FACTSHEET

GREATSOILS

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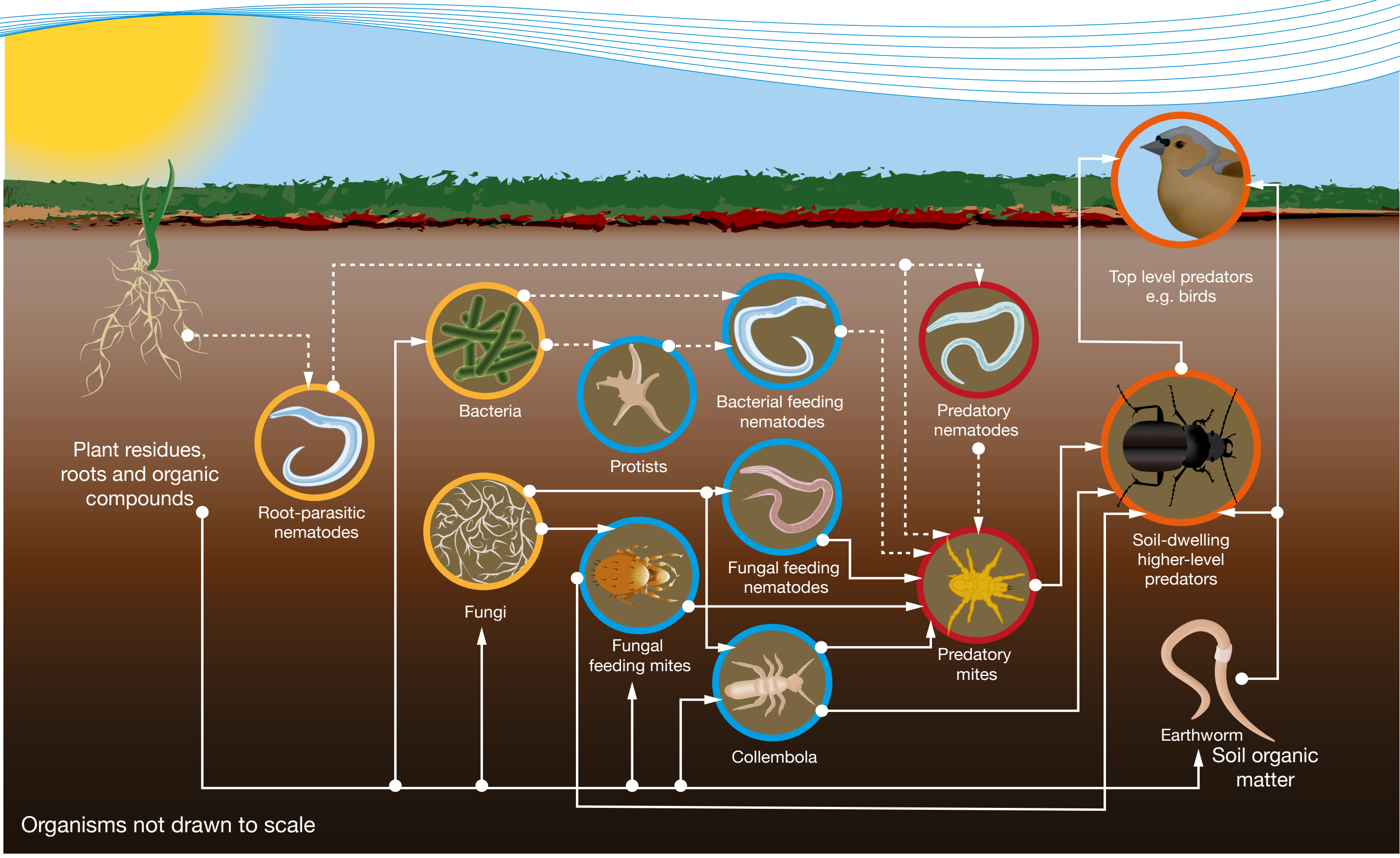
The soil food web



Basal trophic level:
Food sources that are either living plant tissue or dead organic matter, such as plant litter, or the dung and dead remains of soil or above-ground organisms.

Second trophic level:
These microorganisms feed on food sources in the basal trophic level, and comprise decomposers feeding on dead organic matter, herbivores and plant parasites that feed on living plants, and microbes that feed on compounds exuded from roots.

Third trophic level:
Nematodes and microarthropods that graze on bacteria or fungi, but may also eat dead organic matter.

Fourth trophic level:
Larger microarthropods and nematodes that eat their smaller cousins.

Fifth and higher trophic level:
The higher-level predators in the soil food web include predatory mites, centipedes and beetles.

Figure 1. Relationship between organic matter decomposition and the types of microorganisms and animals within the soil food web. Organisms are subdivided according to what they feed on into trophic groups where relevant.

Complexity of life in soil

Soils contain a very high diversity of organisms. These soil organisms interact with one another and the chemical and physical properties of the soil to drive soil processes.

Due to limited knowledge about the physiology and environmental requirements of individual species in many cases, it is often convenient to consider soil organisms in functional groups, i.e. by the roles they play and processes they carry out.

Each species in a functional group does a similar job and so has similar impacts on community or ecosystem processes. For example, we can group together all nitrogen-fixing bacteria; all wood decay fungi; all bacterial-feeding nematodes; or all vertical burrowing (anecic) earthworms.

1 g soil, the same size as a sugar cube, will not only contain different types of organisms (i.e. bacteria, fungi, protists, nematodes, Collembola, mites), but will contain a lot of them (one billion individual bacteria) and many different kinds of each type (ten thousand different bacterial species).

Who's eating who?

One of the most common groupings of soil organisms is according to what they eat, i.e. dividing them into trophic groups. Trophic level simply refers to the types of food consumed by soil organisms. It also reflects the flow of energy through the soil food web, as all organisms consume food to get the energy they need to grow and reproduce (Figure 1).

Nutrient recycling

Throughout the food web, every time an organism feeds, waste nutrients are excreted in a form that is more available to plants. Plant roots are hot spots for such feeding activity, so plants can readily take up these nutrients, leading to the production of more plant material, supplying new organic matter to the soil and completing recycling of nutrients.

Soil fauna can account overall for 30–40% of net nitrogen released into plant-available forms. The remaining nutrient is released by microbes or the enzymes they produce.

The high level of feeding activity around plant roots, driven by the compounds that plants exude, not only releases nutrients where plants can access them, but also provides a diverse range of predators that can attack root pests. These root exudates also support beneficial microbes that help produce plant growth compounds and fight off disease.

Soil organisms shape their world

The soil environment shows extreme variation in space (vertical and horizontal) and time. Thus, a wide range of surface types, pore sizes, microclimates and resources form the landscape in which soil organisms live and interact.

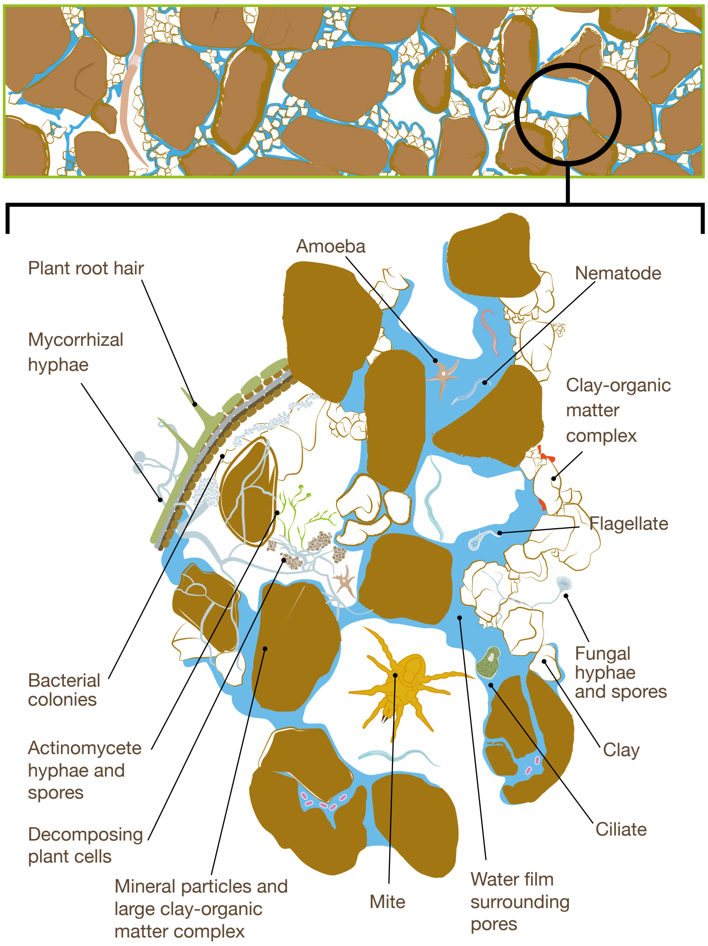


Figure 2. Roots use pores of >100 µm as points of entry, while root hairs, protists and fungi use pores of >10 µm, but bacteria can move in water films of only 1µm depth

The habitat space in soil is defined by the size, organisation and connectivity of the soil pore network.

The pore size distribution controls the balance of oxygen and water available to organisms at any given soil moisture potential, as well as regulating access of soil organisms to one another and to their resources.

Larger pores can drain freely, but water is held on particle surfaces and in smaller soil pores. The dung and organic compounds excreted by soil organisms is also very efficient at storing water in soil, and also acts as a sponge for many plant nutrients, retaining them in the soil in a form that plant roots can release.

The amount and nature of the pore space in soil is dependent both on soil texture and the way in which the mineral particles and soil organic matter are aggregated together, i.e. the soil structure.

Soil structure influences the nature and activity of soil organisms, but soil organisms also have a key role in building and stabilising the soil structure.

Soil organisms produce a range of sticky compounds (glycoprotein and polysaccharide gums) that help bind clay, silt and sand particles into microaggregates. Roots and fungi help to enmesh and bind these into larger aggregates or push tightly bound clay particles apart, and bacteria can form protective biofilms over aggregate surfaces. Plant roots also have a central role in structure development, through drying and compression as they grow.

Earthworms change the structure of soil by burrowing and generating new stable aggregates as worm casts. This creates new microhabitats for other soil organisms and plant roots; this is why they are also called ecosystem engineers.

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Further Information

For further information on soil management and soil biology visit **ahdb.org.uk/greatsoils**

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