

Healthy Soil and Leaf Litter Layers

Where do most animals live in natural bushland? Where is the greatest biodiversity? What is the powerhouse of ecological processes? To find the answer just take a look under your feet! This Note looks at the importance of the soil and litter layers.

While the soil and leaf litter layers may not generate the same amount of interest as other components of an ecosystem, they are of critical importance for biological diversity and ecosystem health because:

- An enormous number of species live there.
- Food chains start with the small soil and leaf litter organisms, which are

preyed on by larger animals.

- Soil and leaf litter organisms help decompose organic material, spreading it around and releasing nutrients for new growth. They also contribute to the dispersal of seeds and fungal spores. The leaf litter layer is vital for protecting the underlying soil from erosion, maintaining good soil structure and fertility, and aiding moisture retention.

A hidden world

Most people are unaware of the abundance and diversity of life forms inhabiting the soil and leaf litter.

The soil and litter layers are a hidden

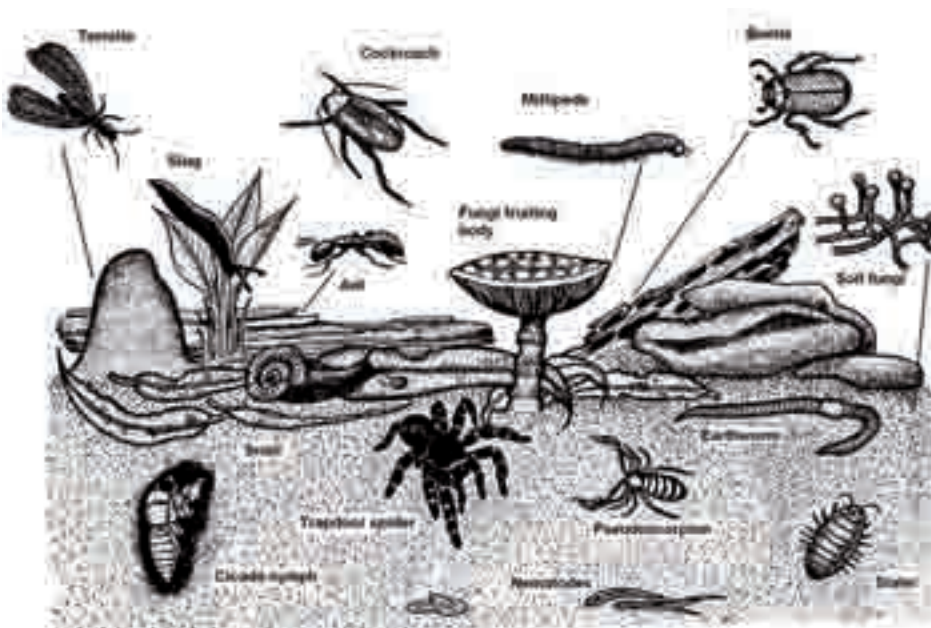
world, at least from casual observation, as the activities of life and death go on mostly in darkness and out of the sight of humans.

Most of the life forms range in size from fairly small (i.e. no more than a few centimetres) to microscopic and may require specialised equipment and techniques to be found, observed and identified.

Many of the organisms inhabiting the soil and leaf litter, such as worms, mites, spiders, springtails, insect larvae and a wide range of other invertebrates as well as fungi and bacteria, are unfamiliar to many people.



Millipedes can often be found in the litter layer, feeding on living and dead plant matter.



A great diversity of organisms live in the litter and soil layer.

Redrawn from: Dorricott KE and Roberts BR (1993) *Wildlife Conservation on Planned Properties: a guidebook for Queensland landholders*. University of Southern Queensland.

Decomposition

Decomposition processes in the soil and leaf litter are essential for maintaining a healthy ecosystem. Australian soils are mostly highly weathered and lacking in the nutrients (such as nitrogen and phosphorous) needed for plant growth. It is vital that all available nutrients in decaying plant material are recycled back to living plants through the plants' roots, a process that is assisted by nitrogen fixing bacteria and mycorrhizal fungi (see *Land for Wildlife Note S2 - The Value of Fungi*). If the leaf litter layer and the associated decomposer organisms are removed, the cycle will be broken and the whole ecosystem will go into decline.

The litter layer is an important feature of rainforests providing habitat for a diversity of wildlife species.



How does decomposition work?

The process of decomposition involves complex relationships and dependencies between soil and leaf litter organisms. These organisms drive the decomposition and recycling process in two ways. Firstly by physically mixing the organic material with the soil and transporting it to where the plants can use it, and secondly, by breaking the leaf litter into smaller fragments, digesting it and excreting it in forms that can be consumed by smaller and smaller organisms.

Nutrients are eventually returned to the soil in a form that can be taken up by plants. For example, leaf material is first colonised by bacteria and fungi that help make it palatable and digestible for tiny invertebrates, like mites and springtails. Once leaves are chewed and digested by the invertebrates they are excreted, thus reducing the leaf material to even smaller particles. Earthworms and other invertebrates mix this organic matter with the soil, improving soil fertility and helping spread fungal spores, which continues the decomposition process.

The rate of decomposition of the leaf litter is determined by several factors including:

- The abundance and diversity of fungi, bacteria and invertebrates present.
- Climatic and seasonal conditions - decomposition is faster in warm, humid climates than in dry or cold climates.
- The physical and chemical composition of leaves. Some leaves, like those of most rainforest plants are more palatable, while eucalypt leaves are tougher or contain chemicals that soil and leaf litter organisms find difficult to digest.

If soil and leaf litter organisms are not present, some break down of organic material will occur through non-biological processes but it will happen very slowly and nutrients will remain trapped in the unprocessed leaf litter.



Soil and litter habitats

The soil and leaf litter provide a spatially diverse habitat that changes over time. The amount of leaf litter may change on a seasonal basis resulting in leaf litter depth peaking perhaps once or twice through the year. The amount of accumulated leaf litter depends on the factors of decomposition listed above plus rainfall and the frequency and intensity of fire. Leaf litter, along with most of the organisms that inhabit it, may be completely consumed in a fire leaving the soil exposed and vulnerable to erosion. A new suite of fauna species such as predatory ants, may opportunistically colonise burnt areas until a new leaf litter layer is formed. The original species can then gradually re-colonise the site from unburnt areas.

The composition of the leaf litter may also vary over time. For example, leaves of different plant species and a range of different fruits and flowers may be present at different times of the year.

Some animals utilise different depths of the leaf litter and soil depending on the season, environmental conditions and their lifecycle stage.

Animals, such as spiders and ants, range freely over the surface of the leaf litter while others, such as earthworms, tunnel through the soil or live permanently in burrows. Many insects such as cicadas and beetles spend their larval or nymph life stage in the leaf litter or soil while the adults live in the forest canopy.

Termites play an important role in the recycling of plant nutrients and maintaining soil fertility through the disintegration and decomposition of dead wood, surface vegetation and plant debris. By their feeding and tunnelling actions, termites can aid water infiltration and contribute to improved soil structure and porosity.



The litter layer provides habitat for a range of reptile species. Pictured is the Golden Water Skink (Elamprus quoyii).



Bandy Bandy snakes shelter under leaf litter, logs and rocks, and can easily burrow into the soil. Bandy Bandys have a very limited diet preying only on blind snakes. There are 18 species of blind snakes in Queensland, all of which live in soil cavities, in ants nests or under thick leaf litter. Photo by Deborah Metters.



The litter layer provides an important source of food for a number of small native mammals including the Yellow-footed Antechinus.

Many soil and litter organisms are very susceptible to drying out so will only emerge to forage on the surface during the night or on wet/overcast days. Generally the diversity of soil and leaf litter species will depend on the depth, complexity of structure and composition of the leaf litter. More species will usually be found where leaf litter is deeper and formed from a greater variety of plant species (e.g. rainforest habitats). The presence of fallen branches and rotting logs will add to the structural diversity and so influence the abundance and diversity of species present.

Protecting soil and leaf litter layers

The soil and leaf litter layers are an integral part of an ecosystem and if they are degraded so is the whole ecosystem. Common management practices such as burning, grazing and tidying-up the undergrowth can have a direct and dramatic impact on soil and litter layers.

Retaining features such as rocks, fallen logs, leaf litter and branches provides important refuge habitats for many soil and litter dependent animals such as the threatened Collared Delma (*Delma torquata*), a small legless lizard.

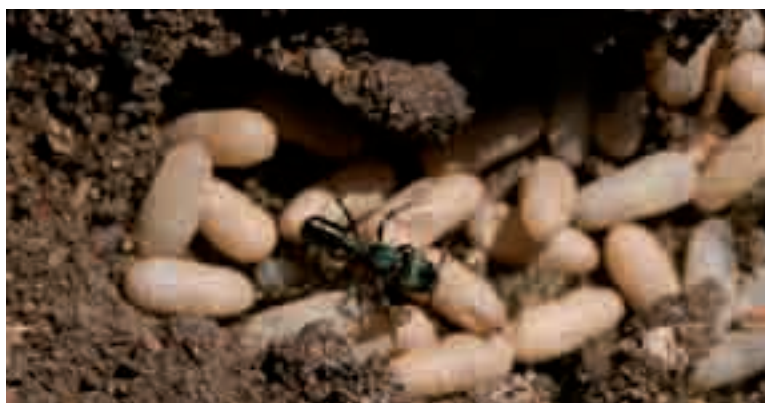
If your bushland is in good condition with groundcover plants and intact soil and leaf litter layers, then you will probably have a full complement of soil and leaf litter organisms. This will, in turn, maintain the decomposition processes and nutrient cycles, keeping your soils healthy, plants healthy and wildlife abundant.

What you can do

- ✓ Retain trees and understorey plants to contribute leaf litter, shade, humidity and shelter, to aid the retention of soil and leaf litter organisms.
- ✓ Use pesticides and fertilisers appropriately.
- ✓ Maintain ecologically appropriate fire regimes and do not burn too frequently.
- ✓ Avoid soil trampling and compression by stock and vehicles.
- ✓ Do not 'tidy-up' the leaf litter layer by burning or raking.
- ✓ Retain rocks and fallen logs in bushland areas to provide important refuge habitats for soil and leaf litter dependent animals.



Giant King Crickets live in rainforests and forage in the litter layer at night-time. Photo by Darryl Larsen.



Australian landscapes contain a great diversity of ant species with just over 1300 identified so far.



Rotting logs add to the litter layer and provide important shelter and breeding sites for a range of ground-dwelling animals.

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