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Lichens Function as Indicators of Nitrogen Pollution in Forests

RIVERSIDE, Calif. October 6, 2008—Scientists have found lichens can give insight into nitrogen air pollution effects on Sierra Nevada and San Bernardino mountain ecosystems, and protecting them provides safeguards for less sensitive species.

Their findings are presented this month in the international journal *Environmental Pollution* and are significant because nitrogen from air pollution causes detrimental chemical and biological effects to terrestrial and aquatic ecosystems. Other harmful effects include elevated nitrate concentrations in streams and groundwater, and weakened California forests more susceptible to bark beetle infestations and fires.

The U.S. Forest Service funded the study, which included the agency's own researchers working with scientists at the University of Arizona and Spain's National Research Center for Energy, Environment and Technology.

According to the scientists, nitrogen pollution that has virtually eliminated lichen species in the Los Angeles Basin and San Bernardino Mountains is now exceeding critical loads over much of the Western Sierra Nevada as far north as Lake Tahoe. Other areas in corridors of polluted air such as the Central Valley are also exceeding nitrogen critical loads.

"Publicity surrounds the carbon cycle and its effects on the environment, but humans have altered the global nitrogen cycle to a greater degree," said Mark Fenn, a Forest Service plant pathologist and one of the study's authors. "There are now significant changes in lichen indicator groups because nitrogen critical loads are being exceeded over much of California."

Scientists involved in the research studied 24 mixed-conifer forest sites exposed to a wide range of atmospheric nitrogen deposition and monitored adverse changes in lichens, among the most sensitive biological indicators of nitrogen effects.

The result is a useful tool for determining critical loads and preventing broader impacts to forests. Protecting lichens also has inherent value because of their complex hydrological, nutrient cycling, wildlife forage and nesting material roles.

"Quantifying nitrogen critical loads helps land managers determine the point at which unacceptable impacts occur to sensitive ecosystems," Fenn said. "This helps bring air quality management that is more firmly rooted in ecosystem protection."

The United Nations' International Cooperative Program on Effects of Air Pollution on Natural Vegetation and Crops has led the largest effort to quantify nitrogen critical loads. Similar coordinated efforts do not exist in the United States. But, U.S. research in critical loads is increasing.

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