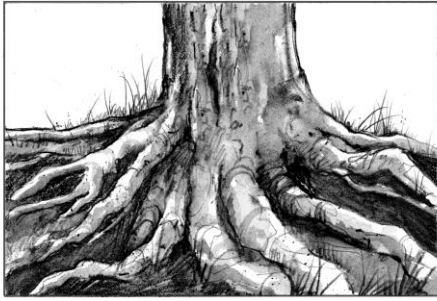


The Outside Story



The Dirt on Roots

By: Joe Rankin

You can pretty much count on a tree to stay in one place, at least in the real world. Not so in fiction. Remember the walking, talking Ents in the *Lord of the Rings* movies? Or Groot, the tree-like alien in the science fiction film *Guardians of the Galaxy*?

Roots anchor a tree, of course, allowing it to stand up to much of what nature can throw at it; they also provide life-giving nutrients. Tree roots are a marvel of evolution: part of a whole-tree plumbing system that makes the one in your house seem primitive.

Most of a tree's roots, even of those species that have a so-called taproot, are within the top 18 inches of soil. That's typically where the richest organic matter and the most water is.

A tree's root system can extend a long way from the trunk, far beyond the edge of the crown. And a tree can have hundreds of miles of roots, some as thin as a human hair.

Kevin Smith, the supervisory plant physiologist at the U.S. Forest Service Northern Research Station lab in Durham, New Hampshire, has followed roots 50 feet from the trunk of a spruce. And he's used trowels and tiny picks to tease out the finest roots. It's tedious, painstaking work, he said. "They break off so easily."

Root tips can be as small as a tenth of a millimeter in diameter. "That's where the business end of a root is. That's where the tree is absorbing its nutrients."

Smith clarified: "absorbing" is too passive a word. The elements a tree needs, like calcium, magnesium, potassium, nitrogen, aren't just floating around the soil waiting to be slurped up by a tree, Smith explained. They're bound to soil particles. To be able to use them, the tree has to free them up. To do this, the tree releases a proton – a hydrogen ion – that knocks the element free from the particles it's bound to. The tree then scoops it up. "All of this takes energy," said Smith. To fire the ion, the tree has to burn sugar.

A tree's root system is not static. The fine, non-woody roots dry up and die and get replenished repeatedly, as long as there are nutrients in that area. Tree roots don't grow toward nutrients, or toward anything, really, but once they find a sweet spot they grow like crazy to take advantage of it. Studies have shown that the non-woody roots of up to seven trees can occupy the same square meter of soil. Roots from different trees, particularly those belonging to the same species, can even grow together, grafting themselves to each other.

Some species have evolved defensive systems to limit competition. Black walnuts, for instance, produce the toxin juglone in their roots, buds, and nuts. The toxin inhibits other plants' growth, a phenomenon called allelopathy.

One of the most interesting things about the roots of forest trees is that they generally don't work alone. They partner with mycorrhizal fungi. The fungi provide the tree with mineral elements from the soil, while the tree reciprocates with sugars that the fungi can't make on their own. Delve into the duff on the forest floor – the tough white threads you'll see twining throughout the soil are the fungal network, known as hyphae, and the mushrooms you see on the soil surface are the fungal fruiting bodies. A tree may also release sugars into the soil that will benefit other fungi and microbes, including ones that fix nitrogen from the air, which, of course, benefits the tree.

Trees aren't just taking nourishment from the soil. They provide it, too. Their shed leaves and branches fall to the ground and replenish elements. Fungi in the forest floor help break them down.

While trees can't walk like the Ents and Groot, we shouldn't feel sorry for them, said Smith. "Trees have adapted pretty well to the rooted life. They've developed beautiful and intricate lifestyles that keep themselves and the forests going." It's interesting, he added, to walk through a forest and contemplate the fact that everything there – trees, bugs, mammals, birds, amphibians – relies on healthy root systems in healthy soil.

Joe Rankin is a forestry writer. He lives in Maine. The illustration for this column was drawn by Adelaide Tyrol. The Outside Story is assigned and edited by Northern Woodlands magazine: northernwoodlands.org, and sponsored by the Wellborn Ecology Fund of New Hampshire Charitable Foundation: wellborn@nhcf.org

**Northern
Woodlands**

PO Box 471, Corinth, Vermont 05039
Tel. 802.439.6292 Fax 802.439.6296
www.northernwoodlands.org

This article is reprinted with the permission of the Center For Northern Woodlands Education. A not for profit organization, Northern Woodlands seeks to advance a culture of forest stewardship in the northeast by increasing understanding of and appreciation for the natural wonders, economic productivity and ecological integrity of the region's forests. Subscribe or donate at www.northernwoodlands.org.