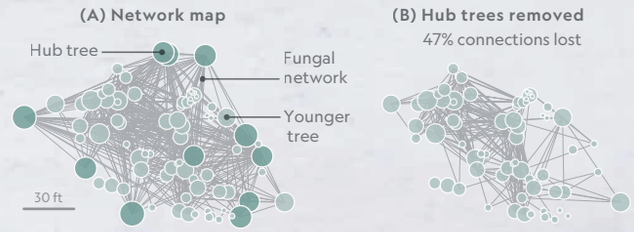
ILLUMINATING THE MYSTERIES—AND WONDERS—ALL AROUND US EVERY DAY
NATIONAL GEOGRAPHIC | VOL. 233 NO. 6

LOST CONNECTIONS
By sharing resources, networked forests with healthy hub trees become more resilient. Researchers examined fungal DNA to map connections in a Canadian forest (A) and found that the selective removal of hub trees (B)—by loggers, for example, or from an insect invasion—could cause more connections to be lost than if trees were removed randomly. Clear-cutting would destroy all links.



All distances are to scale; tree diameters shown at larger scale.

TALKING TREES

DAISY CHUNG AND **RYAN T. WILLIAMS**

BENEATH A SINGLE PATCH of forest soil lies a vast interconnected web of life. Forest ecologist Suzanne Simard likens it to a kind of hidden intelligence. By tracking specific chemicals, she and other scientists observed how trees in the Douglas fir forests of Canada "talk," forming underground symbiotic relationships—called mycorrhizae—with fungi to relay stress signals and share resources with one another.

Douglas fir (hub tree)
Douglas fir (younger tree)
Paper birch
Western spruce budworm
Douglas fir (hub tree)
Excess sugar from photosynthesis
Douglas fir (seedling)
Symbiotic fungal network
Nitrogen, potassium, phosphorus, and other nutrients
Chemical stress signals
Ponderosa pine
Symbiotic fungal network
FOREST IN DISTRESS

Understory nursery
Douglas fir trees use the network to identify and nurture related seedlings.

Seasonal partners
Deciduous paper birch and evergreen Douglas fir trade resources seasonally.

In spring and fall, firs share sugar with leafless birches.

In summer, birches return the favor to shaded firs.

Pine preparation
Fir trees infected with budworms send stress signals to nearby pines.

Resource pathways
- Sugar from trees
- Nutrients from soil
- Mixed resources from network: nutrients and carbon (from sugar)
- Chemical stress signals

Enlarged section of tree root tip
Resource-exchange pathway
Fungal thread
Tree root cell

1
Excess production
Taller, older trees, called hub trees, often have more access to sunlight and produce more sugar through photosynthesis than they need.

2
Exchange of goods
A mass of fungal threads, or mycelium, envelops the root tips of a hub tree, feeding it nutrients from the soil in exchange for sugar, which the fungus lacks.

3
Deep connections
Weaker firs in the shaded understory tap into the network as it swells with resources. Firs can also share with other species, such as birch.

WARNING SIGNS
Through the network, trees under stress can transfer resources, such as water, and can send chemical signals that trigger defensive mechanisms in other trees. Threats like insect infestation and drought are expected to increase as the climate changes.

ART: BEAU DANIELS. SOURCES: SUZANNE SIMARD AND CAMILLE DEFRENNE, UNIVERSITY OF BRITISH COLUMBIA; KEVIN BEILER, BEUTH UNIVERSITY OF APPLIED SCIENCES BERLIN

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