



Are Yew Talkin' to Tree?

Science Works to Unravel the Mysteries of Tree and Plant Communication

Once thought to be as silent and stoic as statues, it is now known that if we had the ability to hear it, the trees and plants of the forest would be emitting a cacophony of communication. Though not quite (yet) reaching Tolkienesque Ent levels of dialogue, they aren't far off. From underground mycorrhizal networks to ultrasonic sound emissions and chemical signalling through the air, trees and plants are more plugged in than the CIA. This relatively new field of study is not without controversy however, and many scientists are urging for caution when expounding upon the wonders of our woodlands. This has led to some tension among those with roots in the plant biology/forest ecology community. But most dissenting scientists don't want to Debbie-downer people's joy and awe about forests, they only want to see more research that backs up many popular ideas.

This, is CMN.

One of the controversies of tree connections and communication is the synergistic power of "common mycorrhizal networks" (CMNs). A CMN is formed when below ground mycorrhizal fungal hyphae (filaments of fungi that intertwine with the root tips of plants to the benefit both organisms) connect multiple plants of the same and different species. The fungal hyphae break down soil minerals making them available to the trees, and the fungi are rewarded with a steady supply of sugar. Studies have found that these subterranean conduits can help trees share carbon, water, hormones, and maybe even alarm signals. In the northeast where NETN parks are located, there is concern that [invasive earthworm species](#) can significantly impact these fungal communities, reducing their diversity and abundance. The existence of CMN's is not debated. Where things get a little janky is determining just how widespread they are, how long they last, and what kinds of functions they can actually perform in a forest.

Weaving a Tangled Wood Wide Web

Humans are, well, human. It can be extremely hard, even for the most disciplined of scientists amongst us (humans every one of them), to not assign some anthropomorphic traits and values to their study subjects. After all, it is much easier to relate to the world around us with a human analogue for comparison. Though this can be helpful, it can muddy the waters when the metaphors go too far. We often project our own deeply held beliefs and wants onto nature, or hold up desirable perceived traits of nature as a model for human behavior. This is one of the big criticisms of those in the scientific community who are pushing back against the grandest and most altruistic conceptions of CMN's, or the

"wood wide web" as its known in popular media. Critics don't argue that these functions are not possible, they just fear that science no-no's like *positive citation bias* and *over interpreted results* have overstated the confidence in the ways plants actually interact with each other through CMNs.

Trying to definitively demonstrate exactly what is happening below our feet and over our heads in a forest setting is daunting to say the least. Scientific experiments can be cumbersome, expensive, and challenging to replicate. A scientifically acceptable way of demonstrating whether a particular species of fungus connects any two forest trees is to sequence its genes and construct a map of where genetically identical fungi are growing. Even these kinds of studies are not bulletproof however, since a genetic sample only provides a one-off snapshot and can't definitively prove whether the samples of fungi collected from two different trees are really connected since there are myriad reasons they could have been severed or separated, especially in a forest invaded by earthworms. Only a few (~5) such studies have been conducted across just 2 forest types with 2 tree species and 3 fungal varieties. Tantalizingly promising findings have been found, but they are just not as wide spread as popular literature may lead one to believe. For example, the idea that trees routinely share warnings about insect attacks or other dangers through CMNs relies on a single greenhouse study in 2015. There was also a 2016 Swiss study where researchers sprayed several trees' leaves with an identifiable isotope of carbon. Excitingly, they were subsequently able to detect the isotope in unsprayed neighboring trees, but this is still not absolute proof it was a CMN that was responsible. Transfer of resources can also happen directly root-to-root or through pores in the soil.

The Perils of Plant Personification

A loaded term that is a bridge too far for many scientists is the concept of "plant intelligence", or even consciousness. Now, it does not help that there is no scientific consensus for what even *human* consciousness is, so trying to apply it to the plant world is problematic from the get-go. Research



Trees benefit from an underground network of mycorrhizal fungi.

focusing on evidence of complex plant behaviors like communication, learning and memory abilities, and the integration of environmental stimuli suggest that plants may indeed possess a form of what might be called “intelligence.” But without a central nervous system it cannot be directly correlated to the human equivalent and is badly in need of its own umbrella term to encapsulate it all (you’d think the Germans would have already created one. Like “farfrumhuman” or “derplantkunthink”).

A 2023 article in the journal *Nature Ecology & Evolution* argued many of these points. The claims that CMNs are widespread in forests and that they regularly share resources to benefit tree seedlings of the same and/or different species, it is argued, are insufficiently supported because of widely varying results from field studies. Results may also have alternative explanations or be too limited to support sweeping generalizations. Additionally, the idea that mature trees preferentially send resources and defense signals to offspring through their CMNs lacks peer-reviewed, published evidence. Article authors go on to say that unsupported claims of CMN functions have doubled in the past 25 years, and the aforementioned no-no of a bias towards citing positive effects may be obscuring a true understanding of the structure and function of CMNs in forests. To reiterate, they are not saying these phenomena aren’t happening, only more corroborating evidence is needed to bolster confidence in them.

There’s Something in the Air.

Less controversial about what’s happening below ground is some topside plant communications. It has been known for at least a couple of decades that trees and plants can communicate by releasing volatile organic compounds (VOCs). But just how specific that communication is, is a more recent revelation. The classic example is when a tree, lets say a [white oak](#), is being aggressively fed on by gypsy moth caterpillars. The oak can release VOCs that get carried by the wind to neighboring oaks. Even if they are not yet infested with caterpillars, they begin producing tannins and phenolic compounds in their leaves as a defense in preparation. Species of other trees and plants exhibit similar behaviors when being fed on by herbivores. In a phenomenon known as “indirect plant defense”, plants can release specific chemical compounds to lure potential pest predators or parasitoids. The type of VOCs emitted can even be tailored to the specific offender, with different compound blends produced for caterpillars, aphids, or beetles. When a cabbage plant is being fed upon by a species of cabbage white caterpillar, it “knows” which species it is by analyzing its saliva. It then

can release VOCs that attract the parasitoid wasps that prey on them. The wasps lay eggs on the caterpillar which eventually hatch and kill it.

But of course nature is ever evolving. As soon as a prey species mounts a successful defense, predators inevitably begin trying to overcome it. In Africa, for example, acacia trees emit VOC’s when herds of giraffes feed on them. The giraffes have become wise to this, and will only feed downwind when possible to avoid trees that may have received the forewarning and begun to produce extra tannins making their leaves less palatable and more difficult to digest for the herbivores.

The Grass is Always Screamer.

You likely aren’t aware of it but if you have ever cut grass in your life, or even been around a freshly cut lawn, you’ve been witness to a VOC call for help. When a blade of grass is cut, perhaps unsurprisingly, it senses this as a trauma and releases a blend of alcohols, aldehydes, ketones, and esters (VOCs) that we can smell. On the individual blade of grass scale this would be unnoticeable, but when we trim an entire lawn, it is extremely obvious.

The Sound of Science

Within the past couple of years, scientists have been exploring the soundscape created by plants. First described in 2023 by a team of scientists at Tel Aviv University, stressed plants will emit sounds. In this specific study,

tomato and tobacco plants were mic’ed up, and when drought stressed or after having a stem cut, they would emit ultrasonic (out of human hearing range) pops. These sounds don’t appear to be a direct form of communication however, having more to do with physics than philology- akin to the involuntary pops and crackles of a log on a fire rather than a deliberate utterance. When a plant’s stem or leaf is cut, the sudden loss of pressure causes air bubbles to form in the xylem (the tissue responsible for water transport), which eventually collapse and produce an ultrasonic popping or clicking sound known as cavitation. This happens to trees as well as other kinds of plants when damaged. Though not a purposeful emittance for their fellow plant life, other creatures of nature may be paying attention. Some beetle and insect species can sense these ultrasonic frequencies, which can help them find potentially vulnerable plants with lower defenses. Further studies in this field and all aspects of plant communication will only help provide deeper insights and appreciation for the forests of our parks and communities.

*“If trees could scream,
I would be so cavalier
about cutting them down? We
might,... if they screamed all
the time,... for no good reason.”
- Deep Thoughts by Jack Handey*

