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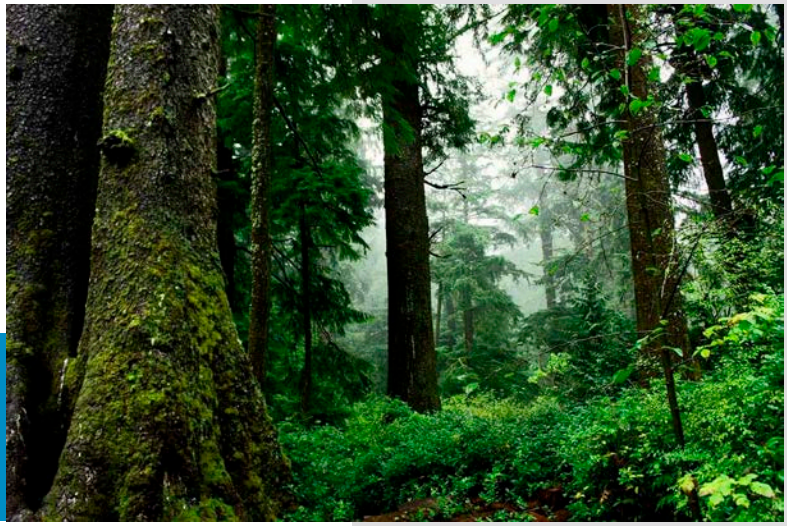
Trees Can Talk



An old-growth forest.

Credit: Patte David, U.S. Fish and Wildlife Service (public domain), via Wikimedia Commons

We talked about how a fungal network connects plants underground. But did you know it allows them to *communicate*?

Specifically, they exchange sugars, and chemical and electrical signals, with each other.

The largest trees are now known to "mother" the surrounding forest. They give their sugars back to the entire soil community, to support neighboring plants and trees.

They've even been shown to preferentially identify young trees within their own species, and send them a larger serving of sugars via the fungal network.

And, plants and trees have learned to communicate through the air.

Many studies have shown that, when attacked by insects or disease, they release distress hormones to other plants, as well as defensive compounds.

Pine trees, for instance, when preyed on by caterpillars, send out pheromones that attract wasps to the forest, which prey on the caterpillars.

Acacia trees, when eaten by grazing giraffes, release ethylene gas, which prompts other acacias to flood their leaves with bitter tannins. Giraffes have learned to graze downwind...

Traditional lumber practices have removed large trees, with the idea that it allows other trees to access their sunlight. This new research may require rethinking how we maintain healthy forests.

This isn't to say that trees can think—at least not in the way that humans define sentience.

But they certainly have a type of language that has allowed them to thrive for millions of years. We're only *now* learning to understand it.

Bureau of Economic Geology

Background: Trees Can Talk

Synopsis: The forest system is so interconnected that plants have evolved to communicate using chemical, hormonal, and electrical defensive signals.

- Recent research shows that mycorrhizae form associations with multiple plants, linking them together and enabling neighborhood communication about threats and diseases (*defense signaling*) using chemical, hormonal, and electrical signals along an organic "Internet."
  - In the UK, an experiment with broad beans showed that when aphids attacked one plant, it signaled nearby bean plants to activate their defensive chemicals that repel aphids and attract wasps that prey on aphids. Similar findings have been reported of diseased tomato plants warning nearby healthy plants to produce defenses.
- Trees also communicate through the air using pheromones and gases like ethylene.
  - Pine trees, when preyed on by caterpillars, send out pheromones to attract wasps to the forest, which prey on the caterpillars.
  - Acacia trees, when eaten by browsing giraffes, release ethylene gas, which prompts other acacias to flood their leaves with defensive and unappetizing tannins. As a result, giraffes have learned to browse trees that are downwind and progress upwind as they feed.
- Hub trees in forests are generally the oldest and largest trees, reaching high above the forest canopy and enabling access to sunlight for photosynthesis.
  - Researchers have found that these trees regularly provide at least 10 percent of their sugars to the forest soil ecosystem.
  - They support neighboring trees and plants regardless of species but are able to distinguish their own offspring (*kin recognition*), providing a larger proportion of carbohydrates to them along the fungal network.
  - If hub trees are injured, they dump their carbon into the soil ecosystem and increase sugar transmission to their own offspring to ensure species survival.
- Like the human microbiome protects human health, the soil microbiome protects the health of plant ecosystems that provide us humans with our sustenance.
  - For centuries, however, our agricultural practices have worked *against* these natural systems.
    - As new forests were planted, typical forestry practices called for the removal of large old-growth trees, thinking that these trees were robbing smaller trees of sunlight and nutrients.
    - Recent studies have found that these large old trees and their fungal networks serve as nursemaids, protecting the smaller trees around them.
  - Agricultural practices of growing only a single crop (*monoculture*), tilling, and using fertilizers and herbicides have decreased the diversity of soil microbiomes, resulting in less nutritious and less productive crops.
    - Researchers are using genomic studies to customize improvement of the soil microbiome for specific crops in specific soils.
    - Plant succession appears to be controlled in part by fungi: soils with more plentiful fungi develop more productive and diverse flora.
- The soil microbiome sequesters more carbon than is found in Earth's atmosphere and terrestrial plants combined.
  - Fungal filaments, the mycelium, are coated with a sticky carbon-intensive molecule called *glomalin*. Accounting for the huge surface area of mycorrhizae, researchers have estimated that the glomalin coating mycorrhizal filaments may hold a third of all soil carbon on Earth.

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