The World

'Finding the Mother Tree' explores the intricate communication networks within a forest

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Ancient forests are awe-inspiring. But no less amazing is the complicated network of life beneath the forest soil. There, an intricate web of roots, insects, fungi, and bacteria is teeming with life, and contains twice as much carbon as the trees themselves.

In her new book, "Finding the Mother Tree: Discovering the Wisdom of the Forest," ecologist Suzanne Simard reveals what she's discovered about these connections through decades of experiments with trees. Simard teaches forest ecology at the University of British Columbia.

Simard grew up in a province of forests in British Columbia, and multiple generations of her family were horse loggers. After she became a forester at age 22, she says, she started to learn that "horse logging wasn't at all what the forest industry had become."

"It had become this clear-cutting machine that wouldn't just take out the odd tree here and there, wasn't selective logging, it was clear-cut logging," Simard says. "And that means taking every tree out. My job at the time was to replant these forests with trees — seedlings — and try to help them recover, but what I found was that when you don't have surrounding trees and good soil, it's harder to get trees growing."

Simard noticed that forestry practices like spraying native plants with herbicide to make way for seedlings was having a detrimental effect on the trees. "The trees actually seem to need these native plants around them as part of their successional process of healing the land. … That started to get me to look below ground at what we might be doing wrong," she says.

Simard noticed that some trees would do well, but others would suffer from pathogens and insect infestations, especially a root pathogen that infected many of the Douglas firs. This pathogen would spread from fir to fir and affect the whole plantation.

"So I thought, well, if it's a root pathogen, I need to look below ground at what's going on here," she explains. "These root pathogens — these fungal pathogens — really were attacking the big roots of the trees and then girdling them — in other words, infecting the base of the tree — and then [the trees] would just die within a year or two. And so I thought, well, we're disrupting the soil balance."

Simard started looking at the fungal communities below ground. There are thousands of species of fungi, roughly divided into three or four main groups, including pathogens, which kill trees; saprotrophs, which decay things; and mycorrhizal fungi, which are helper fungi. Mycorrhiza literally means fungus root.

"It's a relationship, a symbiotic, mutualistic relationship between trees and fungi, where the tree provides photosynthate, or carbon energy, to the fungus," Simard explains. "The fungus then uses that energy to grow mycelium through the soil. And as it does that, it kind of coats all the particles and soil pores and draws out the nutrients and delivers [them] back to the plant or the tree in exchange for this photosynthate. So they both are benefiting from this."

These fungi can also connect trees together, Simard discovered. Through mycorrhiza, ancient "mother trees" and other plants send nutrients and warning signals back and forth for the benefit of the entire forest ecosystem.

Mycorrhiza can connect trees of the same species or of different species, Simard says. She found, for example, that the paper birch, which was thought to be a competitor of the Douglas fir, is also a sort of a collaborator that helps deliver carbon to the fir trees.

This insight into how carbon moves between trees in a forest with the help of fungi could have profound implications for how humanity addresses climate change. Forests contain about 80% of Earth's terrestrial carbon, so they're hugely important in the global carbon budget, Simard points out. "Anything that happens to forests affects the global carbon budget, and we are affecting our forests every single day."

Simard's research showed that saving old trees, the so-called mother trees, which are the linchpins of forest recovery, from any kind of disturbance, whether it's fire or logging or insect infestations, is essential to the regeneration of a forest.

Old growth forests, which hold some of Earth's most ancient trees, store a tremendous amount of carbon in the soil and in their trunks, and they're rich hubs of biodiversity — from the fungi in the soil to the lichens in their crowns and the birds and animals that live in them.

"But we're logging them at this incredible rate right now," Simard points out. "Where I live, in British Columbia, we really only have 3% of our valley bottom, huge old growth forests left. And this isn't just happening in British Columbia, it's happening around the world."

"[T]o keep the biosphere in balance, we need to maintain forest cover across the globe," she continues. "And we're losing it really quickly, not just because of logging, but wildfire and insect infestations that are driven by climate change. And so trees are not going to be able to migrate or adapt as quickly as they need to, to keep up with the velocity at which climate is changing."

Unlike in trees, however, evolution in fungi doesn't take long. Because fungi have a shorter lifespan and reproduce within a year, they can mutate and be different from one year to the next. "They can actually serve as an interface between the rapidly changing climate and the more slowly changing trees," Simard says.

Maintaining a healthy microbiome around the trees, including the fungi, can help trees survive and perhaps migrate a little further and faster to keep up with the speed of climate change and "to make sure that in the new environments that they're in that they're able to cope as best as they possibly can," she adds.

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