



Ozone at Big Bend National Park

Importance

Air pollution damages resources and values that national parks are mandated to protect. Both the Clean Air Act and the National Park Service (NPS) Organic Act protect air resources in national parks, and NPS managers have a special responsibility to protect park natural and cultural resources. The Chihuahuan Desert Network (CHDN) monitors air quality conditions to understand their interactions with physical and biological components of the ecosystem. At Big Bend National Park, the CHDN has identified atmospheric deposition, visibility, and ozone as high-priority vital signs for monitoring.

Long-term Monitoring

For Big Bend National Park (NP), the CHDN acquires, analyzes, and reports on air quality data from the National Atmospheric Deposition Program/National Trends Network (NADP, wet deposition), Clean Air Status and Trends Network (CASTNet, 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).

CHDN 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 will support 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).

Park Overview

Big Bend NP is designated as a Class 1 air quality unit under the Clean Air Act, which means it receives the highest protection under the Act. Visibility, vegetation, surface waters, soils, fish and wildlife and night skies are all potentially sensitive to air pollution and are identified



NPS/ERIC LEONARD

Lost Mine Trail, Big Bend National Park.

as air quality-related values (AQRVs) for the park. Big Bend NP has several ozone-sensitive plants including skunkbush (*Rhus trilobata*) and ponderosa pine (*Pinus ponderosa*). Ozone concentrations and cumulative doses are at levels in the park known to cause injury to such sensitive plants. Fortunately, the generally dry conditions in the park cause increased plant pore (stomatal) closures, thereby reducing ozone uptake by plants and the injury that results.

Ozone

Overview

Naturally occurring ozone in the upper atmosphere absorbs the sun's harmful ultraviolet rays and helps to protect all life on earth. In the lower atmosphere, however, ozone is an air pollutant, forming when nitrogen oxides (NO_x) from vehicles, power plants, and other sources combine with volatile organic compounds (VOCs) from gasoline, solvents, and vegetation in the presence of sunlight. Ground-level ozone is one of the most wide-

spread pollutants affecting vegetation and public health in the United States.

Ozone enters plant leaves through pores (stomata), where it can kill plant tissues, causing visible injury, or reduce photosynthesis, growth, and reproduction. In humans, exposure to ozone can cause respiratory problems and impairment of the body's immune system.

The U.S. Environmental Protection Agency (EPA) has set ozone national ambient air-quality standards of 75 parts per billion (ppb) averaged over an 8-hour period to protect human health (primary standard) and vegetation (secondary standard). Compliance with the standards occurs if the three-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at a monitor over the course of one year does not exceed 75 ppb. Areas not meeting the standards are designated as non-attainment areas, and states are required to develop plans to bring such areas into attainment.

In addition, scientists use various exposure indices to quantify ozone exposure to plants—indices considered biologically relevant because they take into account both peak ozone concentrations and cumulative exposure to ozone. These indices include the W126 (the annual index of the sum of weighted hourly concentrations, 8 AM–8 PM, during the three-month period with the maximum index value).

Monitoring Results

Ozone levels did not exceed EPA standards in 2010. The three-year running average (2008–2010) of the fourth-highest daily eight-hour ozone concentration was 64 ppb. Since 1991, Big Bend NP has not exceeded the daily ozone threshold where the 8-hour average ozone concentration is greater than 75 ppb. Annual ozone levels at Big Bend NP (1991–2007) have been consistently below the current standard of 75 ppb and there are no long-term trends in ozone (Figure 1). More recently, ten-year trends (1999–2008) showed a possible (not significant) increase in ozone ($0.05 < p \leq 0.15$) at Big Bend NP (decreasing air quality).

The plant exposure index (W126) in Big Bend NP in 2010 was 8 ppm-hours, at the lower end of the condition range considered by NPS ARD to be moderate. Big Bend NP's three-year Average Maximum three-month W126 has generally been below 15 ppm-hrs since 1991 (Figure 2).

The NPS Air Resources Division uses an index to characterize each type of park air quality measure as good, moderate, or of significant concern. For 2009, ozone was in moderate condition with no trend for Big Bend NP, and met the 2009 GPRA goal of improving or not degrading ozone conditions.

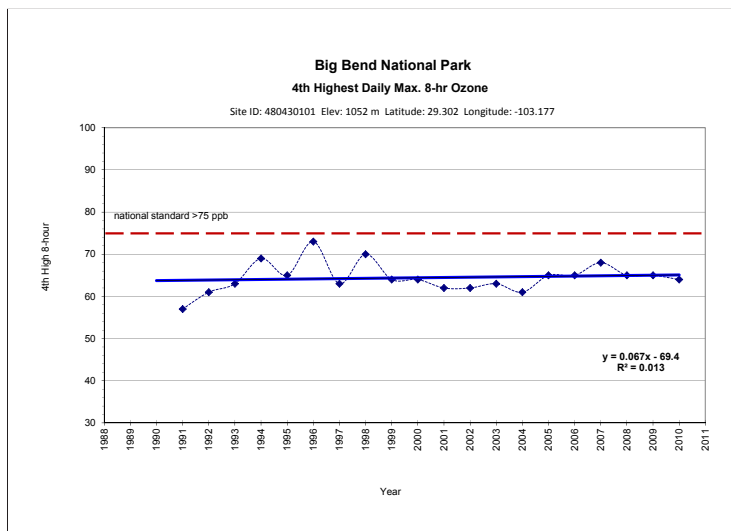


Figure 1. Trend in annual fourth-highest daily maximum eight-hour ozone concentration, Big Bend National Park, 1991-2007.

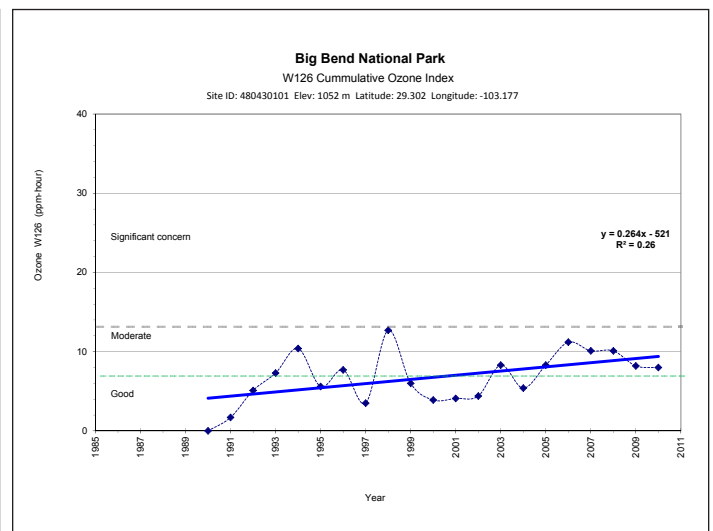


Figure 2. Trend in cumulative sum W126 for annual maximum three-month period, daytime hours, Big Bend National Park, 1991-2007.



For more information

Chihuahuan Desert Inventory & Monitoring Network | National Park Service | Las Cruces, New Mexico
<http://science.nature.nps.gov/im/units/chdr/>