ECOLOGY

Rare Tree Species Thrive in Local Neighborhoods

Biodiversity may be threatened worldwide, but small pockets of tropical-forest trees are surprisingly becoming more diverse over time. An analysis of decades of data from seven forests across the globe, reported on page 527, indicates that, on a small scale, rare tree species are thriving, and even surviving better than common species. The forests studied were relatively pristine, but the results may apply to forests in trouble as well, if enough healthy pockets of trees persist. All over the world, "local increases in diversity are taking place," says Christopher Wills, an evolutionary biologist at the University of California, San Diego. His conclusion: "Even if an ecosystem is damaged, it can recover."

Diversity reigns. In small patches of a tropical forest, rare species often do better than common ones.

For as long as biologists have marveled at the vast number of organisms in the tropics, they have struggled to understand why such biodiversity exists. To tackle this question, Wills tapped data on seven research forests monitored by the Center for Tropical Forest Science, based at the Smithsonian Tropical Research Institute in Panama. These reserves, in India, Puerto Rico, Panama, Thailand, Sri Lanka, and Malaysia, range in size from 16 to 52 hectares and contain anywhere from 74 to 1186 tree species, depending on rainfall and other environmental conditions.

At each forest, researchers conduct 5-year or 10-year censuses, counting every tree over 1 centimeter in diameter at chest height. At the same time, they note dead trees and track the number of trees that have grown big enough to be counted. Because the local collaborators follow a common survey protocol, Wills and his colleagues were able to compare each forest's results.

The researchers did two types of analyses. To track changes in the number of species over time, they divided the forests into 10-meter squares, counted the number of tree species in each square, and calculated the density of those species. Then, to get a sense of how the findings might change depending on the size of plot studied, the researchers repeated their analyses using 20-, 30-, 40-, and 50-meter squares. The surveyed trees fell into one of four groups: recruits (trees newly counted because they had reached the minimum size), newly dead trees, younger trees, and older trees in the plot.

Within these plots, more trees of the common species died over time than did members of rarer species, increasing the relative representation of rare species. The team found ▶

CHEMISTRY

Walk on the Wild Side Yields Supersensitive Chemical Measurements

Following the lead of astronomers who build their telescopes on remote mountaintops, German researchers have taken to the woods to generate ultrahigh-precision chemical measurements. By fleeing the magnetic interference common to civilization, a team at Forschungszentrum Jülich and Aachen University has devised a low-tech version of nuclear magnetic resonance (NMR) spectroscopy that can outperform multimillion-dollar lab instruments. The tabletop-sized device could hold the key to a new, low-cost version of NMR spectroscopy.

"It's a very beautiful piece of work," says Alexander Pines, a chemist at the University of California, Berkeley, and a pioneer in low-field NMR. His group and others have found ways to do away with expensive, high-field magnets, but only by using either other high-tech gear such as detectors or uncommonly large sample volumes (*Science*, 22 March 2002, p. 2195). By contrast, the new technique can get high-quality chemical data on a few milliliters of a liquid with standard electronic equipment. The improvement could lead to easier ways to monitor chemicals during manufacturing and track chemical spills, Pines says.

NMR works because some atomic nuclei behave like tiny bar magnets. In typical NMR experiments, researchers place a chemical sample at the center of a giant, high-field superconducting magnet that causes the nuclear spins to precess around the magnetic field at a rate that is unique for each atomic species. Next, they hit their sample with radio pulses that nudge the nuclear spins away from their normal orbit; the timing of their realignment betrays their identity and chemical neighbors. The larger the external magnetic field, the easier it is to see the signal, which makes it possible to work out the structure of larger and more complex molecules.

The new technique makes use of another NMR signal, called the "J coupling," which doesn't depend on the external field. When J coupling occurs, the spins of atomic nuclei affect the behavior of the electrons that form the chemical bonds between the atoms. This influence shows up on an NMR spectrometer as patterns that reveal the structure of the component molecule.

Tracking J coupling in a lab is a challenge, because even a nearby screwdriver can create imbalances in the magnetic field that wash out the J-coupling signature. Ultrasensitive superconducting detectors called SQUIDs can overcome the problem, but they are costly and need expensive cooling equipment.

So the German team—Stephan Appelt, Holger Kühn, and F. Wolfgang Häsing of the Forschungszentrum Jülich and Bernhard Blümich of Aachen University—opted to do away with extra equipment by working in a forest 5 kilometers south of Jülich. By escaping the magnetic interference of civilization and shielding their electronic gear, the scientists obtained J-coupling information at least 10 times as precise as with superconducting magnets 100,000 times more powerful, they report online this week in *Nature Physics*.

Low-field detectors will never replace high-field NMR for working out the structures of highly complex molecules such as proteins, Blümich says. But their low cost—thousands instead of millions of dollars—could push the technology rapidly into new areas of remote chemical detection.

–ROBERT F. SERVICE

CREDIT: C. WILLS ET AL., SCIENCE

the same trend in plots of all sizes, but it was most evident in the 10-meter squares. And these results were consistent from forest to forest. "One would not expect to find such congruence unless similar processes are operating," says ecologist Theodore Fleming of the University of Miami, Florida.

What explains the success of the rarer tree species? Being closer together, common trees are more prone to deadly infections. They may also face stiffer competition for certain resources. In contrast, rarer trees, by depending on slightly different sets of resources, may not have this problem. There's a delicate balance, however, says Wills: "If [a species] gets too common, it loses advantage."

The findings challenge a theory about forest diversity. According to the so-called neutral theory, plant species are gained and lost randomly. Thus, "diversity is just an accident of history," says Wills. However, "what we are finding is that it's not neutral; [diversity] is being selected for."

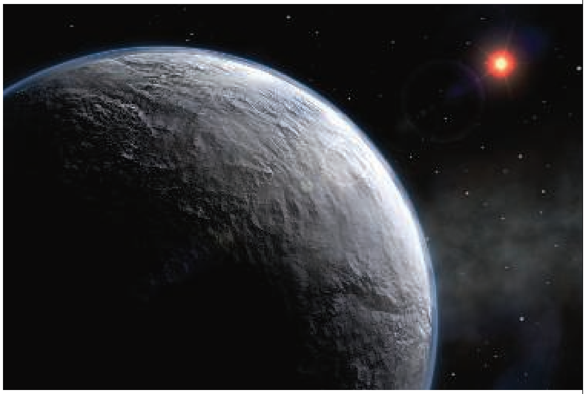
Such a result should be exciting to ecologists studying grasslands, temperate forests, and perhaps even coral reefs, notes Scott Armbruster, an evolutionary ecologist at the University of Portsmouth, U.K.: "That these patterns are found to be so consistent across so many distant tropical forests suggests to me that the conclusion may eventually be found to hold for other diverse ecosystems as well."

–ELIZABETH PENNISI

EXTRASOLAR PLANETS

I Spy . . . a Cold, Little Planet

Applying the technique of gravitational microlensing to the search for planets beyond the solar system, a superconsortium of astronomers has detected a frozen ice ball much smaller than Neptune orbiting a faint star in the distant central bulge of the galaxy. It's the first of a new class of cold, diminutive extrasolar planets.



Not so hot. Microlensing can detect smaller planets that are far enough from their stars to avoid being roasted.

"It's a tremendously exciting result," says astronomer Sara Seager of the Carnegie Institution of Washington's Department of Terrestrial Magnetism in Washington, D.C. Microlensing "does things we can't do any other way," she adds. By opening a new window on "super Earths"—the least massive exoplanets yet found—it has suggested that such planets are far more common than the sizzling, Jupiter-sized gas balls that have made the news in recent years.

Microlensing depends on gravity's ability to bend light, as Einstein predicted it could do. By monitoring the brightness of millions of stars at once, astronomers can tell when one star passes in front of a brighter, more distant star, gravitationally bending its light and brightening it the way a glass lens would. If the nearer or "lens" star happens to have a planet, it too will gravitationally brighten the source star. This is the only way astronomers can detect relatively small planets at some distance from their stars. The 170 "hot Jupiters"—massive, gaseous bodies orbiting scorchingly close to their stars—have been spotted by the wobble they gravitationally induce in their stars.

On 11 July of last year, the OGLE collaboration of astronomers announced that a particular star was beginning to brighten. The PLANET and MOA collaborations joined in, and, on 9 August, the combined observations revealed a small, half-day-long brightening superimposed on a slow dimming.

In this week's issue of *Nature*, the 73 astronomers of the three collaborations report that the secondary microlensing event was caused by a planet three to 10 times the mass of Earth; Neptune is 17 times Earth's mass, and Jupiter, 318 times. The exoplanet orbits its small, faint star at a distance of about three times Earth's distance from the sun and therefore is probably as cold as Pluto. In contrast, hot Jupiters swing around their stars in a matter of a few day days and reach thousands of degrees.

Microlensing's diminutive discovery implies that planets smaller than Neptune dominate between 1 and 10 astronomical units from their stars, the *Nature* authors say. That is in line with the leading theory of planet formation, in which multi-Earth-size cores of ice and rock form first and then, with luck, gather gas to form a Jupiter. All of this bodes well for future microlensing searches, as well as for finding habitable, Earth-size exoplanets.

–RICHARD A. KERR

CREDIT: EUROPEAN SOUTHERN OBSERVATORY

Cell Vote a Go in MO

A Missouri judge last week ruled that stem cell advocates could begin collecting signatures for a ballot initiative that would explicitly permit research cloning, or somatic cell nuclear transfer, to generate human embryonic stem cells. The proposal would also outlaw reproductive cloning. Opponents called the proposed ballot language "misleading," but a Cole County judge called the wording "fair." The pro-research initiative must garner 150,000 signatures by 9 May to earn a fall ballot spot.

In the meantime, Republican state Senator Matt Bartle plans to introduce a bill banning the creation of a "human being" in any way other than through union of sperm and egg.

–CONSTANCE HOLDEN

Call Ourselves an Institute

PARIS AND BERLIN—A fight over a proposed 80,000-m^2 multidisciplinary institute outside Paris has pitted researchers against the French government once again. The Save French Research movement opposes plans for the European Institute of Technology in Saclay, preferring to link up and strengthen existing ones to form a multicenter European Technology Institute. Supporters say current technology labs are too dispersed and dilapidated to form a nucleus of excellence. Research Minister François Goulard, a project supporter, says he hopes it would take shape in the next few months.

Meanwhile, the German government has named 10 finalists in a competitive initiative designed to boost several universities to world-class status. Dark horse University of Bremen joined the University of Heidelberg among the finalists.

–BARBARA CASASSUS AND GRETCHEN VOGEL

Researcher Rules Eased

Easing scientists' concerns, the U.S. Department of Commerce has decided that export-control rules restricting foreign researchers in the United States from using sensitive technologies should be based on the person's most recent country of citizenship or permanent residency and not country of birth. The changes to the rules, which are aimed at preventing the transfer of sensitive technologies to countries the United States views as national security threats including China and Russia, are expected to be finalized soon.

–YUDHIJIT BHATTACHARJEE