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Science 12 March 1999:
 Vol. 283, no. 5408, pp. 1623 - 1625
 DOI: 10.1126/science.283.5408.1623

NEWS FOCUS

ECOLOGY:
Scientists--and Climbers--Discover Cliff Ecosystems

Kevin Krajick

Researchers venturing onto remote bluffs find them to be oases of diversity, but rock climbers are taking out species even as scientists discover them

They're vertical, they're made of rock, and you can't see them up close without risking your neck. So it's not surprising that few biologists have paid much attention to cliffs. But lately, some hardy researchers have dangled from ropes alongside high bluffs, and they are finding unusual and ancient communities that don't exist in the flatlands below.

These first forays have turned up surprisingly diverse communities, including rare plants and lichens, birds, and trees nearly 1000 years old. "Cliffs protect themselves very well by being so inaccessible, so they can have unusual communities even in heavily populated areas," says Jerry Freilich, former ecologist for California's Joshua Tree National Park. Joshua Tree and other parks are commissioning new studies on these hard-to-reach habitats, largely because a boom in rock climbing is putting unprecedented pressure on them, says Freilich, now science director for the Nature Conservancy of Wyoming.



Life on the edge. Ancient trees on the Niagara Escarpment are adapted to harsh cliff conditions.

CREDIT: P. KELLY

Wildlife biologists have long known that raptors such as peregrine falcons and red-tailed hawks nest on cliffs, where predators can't get at their young. And a few researchers cataloged sea-cliff plants in Ireland and Britain in the 1980s. But until fairly recently, there have been no studies of cliffs as distinct ecosystems. "Look at how hostile they appear. No one really viewed them as habitat," says Richard Knight, a professor of wildlife biology at Colorado State University in Fort Collins.

Knight and graduate student Richard Camp recently discovered that some of Joshua Tree's granite spires are actually islandlike centers of diversity. They found 60% more bird species, and three times as many plant species, on the cliffs than were on the flat, arid desert floors below. From top to bottom, the cliffs provide all sorts of niches: Rock wrens and white-throated swifts rush in and out of cracks where they nest in great chirping masses, while the prairie falcons that prey on them incubate eggs on nearby ledges. Rock faces concentrate infrequent rains, dribbling moisture down to ledges and cliff bases to supply trees and succulents such as quercus oak and staghorn cactus that won't grow elsewhere; Lazuli buntings and other Neotropical migrant birds use this vegetation for nesting and food.

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Researchers are still figuring out what makes some of these rocky, windswept sites so rich. One reason is that cliffs create a classic "edge effect"--a break in the normal landscape that is often more diverse than, say, the monotonous interior of a forest. Winds that bring insects and seeds from all over may also play a role. For whatever reason, "we do know the Joshua Tree cliffs are a distinct place," says Knight.



Up, up, and away. Climbers on granite spires in Joshua Tree National Monument put cliff plants and birds at risk.

CREDIT: R. L. KNIGHT/COLORADO STATE UNIVERSITY

And because cliffs are so inaccessible, organisms once widespread may end up clinging to them as sanctuaries. About 5 years ago, in a boat off the Hawaiian island of Kauai, biologists from the National Tropical Botanical Garden there spotted what they believe were the last surviving individuals of *Munroidendron racemosum*, a primitive-looking tree with long, pendulous branches. The trees were sprouting from volcanic cliff ledges that looked as if they were about to crumble into the sea. All the others of their kind, once common on the island, had been eaten by human-introduced goats that couldn't reach this one last refuge. The biologists rappelled down, rescued seeds, and have since repropagated the species, says Paul Cox, director of the botanical garden.

Cliffs in the midwestern and southern United States also are home to a host of endangered species that have either been pushed there or just prefer rocky spots. They include such plants as mud warts and water hyssops, which grow in shallow seasonal pools that form in cliff rocks in Minnesota, and lichens such as *Parmelia stictica*, which cling to vertical faces.

Lichens are often a major component of cliff ecosystems, notes biologist Michael Farris of Hamline University in St. Paul, Minnesota, but these low-profile organisms are hard to identify and poorly known. So lichen biology remains a wide-open field. Last summer, rock climber Peter Smith, then a master's student in biology at Appalachian State University in Boone, North Carolina, surveyed one small part of the walls of nearby Linville Gorge and quickly came up with 23 genera inhabiting several distinct zones according to moisture. He also spotted one entirely new species, since named *Fuscidea pallida*. "He only did 12 transects, which makes us think there are many more undiscovered things up there," says Gary Walker, Smith's adviser.

In addition to their diversity, parts of cliff ecosystems can be remarkably ancient. Botanist Doug Larson and dendrochronologist Peter Kelly of the University of Guelph in Ontario, Canada, have found that some of the eastern white cedars dominating the 800-kilometer-long Niagara Escarpment of the Great Lakes region are up to 800 years old; well-preserved dead trees are more than twice that age.

Many of the cedars have multiple root systems attached directly to soil-less solution hollows and cracks in bare rock. Larson and his colleagues have found dense colonies of algae, bacteria, and fungi penetrating 1 to 3 millimeters into these apparently solid rocks. Larson hypothesizes that these so-called cryptoendoliths--previously known mainly from Antarctica--may help nourish the trees. Larson also notes that the cedars are apparently adapted to slow growth rates; in fact they are among the slowest growing plants known, adding only a couple of layers of cells each year, compared to perhaps 600 layers for their cousins on flat land. Twisted trunks may reach 3 feet in diameter, but some 200-year-old specimens are no bigger than a toilet plunger. Larson believes slow growth assures longevity and thus survival of the species. "It's an advantage--if they grew fast, gravity would drag them off before they got a chance to reproduce," he says.

Unfortunately, scientists are not the only ones discovering cliffs. Last year, 4 million people went rock climbing in the United States alone, and they left their mark on these fragile ecosystems, as Knight and Camp report in studies in the December 1998 issue of *Conservation Biology* and the April issue of the *Wildlife Society Bulletin*. Some Joshua Tree prominences are now hung with so many ropes that they look like Gulliver tied down by Lilliputians. To keep regular routes safe, climbers routinely "garden" them, pulling plants and soil out of cracks and wire-brushing lichens off protruding handholds.

Not surprisingly, Knight and Camp's studies show that climbers reduce plant cover and drive off birds. Independent botany consultant Victoria Nuzzo of Rockford, Illinois, showed that climbers reduced lichen cover and species by half and took out three-quarters of threatened cliff goldenrod plants at one site in northern Illinois's Mississippi Palisades State Park. Perhaps worst of all, climbers on the Niagara Escarpment are clearing the way by cutting down the old trees. Survivors may be used to fasten ropes, which strips their bark. Dendrochronologist Kelly has meticulously documented the damage; he dated one tree that germinated in 1215--and had its main axis sawed off in 1992.

Because the recognition of cliff life is so new, few parks have gotten around to making rules. As studies build, that may change. "I like to think that the more we learn about these places, the more we can demonstrate how special they are," says Kelly.

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Science. ISSN 0036-8075 (print), 1095-9203 (online)

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