Atmospheric Deposition

United States Department of Agriculture

Forest Service Air Program

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Background

Nitrogen deposition from coal, natural gas, gasoline and diesel fuel combustion causes:

- Chemical changes in soils and trees
- Nitrogen saturation in soils with runoff to lakes
- Altered terrestrial and aquatic plant communities

Deposition of sulfur from coal-fired power plants and refineries causes:

- Lake and stream acidification
- Altered soil chemistry and nutrient cycling
- Mobilization of aluminum in soil
- Altered growth of spruce-fir forests

Chronic acid deposition in the east has affected tree growth in spruce-fir forests like Otter Creek and Dolly Sods Wilderness of the Southern Appalachians. Episodic deposition in western forests has been linked to nitrogen saturation of high elevation watersheds and eutrophication of surface waters.

Successes

Lye Brook Wilderness: The Forest Service has advised state agencies to reduce emissions causing ecosystem degradation. Over 40 cooperators are working to integrate research and monitoring programs in Vermont Forests. Deposition impacts on biota, including amphibians and lichens, and mercury in lakes are being addressed.

Partnerships with FS Research: Demonstration sites have been established to monitor and model deposition impacts to: Fernow Experimental Forest, Monongahela National Forest and Kings River, Sierra National Forest ecosystems (**Fig 2**). Broader networking with Forest Health Monitoring is under consideration.

Mt. Zirkel Wilderness: The Air Program achieved landmark emissions reductions at the Craig and Hayden power plants impacting the Mt. Zirkel Wilderness, CO. As a result of both negotiations and legal action, there has been a substantial decrease in sulfur dioxide emissions (83% at Hayden). Sulfate levels in precipitation have been reduced. Improvements in surface water chemistry should soon be detectable.

Fig 1. Deposition modeling demo sites Fernow, WV and Kings River, CA.

Challenges

Sulfur deposition has decreased but nitrogen deposition is increasing, threatening some of our most pristine ecosystems (**Fig 2**). Ecosystems continue to decline due to cascading effects, loss of buffering capacity, chronic acidification, and long recovery times. Synergistic effects, including "pest infestations," are difficult to detect and remedy. Atmospheric deposition is such a problem that liming (addition of calcium carbonate) has been used in headwater streams in St. Marys Wilderness to restore declining species diversity and improve survival rates of fish and insects. Liming is also being considered in other coldwater streams of the Southern Appalachian Mountains to restore trout habitat. New technology is needed, e.g., to monitor fog and cloudwater chemistry at high elevations (**Fig 3**).

Fig 2. Our most pristine ecosystems are at risk. L to r: Desolation Wilderness, GLEES research site, Mt. Zirkel Wilderness.

Fig 3. Throughfall and fog monitoring.