Tree Communication

the wood wide web

By Irene O. Sabin '94

The idea that trees have a communication system, which can send, receive and interpret messages, has been studied by scientists for many years.

Two studies published in 1983 showed that healthy willow trees, poplars and sugar maples started to produce chemicals for repelling insects ("anti-herbivore phenols") when neighboring trees were under attack. Since then, at least 40 studies have replicated and corroborated the experiment.

Scientists state that trees have their own social network connected by a natural internet. The lexicon of tree language includes electrical signals, defensive and offensive chemicals, airborne VOCs, alluring scents, and the ability to "hear" sound vibrations, "see" wavelengths and shadows, and "taste" and "feel" their outside environment. For example, trees calculate temperature and length of days to determine the change of seasons. They signal to us that fall is coming by changing chemicals to produce the color we see in their leaves.

Chemical communication between plants is very complex and 20 different groups of molecules have been discovered to be active in the communication process, so far. There are about 100,000 different substances, which are called secondary metabolites, in the root zone of trees. They are needed to combat microbes, insects and other plants. Scientists have concluded that the database and "motherboard" of the arboreal communication network is located below ground, in the root and mycorrhizal system of each tree which is, eventually, connected to others in the forest. This system has been called "the wood wide web."

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Tree roots and the fungi which 19th Century biologist Albert Bernard Frank named mycorrhiza, are mutualistic partners. The trees share the carbohydrates they photosynthesize with the fungi and the mycorrhizae extend the stationary trees' reach to water and soil nutrients through mycelia hyphae, thread-like filaments acting like fiber optic cables that can extend for miles. It is the hyphae that connect trees to others in their family as well as to neighbors that are accepted as good companions. In old growth forests, it is thought that Mother Trees are connected to the entire forest and that these trees nurse and protect their babies via the underground network even when the seedlings sprout in the shade under the heavy crowns of the ancient trees. In these cases, the seedlings grow very slowly forming dense, strong wood which pests cannot easily penetrate.

In 1997, Dr. Suzanne Simard from the University of British Columbia used radioisotopes to show that carbon, nitrogen and water moved between a Douglas fir and a paper birch, both native to the area. When she shaded one tree, carbon based sugars flowed to it from the other tree. Instead of competing, these two trees were sharing resources using the fungal network. Trees can, also, recognize members of their family group as opposed to other species. When a relative encroaches, trees will share resources instead of trying to outcompete the intruder. This cooperation may be one way to ensure that the family genes will continue.

Rutgers Hutcheson Memorial Forest **in Somerset County shows examples of a successional forest after agricultural use, but still has trees that are at least 250 years old.**

In another study, Dr. Simard and her graduate student showed that every tree was connected to every other tree in a single forest stand of 250-300 trees. There is evidence that trees use the wood wide web to warn neighbors about pest attacks. When attacked, trees stimulate their defense genes to make defensive enzymes. Research suggests that they send chemical signals via their roots and mycorrhizal networks to neighboring trees which detect the signals and prepare their own defense systems. Lab results show that defense signals can travel between trees in as little as six hours. Trees can "taste" the saliva of an

The Bookshelf

The Hidden Life of Trees
by Peter Wohllenben

attaching insect and prepare appropriate defenses or send out pheromones for help from beneficial predators. In an experiment at the University of Missouri, a recording w as played of a caterpillar chewing a leaf next to a plant that had not been touched. At the sound, the plant signaled its genes to start producing defense chemicals. Peter Wohllenben, German forester and author, describes seeing an odd grouping of moss-covered stones on a walk in the beech forest which he manages. When he lifted the moss from one of the stones he found tree bark with a green cadmium layer underneath. When he looked at the stones again, he saw that they may be stump remnants of ancient ancestor. Current forest management practices in America encourage the logging of trees large enough to produce lumber while leaving young trees to grow in the open spaces left behind. According to Wohlleben, it is the lone tree left in a logged forest that suffers rather than benefits from all that light and space. It is disoriented after losing its social compass when the trees around it are cut. It may be giddy from all the sunshine and start growing in leaps and bounds forming large cells and air pockets which are attractive to microbes and insects. It may waste energy on sprouts along its lower trunk and may not have enough strength or family support to survive for very long. If it reaches 100 years, the age of a school child in tree life, it will probably be logged for furniture, as well. And, all that open space is an invitation to invasion by exotic species. Dr. Simard believes th at it is important to leave legacy trees and their fungal networks intact for the recovery of forests disturbed by logging or fire and to prevent invasion by exotic species. Some European countries are now leaving 5% of their old forests intact by law. Forests are important to human health . Trees release pytoncides, anti-bacterial chemicals that render forest air to be almost germ-free. To study the health benefits of forests, Korean scientists took groups of older women on walks in forests and in urban areas then measured their vital signs. Walks in a forest show d significant improvement in blood pressure, lung capacity and arterial elasticity. The w omen also felt lighter, happier and less anxious after excursions to the forest. The trips into town showed none of these health benefits. South Korea has now established dozens of " healing forests" using fast growing Hinoki cypress trees which are resistant to pests and give off a refreshing menthol scent.

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Forest Warfare

Trees can produce chemicals to com bat leaf-eating in sects an d then send airborne chemical signals to each other, warning nearby trees to prepare for an insect attack.
Research has shown that a wide range of trees and other plants become more resistant to insects after receiving signals.
https://www.mnn.com/earth-matters/wilderness-resources/blogs/facts-about-trees