon is itself world of life and consists of microbes- fungi 40 %, bacteria, actinomycetes 40 %, earthworm 12 %, micro fauna 5%, and macro/macro fauna 3 %.

The forest litter is a heterogeneous mixture derived from the seasonal loss of various tissues of different species. The physical reduction and mixing of litter are carried out by an abundance of soil animals, ranging from microscopic nematodes to large animals (Hole, 1981).

The classical role of the soil fauna is in the breakdown of dead plants and animals, which are returned to the soil. Accompanying this decaying process is the release of nutrients from the organic body of

plants and animals into the soil. Effects of animals and on the soil results changes in soil fabrics, i.e., size, shape, arrangement of soil components and changes in soil composition (Darlong*et al.* 2009).

Soil invertebrates are important components of tropical forest ecosystem; diverse group of animals creates a range of taxa, the most important being, protozoan, nematodes, earthworms, mites, springtails (collembolan), millipedes, centipedes and range of insects mostly belonging to Dipterans, Coleopteran and Isopteran

MATERIALS AND METHODS

Study area: The Melghat forest, the north-western compact block extending over 3075 sq. km in the Amravati district of Maharashtra. It is situated on the branch of a Gavilgarh hills being the name of the fort on the one of the southern spurs. It is located at, 21° 15' N and 21° 45' N Lat, and 76° 57' E and 77° 30' E.

Climate: In order to get climatic conditions of Melghat forest, the data of rainfall, temperature, humidity and relative humidity was obtained from Sipna's Weather Observation and Information Center and weather stations of Melghat Tiger Reserve. Rainfall ranges from 750-800 mm in southern slopes of Gavilgarh range and rest of the tract, varies from 1000-2500 mm. The higher hills and plateau are very much cooler than plain and valleys, and humidity and plateau during monsoon goes 100% for 30 to 90 days.

Soil: The soil types vary considerably, probably due to different conditions of weathering and considerable variation in the rainfall within tract. The following are local types of soil usually found in Melghat. The soils are- *bouldery soils, clayey soils, alluvium, lateritic loam, gritty loam.*

Sampling Sites: Sampling sites are located over Melghat Forest, the criteria for fixing of sampling locations are based on type of geographical terrain, i.e. Chikhaldara Plateau- higher location, Harisal Plane in Chourakund Range and Sipna River Valley at Kuvapati.

Sampling of humus Soil: During study, humus soil samples were collected by large steel spoon / showel in rainy season at selected locations, where normal undisturbed forested floor, litter level was very thick above the normal mineral soil, a black colored organic material identifies as humus.

Sampling of macro and micro soil Invertebrates: The soil invertebrates (macro arthropods) were captured by hand picking during the humus sampling and with the help of *Barber traps or Pit fall trap* named for their inventor. Sampling of invertebrates started still from start of rainy season (June-September). Soil / litter dwelling micro-invertebrates can be sampled by *Berlese* Apparatus. The macro soil invertebrates collected during sampling of humus and preserved for further identification.

RESULTS AND DISCUSSION

Present study is based on field observations, sampling, isolation of invertebrates their preservation and its identification. During the study, sampling of humus soil at different pre –fixed sampling sites following invertebrates were observed-

Collembola (springtails)- Two microscopic and one macro species of springtails were observed in humus soil samples of Chikhaldara plateau and Semadoh valley at Kuapati site. One red colembelon was observed on rotting wood in soil. During rainy-moist season, where temperature falls down, the moisture content in decomposing litter, the maximum numbers of colembelon were observed.

The colembelon are small, wingless insects, they have name springtails from the fact that, many of the species are jump by means of lever (the furcula) attached to the bottom of abdomen. Generally these collembolans feed on decaying vegetation and associated bacteria and fungi. They prefer dark, damp habitat. These are inhabited both the surface and depth of soil, in the surface in large numbers under overturned rotting logs, leaf litter. Soil springtails are abundant in a variety of environments, from forests to agricultural crops and bogs, from the deep soil to the crown of trees and from seashore to higher mountains (Ponge, 1993).

The population of collembola was found maximum in the month of August in both the year, which coincided with the maximum concentration of soil factors like moisture, pH and organic carbon. (Mandal *et al.*, 2011). Pushpendra Kumar Sharma and others in 2020

observed that, individuals (133) were collected during rainy season, followed by winter season (88) and summer season (56). These observations revealed an important role of temperature and humidity (moisture in the soil) in the distribution of these insects. Springtail communities have been shown to be good indicators of environmental health (Van, 1997).

Mites (acari): The four species of microscopic mites were isolated from humus soil samples of plateau, plane and valley sites. Mites are the most numerous arthropods living in the soil. The acari have very variable morphology and habitat; among them are phyto saprophagus, predators, sapsuckers and haematophagus.

These occur in leaf litter debris and some time mosses and lichens. Oribatid mites graze on algae; consume decomposing plant litter and occasionally dead collembolans. These are important components of decomposers; their abundance, species habitat serves as good indicator of soil health. By their very numbers, they play an important role in the decomposition of organic substances in the soil. They are also apparently suitable as biological indicators (Shelley and Basu, 2015). They also feed on fungi and small arthropods (collembolans, soft bodied mites, insect larvae, and eggs).

Due to the sensitivity of soil mites to soil disturbance, their diversity and numbers can be used as ecological indices for assessing disturbances in ecosystems. (Mehrnaz, et, al., 2020). Recently research has focused on the role of mites (acari) in bio monitoring and their importance as soil bioindicators. Mite communities are extremely sensitive to all types of soil disturbance (Maria, 2007)

Myripoda- Diplopoda (Millipedes): The most of the species were observed in plane and valley areas of forest and lacking at plateau may be due to heavy rain and minimum temperature at Chikhaldara plateau. The four species of this organism was observed in upper soil layer. These were observed in dark and damp places in forest, mostly in humus soil tend to feed on the litter, living plant roots and dead wood. These are herbivorous, and burrows in to litter.

Millipeds are sluggish, timid and secretive creatures, avoids enemies and holding in damp and dark places such as under stones, logs and barks among decaying leaves or in moss or rooten wood. (Patil *et al.*, 2018). Millipedes are known to associate with a wide range of fauna and microbes, thrive on a variety of organic matter of low to high nutrient value, disintegrate organic matter, mix fecal pellets with microbes and transform into humic substances (Sridhar and Ashwini *et al.*, 2011)

Chilopoda (Centipedes): Four species of the centipedes were found in decomposing leaf litter and humus soil. A very typical centipede species *Scolopendra hardwickei* found in Chikhaldara plateau. India harbours 95 species of Scolopendrids, *Scolopendra hardwickei* (Newport 1844) being the largest (Khanna 2009). *Scolopendra hardwickei*, the Indian tiger centipede, is a species of centipede in the family Scolopendridae. *Scolopendra hardwickei* can reach a length of 16 centimeters (6.3 in). It is a pigmented species, with exceptionally bright and contrasting coloration, alternating dark orange and deep black segments, with dark orange legs. Feeding primarily on insects and other invertebrates. Centipedes are common predators in soil, litter in cryptozon habitats. These are elongate, flattened multi segmented body, efficient and active these are earthy and moist environment (litter or cryptozoic habitat).

Symphylan: A typical single species was observed in the sample of Chikhaldara plateau, the samples from plane and valley sites lacking this invertebrate. These are found in forest soil litter decaying wood. Symphyla participate in breaking down organic matter redistributing the nutrients to soil profile. Symphylas are related to centipedes (Chilopoda) and millipedes (Diplopoda). Symphyla are small (0.2-1.2 cm length), creamy white, blind soil myripods, these are very common in soil habitat. These have soft; elongated body consists of 15-24 segments and ends with two pointed cerci. These can easily distinguished from centipedes as they lack the forcipules (poison claws). The present single specimen is approximately 1mm in length and collected from the humus soil of Chikhaldara range forest. Symphylids migrated in response to changes in soil moisture content and could not survive when soil air was less than 100% R.H. (Edwards, 1961).

Diplura (Description): The present specimen of Diplura collected from Chikhaldara range forest, but this was also observed at Kuwapati valley site. Diplura are cryptic animals, blind and colorless, usually 0.3-1.0

cm long. The specimen symphyla was 0.5 cm long, and whitish in color. Diplura found in the top layer of soil, decomposing leaf litter under rotting woods, and under stones. Diplura posses chewing mouthparts and feed on variety of live prey and dead organic matter. The preys are collembolans, soil isopodes, small myripodes, insects and their larvae and even other diplurans. They may also supplement their diet with fungal mycelia and plant debris. Diplura depends on high humidity and moderate temperatures. They are presumably very sensitive to anthropogenic pressures and climate change, and therefore are a suitable model for eco physiological studies and evident priority targets for conservation (Alberto *et al.*, 2021)

Earwig: The specimens of earwig was observed during humus sampling at Semadoh valley site and Chikhaldara range site respectively.

Earwigs are elongate, slender, flattened insects with a dark body and prominent forceps-like cerci at the end of the abdomen. These are of 1.5 cm long and dark brown to black in color. The antennae shows beaded structure and legs are transparent to white. They have no wings. They patrol on ground. The predators are ground beetle, fungi gnats etc., as well as on small invertebrates. European earwigs are generally not regarded as a pest in grain crops internationally (other than occasional harvest contamination), and potentially play a beneficial role in pest management (Sunderland *et al.*, 1980). The interaction between rhizobacteria, plants, and herbivores can affect the predatory earwig's behavior. (Kim *et al.*, 2020). Earwigs are predators in many crop systems, but may be pests in others. To address uncertainty regarding the pest status of European earwig, we review its biology, effects in fruit agro ecosystems, and management. (Robert *et al.*, 2019).

Cockroach: Celatoblatta vulgaris: Specimen cockroach was brown colored with characteristically flattened body, long antennae and long running legs. This species is common to all sampling locations. These are live in litter, under debris, rocks, stones, under bark of logs, in rotten woods. These are omnivorous and may feed on all sort of organic material. They can even eat dead wood which they digest with the help of symbiotic gut flora.

Silver fish (Lepisma sp.): The specimen was found at the Kuwapati site and it measure 1 cm in length. It is a glistening silver white and fish shaped insect, which avoid light. Body surface is covered with loosely attached scales. Three pairs of walking legs are present. It can also be found outdoors under rocks, leaf litter, in caves, and in ant nests (Triplehorn and Johnson 2005). Lepisma hides in damp, cool places and mainly feeds on starch. It is a fast running insect.

Opiliones / Harvestman (Nunsia sp.): The present specimen was collected from humus soil sample of Semadoh Valley site. Harvestman are members of the class Arachnida, together with spiders, scorpions, pseudoscorpians and mites. The body is globular and rounded and is formed by fusion of two parts, the Cephalothoraxes and abdomen. The feeding habitat of harvestman is quite diverse. Some species are predominantly predator, feeding on small invertebrates, while others species are omnivorous and may consume dead plant and animal matter as well as small invertebrates and fungi.

Jumping spider *(Phiddipus audax):* This naming after amazing leaping ability, lives in woods fallen limbs, leaves or ground litter. These do not build web to catch prey. They hunt by their prey on foot. They take shelter under a leaf or bark. They do not hunt during day time. The preys of jumping spider are soil mites, fungi gnats, fungus beetle etc.

Harvestmen constitute an important component of many terrestrial ecosystems, especially in the soil, where they are scavengers or predators of small arthropods and worms, but also on shrubs and trees (Gonzalo and Sharma, 2015). The ground/litter layer and shrub/tree layer habitats differed markedly in species composition, species richness, and relative abundance of several species (Daniel*et al.*, 2012)

Termites: This organism occurred in all the samples of soil humus. The specimen is of solder termite. The ground dwelling termites, the colony is always partly in the ground. The termites are the pre-eminently social insects living in colonies. The principle castes are the reproductive forms, the workers, ant the solders. The solders in most species have mandibulate forms with long jaws and these serves in the defense of colony, protecting the workers when laboring on the nest or when foraging. The subterranean termites build covered runway from the nest through the ground over exposed surfaces to reach wood elsewhere.

Termites have peculiar activities in the soil, inducing significant changes in the soil properties. Soil with termite mound presented higher clay content, acidity, and Al3+ content. Phosphorus contents differed considerably between mound material and soil. Sum of bases and cation exchange capacity of the soil were higher in mounds, and differed within the mounds, according to the sampling height. Total organic carbon and particulate carbon content were highest at the mound base. A marked disparity was observed between the contents of humic substances in the mounds and surrounding soil, with humin fraction differences in distinct topographic position. The high nutrient contents detected in the termite mounds confirm the importance of termites in concentrating nutrients. (Sandra *et al.*, 2018)

Earthworms: The present specimen of earthworm was collected from Semadoh site but it was common to Chikhaldara also. This worm has the more than 70 segments and length was 11 cm. The color of the earthworm pale red and found in between 2-3 inch deep in humus soil. The color of the earthworm was pale indicates it was a deep burrowing species.

In soil, earthworms represent the largest component of the animal biomass and are commonly termed 'ecosystem engineers'. This review considers the contribution of earthworms to ecosystem services through pedogenesis, development of soil structure, water regulation, nutrient cycling, primary production, climate regulation, pollution remediation and cultural services. (Manuel *et al.*, 2013). The earthworm density and biomass were positively correlated with total porosity, organic carbon and nitrogen content, while negatively correlated with soil bulk density and C/N ratio (Hadi *et al.*, 2020).

CONCLUSION:

It is concluded that, decomposing leaf litter and humus soil is a habitat of several micro and macro invertebrates' communities, they will find their food by prey predator relationship, some of them depends upon decaying leaf litter, dead twigs and pieces of wood, the resultant material is soil organic matter; humus.

Acknowledgement: I am very thankful to Late Dr. G.N. Vankhede, Ex Head, Department of Zoology, Sant Gadge Baba Amravati University Amravati for his valuable guidance

Conflicts of Interest: The authors declare no conflict of interest.

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