

Visibility and Particulate Monitoring

The NPS Air Quality Division has been monitoring visibility and particulates that affect visibility at more than 30 park sites. It has also studied the influence of visibility impairment on visitor enjoyment and use of park resources.

Visibility is recorded with both color photography and teleradiometry. The color photography documents the important elements of the scene and how they vary with changing air pollution levels, weather conditions, and sunlight. Teleradiometry uses a special telescope to measure the contrast between the sky in the background and dark landscape features so that changes in contrast caused by pollution or climatic changes can be recorded. Together, the photography and teleradiometry can be used to establish standard visual ranges—the distance from an observer at which a large dark object such as a forested mountain would just disappear against the horizon.

Results to date of visibility monitoring include the following: 1) More than 90 percent of the time, manmade pollution affected scenic views at all NPS monitoring sites. 2) The best average visibility is in northern Nevada, Utah, and southern Idaho. Next best is the Colorado Plateau, where Grand Canyon, Bryce Canyon, and Canyonlands national parks are located. 3)



A ranger removes the air filter from a fine particulate stacked filter at Bandelier NM, one of 30 sites in the NPS visibility monitoring network.

The lowest visibility in the West is in the coastal areas of California and Washington, probably because of natural weather conditions and smoke from prescribed burns. 4) The worst visibility recorded by NPS is in the eastern United States, where relative humidity and air pollution levels are highest. In the summer of 1983, for instance, the median visibility range at Shenandoah National Park was 19 kilometers, as compared with 100 to 200 kilometers for most western parks. 5) Visibility is generally best in the winter and worst in the summer.

Particulates are monitored through the use of stacked filter samplers. Samples are collected over 72-hour periods which are followed by 12 hours off. NPS research and monitoring indicate that particulates are the major contributor to visibility impairment

in parks; especially the very fine particulates (those smaller than 2.5 micrometers in diameter), which scatter light much more effectively than do large particles, which form a large percentage of the pollution mass. Sulfates, the end product of atmospheric chemical transformation of gaseous sulfur dioxide, formed the largest single fraction of the total collected fine particle mass and were the principal impairer of visibility everywhere except in the Northwest, where carbon particles took the lead. On the Colorado Plateau, sulfate particles were responsible for 40 to 65 percent of the visibility impairment and at Shenandoah National Park for over 70 percent. In the Southwest, windblown dust, emissions from construction activities, and traffic on unpaved roads contributed 10 to 30 percent of the visibility reduction, while fine-

particle carbons and nitrates accounted for another 20 percent. (The above information was taken largely from "Pollution Where You'd Least Expect It," by David B. Joseph, *EPA Journal*, March 1986.)

The NPS has studied the influence of visibility on visitor enjoyment of parks through mail-back surveys and on-site interviews. Mail-back surveys to determine which park attributes visitors feel are most essential to a positive experience were conducted at Grand Canyon, Mesa Verde, Mount Rainier, and Great Smoky Mountains national parks during the summers of 1983 and 1984. The results indicated that visitors felt a natural environment, free of pollution and undisturbed by humans was most important to their experience. On-site interviews at Grand Canyon and Mesa Verde were conducted to examine effects visual air quality might have on the recreational experience sought. Seventy-six percent of the visitors interviewed at Grand Canyon said they saw haze and at Mesa Verde, 86 percent. As visitors became more aware of haze, they reported decreased enjoyment of the view and less satisfaction with visual air quality. At the same time, 80 percent or more of the visitors thought the haze was natural, while monitoring showed that 60 to 80 percent of the haze was associated with urban and industrial sources. This suggests the need for expanded interpretation and public education on the state of air quality in parks.

The Park Service is also involved in two cooperative programs to study visibility. The SCENES program is a multi-year research and monitoring investigation of the layered and regional haze problem in the Southwest. SCENES is an acronym for Subregional Cooperative Electric Utility, National Park Service, and Environmental Protection Agency Study. Electric utilities participating in the study are Salt River Project, Southern California Edison, and Electric Power Research Institute. The Department of Defense is also participating. The goal is to establish the relative contributions of various source categories to atmospheric aerosols in the desert southwest, with emphasis on national parks and recreation areas in Arizona and southern Utah and restricted airspace in the western Mohave Desert. Over a dozen monitoring sites have been established. Most are at remote locations designed to monitor regional atmospheric constituents through both optical and aerosol measurements. Field measurements were begun in 1984 and will continue for at least 5 years.

The second cooperative program is IMPROVE (Interagency Monitoring of Protected Visual Environments). Begun in FY1985 (planning only), this program will conduct long-term visibility measurements in national parks, national monuments, and wilderness areas, as required by an EPA regulation written to help carry out objectives of the Clean Air Act. The monitoring program must determine the

background visibility conditions in and around the mandatory class I areas and document the extent of any visibility impairment in those areas that can be attributed to a source or group of sources. All class I areas in the United States will be grouped in visibility regions (tentatively 23). Each region will have one monitoring site representative of all the class I areas in that region. Each site will employ, at a minimum, an automatic teleradiometer, an automatically-actuated 35 mm camera, an SFU particle sampler, and a data collection device to record values from the teleradiometer. The network, under general responsibility of EPA, will consist of 15 NPS sites, 4 U.S. Forest Service sites, and 4 U.S. Fish and Wildlife Service sites. Field measurements are scheduled to begin in FY1986.



A ranger at Canyonlands NP takes visibility measurements with a teleradiometer.