



Bent's Old Fort National Historic Site

Air Quality, Atmospheric Deposition

Air pollution damages resources and values that national parks are mandated to protect. National Park Service (NPS) managers have a special responsibility to monitor and protect air quality and related resources from the adverse effects of air pollution, and to provide recommendations to protect park natural and cultural resources. The Southern Plains Network (SOPN) monitors air quality conditions to understand their interactions with physical and biological components of the ecosystem. It is important to effectively evaluate the effects of these hazards on ecosystem health.

Both the Clean Air Act and the NPS Organic Act protect air resources in national parks. Understanding changes in air quality can aid in interpreting changes in other monitored vital signs and support evaluation of compliance with legislative and reporting requirements. At Bent's Old Fort National Historic Site, the SOPN has identified atmospheric deposition as a high-priority vital sign for monitoring.

Long-term Monitoring

For Bent's Old Fort National Historic Site (NHS), the SOPN acquires, analyzes, and reports on air quality data from the National Atmospheric Deposition Program/ National Trends Network (NADP, wet deposition) and from the National Park Service-Air Resources Division (NPS-ARD). Bent's Old Fort NHS uses data from nearby Las Animas Fish Hatchery, which is about 13 km northeast of the site, to report on air quality trends.

SOPN air quality monitoring objectives are to:

- Determine the conditions and spatial and temporal trends in ozone, nitrogen deposition, sulfur deposition, and visibility-reducing pollutants.
- Determine how ozone, nitrogen deposition, sulfur deposition, and visibility-reducing pollutants vary with associated vital signs (such as vegetation community composition, exotic plant status, and climate).

Management Applications

Information gathered from this protocol supports evaluation of compliance with legislative requirements of the Clean Air Act, regional haze guidelines, National Environmental Policy Act, and the Government Performance and Results Act (GPRA).



NPS/DENNIS CHAPPELL

Holiday celebration at Bent's Old Fort National Historic Site.

Park Overview

Bent's Old Fort NHS is designated a Class II air quality area under the Clean Air Act, which means it is afforded somewhat less stringent protection than areas designated as Class I. Although most parks in the SOPN are some distance from cities and other sources of pollution, they experience occasional poor air quality from pollutants such as nitrogen oxides, sulfur dioxide, ozone, and volatile organic compounds. The closest major stationary source of pollutants is industry in Pueblo, Colorado, approximately 60 miles northwest of the site. This includes a coal-fired electric generating station and the Pueblo Chemical Depot southeast of Pueblo. These air pollutants may adversely affect air quality and natural resources, including vegetation, wildlife, soils, water quality, and visibility.

Atmospheric Deposition

Overview

Atmospheric deposition can be wet (contributed through rain or snow) or dry (particles carried in the air). Wet deposition occurs when air-pollutant emissions, such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), and ammonia (NH_3) from power plants, automobiles, agriculture, and other sources are transported and transformed in the atmosphere and deposited to ecosystems as sulfate (SO_4), nitrate (NO_3) and ammonium (NH_4) compounds via rain or snow. Dry deposition of particles and gases occurs through complex processes, such as settling, impaction, and adsorption.

Nitrogen (N) and sulfur (S) compounds deposited from air pollution can harm surface waters, soils, and vegetation. N and S deposition cause acidification of streams and lakes in some parts of the country, while N deposition is known to disrupt soil nutrient cycling and alter aquatic and plant communities.

Monitoring Results

Only wet deposition is measured for Bent's Old Fort NHS. Wet deposition data from NADP is used to evaluate trends and conditions in N and S compounds. NPS-ARD recently reported both long- and short-term trends in conditions for N and S in its *Air Quality in National Parks: 2009 Annual Performance and Progress Report*.

Ten-year trend data (1999-2008) showed possible degradation in ammonium ($p > 0.05$, increasing concentrations) and no trend in nitrate or sulfate. Figure 1 shows a graph from NADP for 1983-2010, illustrating the trend in ammonium concentrations.

According to the NPS Air Resources Division, Bent's Old Fort NHS met its 2009 GPRA goal for deposition. The GPRA goal is met when deposition of nitrate, ammonium, and sulfate do not show degrading trends over a 10-year time period (1999-2008).

The NPS Air Resources Division uses an index to characterize each type of air quality measure as good, moderate, or of significant concern. For the period 2004-2008, N deposition was a moderate concern at Bent's Old Fort NHS, and S deposition was in good condition.

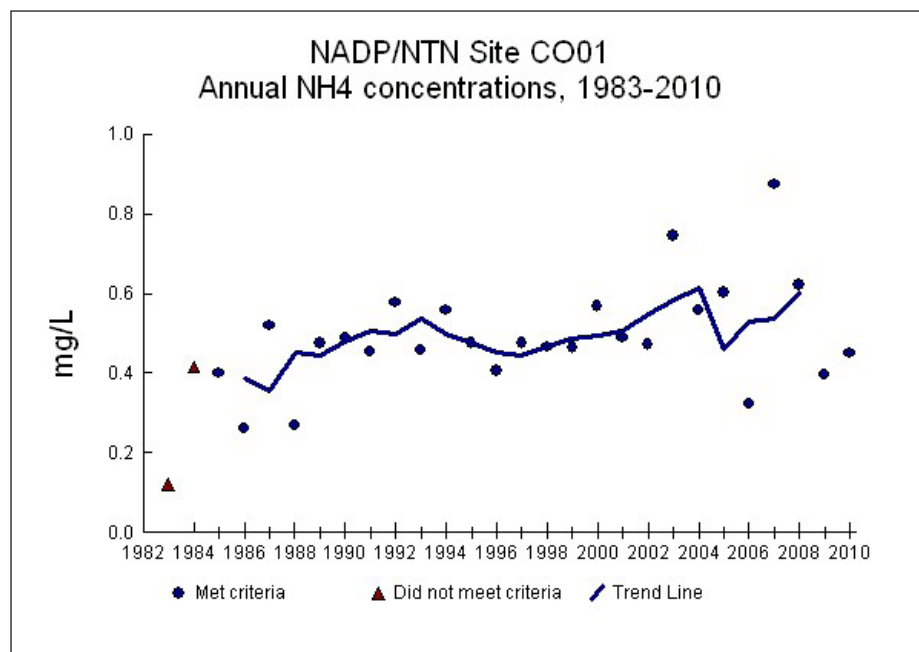


Figure 1. Trend lines (composed of a three-year, centered, weighted, moving average value) for concentrations of ammonium in wet deposition at Las Animas Fish Hatchery (representative of Bent's Old Fort NHS), 1983-2010.



For more information

Southern Plains Inventory & Monitoring Network | National Park Service | <http://science.nature.nps.gov/im/units/sopn/>