# Fungi and the Wood Wide Web

by Hugh Bradshaw and Janet Bostock

There can be fewer more peaceful places in the Park than amongst its veteran oaks, especially on a warm summer's evening. And yet this tranquil scene appears to belie its true ambience – a cut-throat race, sometimes to the death, for each tree to out-compete its neighbour in search of light and nutrients.

However, this continual battle is not the full story. Although over ground the competition seems fierce, underground the story is different. Recent research has shown that related plants within a wood may aid each other, weaker specimens receiving succour from healthier ones, parent trees giving a helping hand to their seedlings.

This surprising situation arises because, within a wood, the trees are part of a vast underground network, an interconnecting web of organisms, which allows nutrients and chemicals to flow between them. This network has inevitably been coined the Wood Wide Web, as it allows the trees to communicate with each other!

Mycorrhizae fungi (also called root fungi) are the main conduit of the web (myco means fungus and rhiza means root). The familiar mushroom shape of a fungus is only its fruiting body – most of the fungus is underground in the form of miniature gossamer-like tubes called hyphae.

These hyphae permeate the soil and fuse with other hyphae to create vast networks. The hyphae also penetrate the root cells of trees and other plants, and so a single fungus can connect with many plants. Once connected, there is a mutual exchange of substances: the fungi syphon off sugars from the trees (made by photosynthesis) whilst the trees take water, nitrates and phosphates from the fungus (absorbed from the soil).

In the UK, up to four-fifths of tree species are dependent on these fungi for their growth. This symbiotic relationship, benefiting both plant and fungus, is ancient, at least 450 million years old. Indeed, without it, many trees would remain pint-sized!

Messages from one tree to another can also be passed through the web. For example, if a tree is under attack from insect infestation, it will boost the presence of certain chemicals in its leaves to make them distasteful to the insects. Chemical signals then travel via the web warning neighbours of an impending attack, and they respond by making their own leaves taste nasty.

The relationship between tree and root fungi starts as soon as the tree seedling germinates, when it releases sugars and chemicals into the soil to attract the hyphae. The fungus in turn produces chemicals to deactivate the seedling's defences, allowing it to fuse with the roots and so linking the seedling to the fungal web. Why is this helpful to the seedling? Because it can then receive sugars from nearby adult trees.

In other words, one tree can help feed another! This has made scientists reconsider the assumption that it's 'every tree for itself'. The Wood Wide Web may mean that evolution has produced a system whereby weaker individual trees can be aided by their healthier neighbours. A tree growing in the shadow of a larger tree may benefit from that tree's pole position in the wood; a dying tree may redistribute its stores of food and a parent tree may help nurture its seedlings.

Perhaps, after all, harmony does reign in the woodland copse!

In a future newsletter, we will talk about the great recyclers of the fungi world, the Saphrotropes (saprós means rotten and trope means nourishment) – they feed off dead organic material in the soil from fallen leaves, wood and insects.

*Photos of Mycorrhizae fungi fruiting bodies:*
*Top left, fly agaric by © Jutta Raftery.*
*Centre, white Geastrum rufescens by © Janet Bostock.*
*These photos by © Barry Hughes:*
*Bottom left, Cantharellus cibarius;*
*Top right, Amanita phalloides;*
*Bottom right, Boletus edulis*