

Soil Fauna and Soil Flora

Soil supports a wide array of organisms of different body-sizes and taxonomic groups. Generally, soil organisms are classified into three major groups namely **microfauna** and **microflora**, **mesofauna**, and **macrofauna**. Mesoflora and macroflora because occur above the surface of soil (land-surface), therefore, are excluded from this discussion :

1. **Microfauna.** It includes animals with body size within the range of 20µm to 200µm. It includes all Protozoa and small-sized mites, nematodes, rotifers, tardigrades and copepode Crustacea. Soil inhabiting **protozoans** such as amoeba, ciliates, zoomastigine flagellates occur near the surface soils, while the testate forms such as Thecamoeba, Euglypha and Diffflugia, have a wider vertical distribution. The common terrestrial **polyclad** is Bipalium. The **nematodes** such as Rhabditis, Diplogaster, Tylenchus, Heterodera, Aphelenchoides, Mononchus, Pratylenchus, Xiphinema and Criconemoides, abound by as much as 1-3 million in raw humus soils to 20 million/m² in grassland soils.
 2. **Microflora.** The microflora of soil includes bacteria, soil fungi, soil actinomycetes, blue green algae and [algae](#). In soil, microflora bacteria form about 90 per cent of the total population. Fungi and algae together represent one per cent and actinomycetes cover only 9 percent.
- **Soil bacteria** grow fairly well in the neutral soils richly supplied with organic nutrients. Soil inhabitant bacteria fall into categories namely—**autotrophic bacteria** and **heterotrophic bacteria**. The autotrophic bacteria derive their energy from the oxidation of simple carbon compounds or from inorganic substances and their carbon from the atmospheric CO₂.
 - The common autotrophic bacteria of soil are nitrifying bacteria, hydrogen bacteria, sulphur bacteria, iron bacteria, manganese bacteria, carbon monoxide bacteria and methane bacteria. Most of soil bacteria are heterotrophic bacteria depending upon the organic matter of soil for their energy source and are primarily concerned with the decomposition of cellulose, and other carbohydrates, proteins, fats and waxes.

- They bring about mineralization of organic matter of soil and release considerable amount of nitrogen, phosphorus and other nutrients for plants. The common nitrogen-fixing bacteria of soil are Rhizobium (occurs in root nodules of leguminous plants); Azotobacter and Clostridium pasteurianum (the latter two are free occurring in soil). Majority of **soil fungi** are found in acidic soils. They may be parasitic, saprophytic and symbiotic.
- **Parasitic fungi** of soil infect roots of plants and cause plant diseases such as cotton root rot and many kinds of wilts, rusts, blights and smuts. Certain wilt-forming fungi produce toxins which are harmful, for example, Fusarium lini, which causes wilt of flax (Alsi) and secretes HCN and Fusarium udum, a fungus causing wilt of pigeon pea (Arhar) secretes fusaric acid in the roots of host plants. However, certain parasitic fungi produce growth stimulating substances for host plant. Fusarium sp., for example, have been found to secrete gibberellin and gibberellic acid (C₁₉H₂₂O₆).
- **Symbiotic fungi** of soil live on the roots of certain plants and both fungus and plants are benefited. **Saprophytic fungi** depend on dead organic matter of soil and derive the energy from decomposition of the latter. They break down cellulose, lignin, and gum, sugars, starch, protein, etc., into simple gradients to be utilized by higher plants as nutrients.
- **Actinomycete fungi** prefer saline soils and bring about the decomposition of organic matter such as cellulose. They produce a variety of antibiotics of great economic significance for man. The most important blue green algae of soil are those which fix nitrogen in soil. Anabaena, Nostoc, Microcystis are important nitrogen fixing blue green algae of soil. They also make soil aggregates because of having mucilage.

3. Mesofauna.

- Mesofauna include animals with body size within the range 200µm to 1 cm. The micro-arthropods Acari (mites) and Collembola (spring tails) are important members of this group which also include the larger nematodes, rotifers, and tardigrades, together with most of the isopods, Arachnida (spiders), Chelognathi (pseudoscorpions), Opiliones (harvestmen),

- Enchytraeidae (pot-worms), insect larvae and small millipedes (Diplopoda), isopods and molluscs.
- Among **annelids** the microscopic enchytraeids are represented by *Enchytraeus fridericia* and *Achaeta lumbricellus*, which are more abundant in organic soils and forests than in grassland. *Oniscus*, *Porcellio*, and *Armadillidum* are the most common isopods (**crustacean**) of the tropics in the humid zone.
 - Among the soil **arachnids**, mites are the most predominant. Mites flourish in moist organic soils and certain mites such as *Galumna*, *Cepheus*, *Hemorobates* occur in lichens and mosses. Certain mites, such as *Schelorbates* and *Brachychthonus* live in humus. The mites are saprophagous, predatory and phytophagous and are involved in the process of organic decomposition and its resultant processes.
 - Certain arachnids such as scorpions, *Thelyphonus*, *Galeodes*; and some spiders are crepuscular, hiding under rocks or in crevices in soil and in loose litter, and has no ecological significance in decomposition like other arachnids. Many **opiliones** or harvestmen occur in forest litter, frequently preying upon soil organisms.
 - Besides mites, only the pseudoscorpions or **chelognathi** occur in surface soils and most decaying vegetations. Of the xerophil litter inhabitants are *Stenatemnus indicus*, *Dhanus indicus*, *Fealla indica* and the hygrophil inhabitants living in the litter and under stones are—*Comsaditha indica*, *Tyrannochthonius madrasensis*, *Tyrannochthonius chelatus* and *Hygrochelifer indicus* (**Murthy**, 1964), feeding on *Collembola*, enchytraeids, etc. The common millipedes or diplopodes of forest soil which are chief decomposers of soils are *Spirostreptus*, *Thyropygus*, *Glomeris*, *Arthrosphaera*, *Polydesmus*, *Iulus*, etc.
 - **Tardigrades** or bear animalcules occur in surface layer of most soils in grassland being represented by the *Macrobiotus* and *Hypsibius*. Among **insects**, apterygote *Collembola* form numerically the most important groups of soil insects. Other insects such as *Dermaptera*, *Psocoptera*, *Dictyoptera*, *Isoptera*, *Coleoptera*, a few *Hymenoptera* and some *Diptera* also occur in soil, sometimes as juveniles.
 - The termites such as *Reticulotermes* and *Odontotermes* are important soil-dwellers of tropics and play an important role in the break up of organic materials and their mixing up

with mineral soils. Among the Hymenoptera, ants are the most important soil dwelling forms. Among Collembola, Onchuridae, Isotomidae, Poduridae and Entomobryidae are richly represented in the soil both in number and species composition.

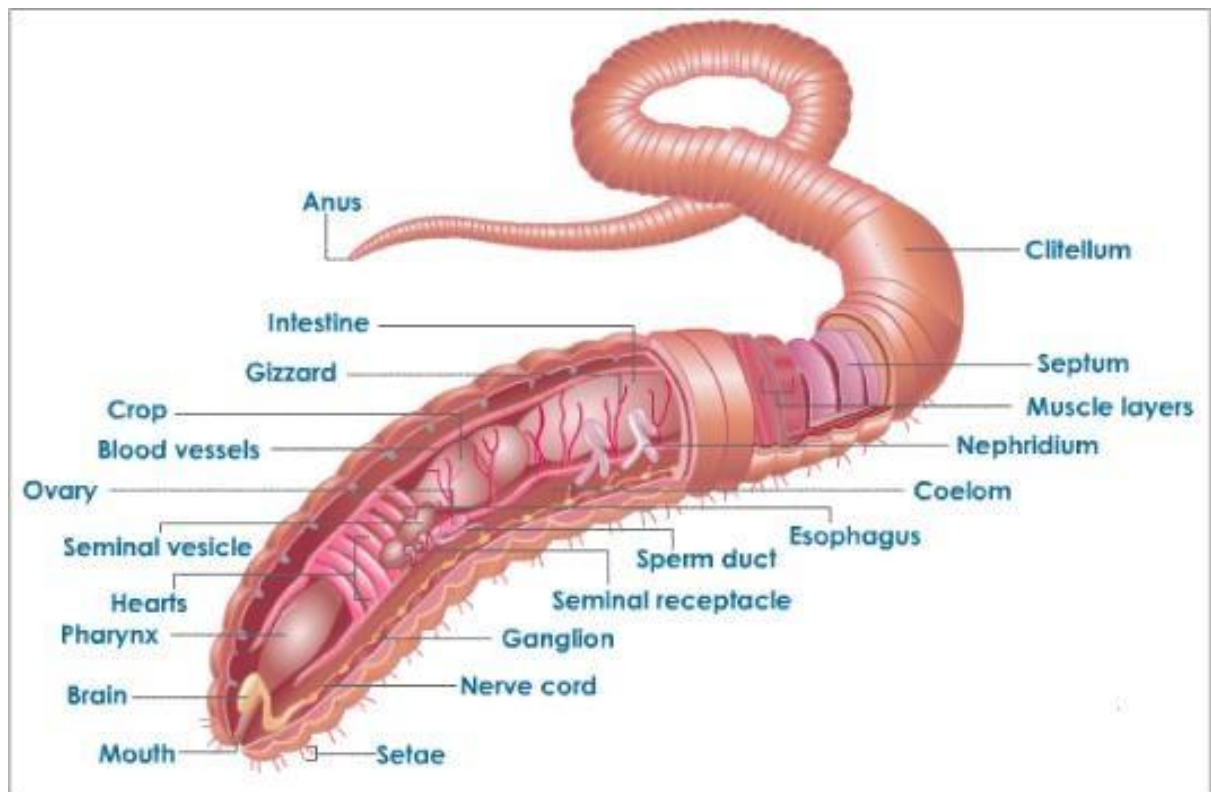
- Large-sized Collumbola such as Tomo-cerus, Entomobrya and Orchesella occur in surface layer, while the smaller Onychurus, Tullbergia, etc., occur in deeper layers of soils. Among Diplura, Anajapyx, Japyx and Campodea are often found in small numbers in moist soils under stones and in humus. Proturans are more abundant than Diplura and very common in moist forest and grass land soils which abound in species of Eosentomon, Acerentomon and Acerentulus.



Oniscus

3. **Macrofauna of soil.** Macrofauna of soil includes those animals whose body size is greater than 1 cm. Here belong the majority of Lumbricidae, the Mollusca, the largest insects and arachnids and the soil-dwelling vertebrates. Earthworms usually occur in abundance in alkaline and moist soils and sparse in acid soils. They have been proverbial for their influence on the process of decomposition of organic materials, breaking up litter fragments and mixing them thoroughly with mineral soils resulting in the formation of organic soils. Some of the common Indian annelidan species of soil are Megascolex, Pheretima, Octochaetus, Drawida and Moniligaster. Among

chilopods the carnivorous Scolopendra and Lithobius are common in moist soils feeding on leaf litter inhabitants. Among soil vertebrates, following animals are well adapted for burrowing life in soils– Ichthyophis, Cacopus systema, Breviceps (Amphibia), Sphenodon, Uromastix, limbless lizards and snakes (Reptilia), Talpa, Dasyurus, Notoryctes and various insectivores and rodents (Mammalia).



Earthworm

- **Adaptations of soil animals.** Animals which are adapted for digging the burrows and for subterranean mode of life are called **fossorial animals**. These animals may dig either for their food or simply for retreat. Zoologically they are primitive, defenseless and unambitious animals. They have following adaptations :
 1. The body contour is either cylindrical (e.g., Ichthyophis, limbless lizards, snakes, earthworms, Scolopendra, etc.), or spindle-shaped or fusiform (e.g., Talpa, Echidna, etc.), so as to offer least resistance to subterranean passage.
 2. The head tapers anteriorly to form a sort of snout for burrowing.

3. The tail is short or vestigial.
4. The eyes tend to become vestigial as they are of no use in dark habitat.
5. The external ears also tend to disappear since they would be obstructing in burrowing.
6. For digging, many structures may be found in different fossorial animals, e.g., hands are well adapted for digging. In the insect *Gryllotalpa*, the forelegs are modified for digging purpose.

The ground-dwelling animals which may be **cur-sorial** (running), such as ostrich, rhea, ungulates, wolves, cats, bears, hyaenas, etc., **saltatory** (jumping) such as rodents, rabbits, wallabies, kangaroos, etc., or **graviportal** (heavy) such as turtles, armadillos, elephants, hippopotami, etc., exhibit different kinds of adaptations for different kinds of soils. For example, if the soil is firm and hard, the large animals inhabiting the ecosystem tend to have small hooves or paws; if the soil is wet and spongy, they tend to have broad hooves or paws.