SCIENCE NEWS 1998 April 11, 1998
Vol. 153 No. 15 p. 230


# Mutualisms seen as partnerships for barter

Trees and fungi routinely swap sugar for fertilizer, but ecologists have not been able to explain how such mutualisms evolve. Now, researchers have developed a theory that explains how these positive interactions between species may arise.

When a species is even slightly better at acquiring one resource than another, the organism will often do better by specializing in the first resource and trading for the second, propose Mark W. Schwartz and Jason D. Hoeksema of the University of California, Davis. In two species with complementary needs and abilities, a mutualism can readily develop.

Nina Wurzburger/Univ. of Ca., Davis

A biological trading association: The orange mycorrhizal fungi coating the root tips of Bishop pine are visible when viewed through a dissecting microscope.

It sounds like economics 101 because it is. "I've taken a very old economic model and applied it to a biological model," says Schwartz, coauthor of a report on mutualism published in the April ECOLOGY.

Even though the analogy between barter and mutualistic associations seems obvious, it is a new way of thinking, says Judith L. Bronstein of the University of Arizona. "Mutualisms have always gotten much less attention than antagonisms like competition or predation."

Schwartz agrees that most ecological theory focuses on competitive interactions and predator-prey relationships. When researchers explored mutualisms with those models in the 1970s, he says, they generated unrealistic results—the species' populations spiral to infinity.

The models also predicted that conditions favoring the rise of mutualisms are rare. Because such beneficial associations are actually common in nature, Schwartz adds, these models weren't much help and ecologists put them aside.

Schwartz and Hoeksema base their model on a common mutualism between fungi and plants. Mycorrhizal fungi grow into the roots of many plants, including all conifers, many forest trees, and many grasses (SN: 4/30/88, p. 285). The fungi and plants exchange nutrients. Plants are more efficient than fungi at capturing carbon, in the form of carbon dioxide, and converting it to energy-rich sugars. Fungi excel at foraging for phosphorus, a soil nutrient included in many fertilizers because it is so hard for plants to obtain. The scientists' model predicts that both the plant and the fungus will get more of the resources they need by trading than by going it alone.

"If I make pants better than you make boots, it's obvious that we stop making two things [each] and we just trade," Schwartz says. "The tricky bit is if you make pants and boots better than I do, but I make boots better than I make pants. It's still better from me to stop making pants altogether and trade my boots for your pants. . . . I'm still going to get more pants back than I would if I made them on my own. . . . The only real constraint is that I can't be equally bad at making everything."

Mutualisms can still arise even if they render only small gains to the participants, Schwartz says. The model also predicts that when those gains vanish, barter should stop. Such alterations in fungus-plant interactions do occur, note the researchers. When soils have high amounts of phosphorus, mycorrhizal associations decrease.

*—M.N. Jensen*