



Atmospheric Deposition at Chiricahua NM

Importance

Both the Clean Air Act and the National Park Service (NPS) Organic Act protect air resources in national parks. Chiricahua National Monument is designated as a Class I area, receiving the highest protection under the Clean Air Act. 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 Chiricahua NM, the Sonoran Desert Network has identified atmospheric deposition, ozone, and visibility as high-priority vital signs for monitoring.

Long-term Monitoring

For Chiricahua National Monument, the Sonoran Desert Network (SODN) acquires, analyzes, and reports on air quality data from the web-based program archives of the National Atmospheric Deposition Program/National Trends Network (NADP; wet deposition), Clean Air Status and Trends Network (dry deposition), National Park Service–Air Resources Division (NPS-ARD) Gaseous Pollutant Monitoring Program (ozone), and the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program (visibility).

Because the NPS-ARD has determined that deposition monitors within 16.1 km (10 miles) of a park boundary may be reasonably considered representative of a park's air quality, the NADP monitor at Chiricahua NM is also suitable for reporting on air quality at Fort Bowie National Historic Site.

SODN air quality monitoring objectives at Chiricahua NM are to:

1. Determine the seasonal and annual status and trends in concentrations of N- and S-containing ions and dry-deposition chemistry;
2. Determine the seasonal and annual status and trends in ozone concentration; and
3. Determine the seasonal and annual status and trends in concentrations of visibility-reducing pollutants.

Management Applications

Information gathered from this protocol will:

- Support evaluation of compliance with legislative requirements of the Clean Air Act, regional haze guidelines,



Airshed, Chiricahua National Monument.

National Environmental Policy Act, and the Government Performance and Results Act (GPRA); and

- Facilitate interpretation of other SODN vital signs, such as vegetation and water-quality measurements.

Park Overview

In 1977, Chiricahua National Monument was designated a Class I air quality area, which provides special protection through state air quality permits. Both local and distant air pollution sources affect air quality in Chiricahua NM. The park's air quality related values (AQRVs) are those resources that are potentially sensitive to air pollution, and include vegetation, wildlife, water quality, soils, and visibility. At present, visibility has been identified as the most sensitive AQRV in the park; other AQRVs may also be sensitive, but have not been sufficiently studied. Although visibility in the park is still superior to that in many parts of the country, visibility in the park is often impaired by light-scattering pollutants (haze).

Atmospheric Deposition

Overview

Wet deposition occurs when air-pollutant emissions, such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), and ammonia (NH₃) from power plants, automobiles, agriculture, and other sources are transported and transformed in the atmosphere and deposited to ecosystems as sulfate (SO₄), nitrate (NO₃),

and ammonium (NH₄) compounds via rain or snow. Dry deposition of particles and gases occurs through complex processes, such as settling, impaction, and adsorption.

Atmospheric deposition can have a variety of effects on ecosystems, including acidification, fertilization, or eutrophication, and accumulation of toxins. In freshwater lakes, streams, and watersheds, deposition from nitrogen (N) and sulfur (S) compounds can cause changes in water chemistry that affect algae, fish, submerged vegetation, and amphibian and aquatic-invertebrate communities.

Monitoring results

Concentrations of nitrate and sulfate in rain and snow showed no trends in Chiricahua NM and Fort Bowie NHS from 1999 to 2008. However, ammonium increased significantly during that time period (Figure 1).

Long-term trends show that Chiricahua NM and Fort Bowie NHS are two of four national parks (of 56 monitored) with deteriorating nitrogen loadings because of increasing ammonium. Ammonia emissions are associated with agriculture, feedlots, and fires. The NPS has shared information and concerns about these trends with the U.S. Environmental Protection Agency, as well as states, tribes, and stakeholders. Collaborative efforts are underway to better understand the causes and effects of nitrogen loadings and to explore options for protecting ecosystem health, if necessary.

Figure 2 depicts overall contributions of wet and dry deposition from 1992 to 2007. Although these estimates suggest that wet deposition exceeded dry deposition, the measurement methods may underestimate dry deposition. Nitrate and am-

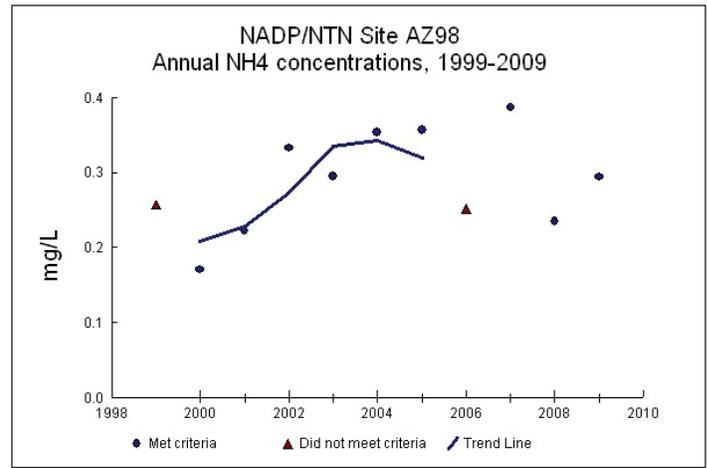


Figure 1. Trend lines (composed of a three-year, centered, weighted, moving average value) for concentrations of ammonium in wet deposition at Chiricahua National Monument, 1999–2009.

monium contributed almost equally in total nitrogen deposition.

Nitrogen deposition condition is of significant concern at Chiricahua NM, with a degrading trend. In some arid ecosystems, nitrogen loadings of 2–3 kg/ha/yr increase growth of invasive grasses, a contributor to wildfire. At Fort Bowie NM, nitrogen deposition is moderate, with a degrading trend. Sulfur deposition condition at both parks is of moderate concern, with no trend. Neither Chiricahua NM nor Fort Bowie NHS is currently meeting its 2009 GPR goal for deposition due to degrading trends in nitrogen wet deposition.

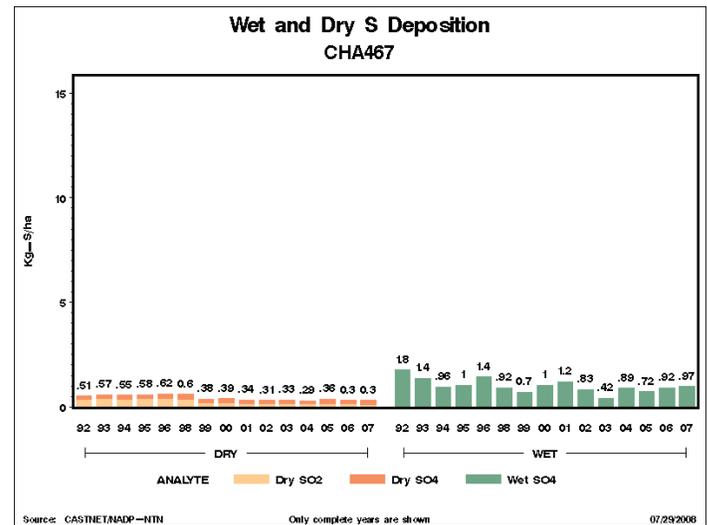
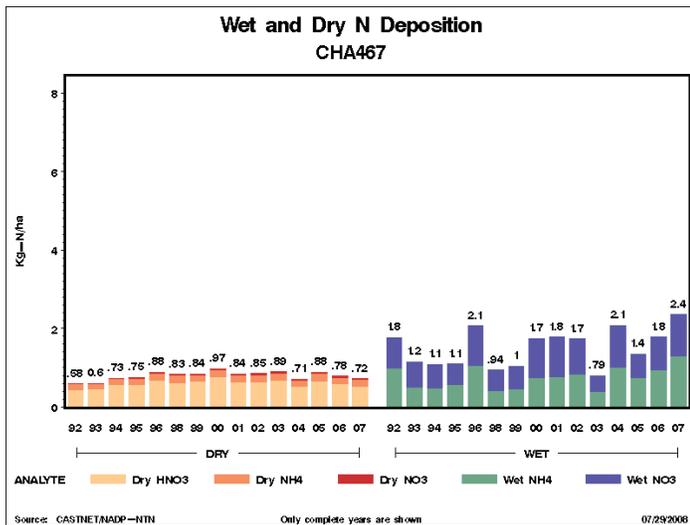


Figure 2. Wet and dry deposition of nitrogen and sulfur at Chiricahua National Monument, 1992–2007.



For more information

Sonoran Desert Network Inventory & Monitoring Program | National Park Service | 7660 E. Broadway Blvd, Suite 303 | Tucson, Arizona 85710
<http://science.nature.nps.gov/im/units/sodn/>