



Ozone

Resource Brief

Importance

Ozone, at ground-level, is a widespread air pollutant in the National Capital Region Network (NCRN). It is not emitted directly from smokestacks or vehicles, but is formed when other pollutants, primarily nitrogen oxides (NO_x) and volatile organic compounds, react in the atmosphere in the presence of sunlight, usually during the warm summer months. In addition to harming human health, ozone causes considerable damage to vegetation.

Ozone injury to plants can cause visible spotting on leaves, leaf yellowing (chlorosis), and growth effects (e.g., premature leaf loss, reduced photosynthesis, and reduced leaf, root, and total dry weights) in sensitive plant species. Other factors besides actual ozone levels can reduce or magnify the extent of ozone injury including levels of soil moisture, presence of other air pollutants, insects or diseases, and other environmental stresses.

Monitoring

Ozone is monitored at several sites around the NCRN by the Clean Air Status and Trends (CASTNet) network and state or local agencies. Data is collected continuously, but is reported as hourly averages. For parks without on-site monitoring, data from monitoring sites is interpolated to represent park conditions.

Ozone and Human Health

The Environmental Protection Agency's (EPA) ozone standard of 75 parts per billion (ppb) is based on the 3-year averages of the fourth-highest daily maximum 8-hour concentration. Ozone levels above 75 ppb are considered harmful to human health. Compliance with the standard is determined from data at individual monitors.

NPS Air Resources Division (ARD) uses a 5-year interpolated value to evaluate ozone condition at parks without on-site monitors. Ozone values ≤ 60 ppb are considered to represent a good condition, 60–75 ppb as moderate condition, and > 75 ppb as significant concern. Using this criteria, all parks in the NCRN have ozone levels of significant concern except for the C&O Canal, which is rated as moderate.

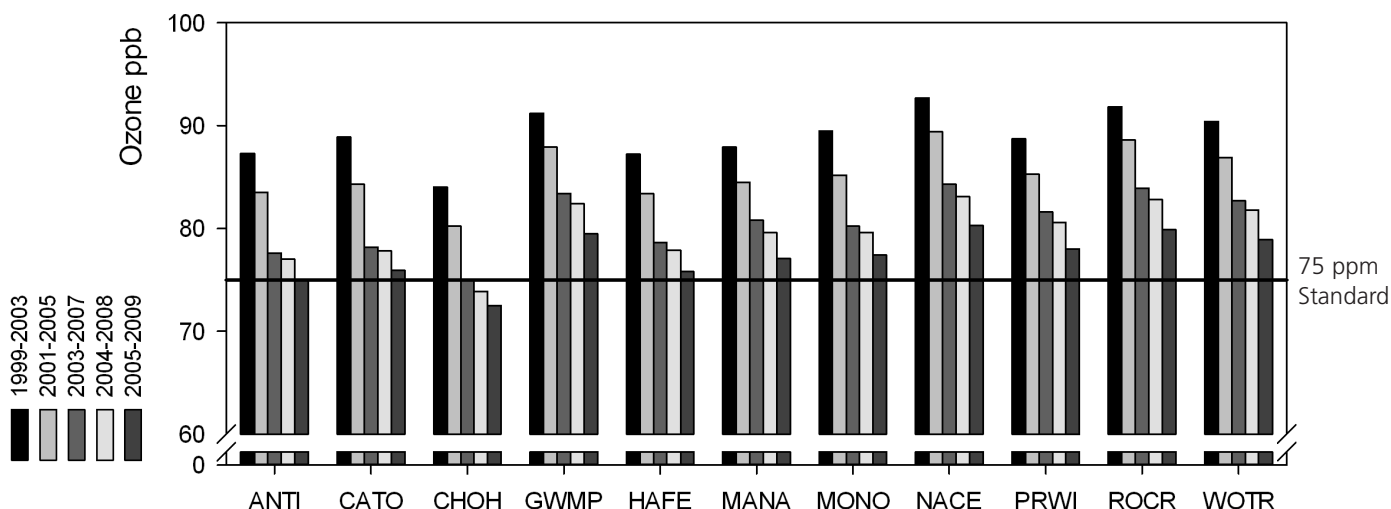
Ozone and Vegetation

Some plant species are more sensitive to ozone than humans. These sensitive plants can develop foliar injury from high ozone exposure levels especially when soil moisture levels are moderate to high. Under these conditions, plants have their stomates open, allowing gas exchange for photosynthesis, but also allowing ozone to enter.

An NPS-ARD assessment using ozone data from 1995-1999 con-

Ozone Levels in the NCRN are Declining* But Most Still Exceed EPA Standard

Most of the NCRN's interpolated, 4th highest 8-hour average ozone levels over 5-year periods, exceed the EPA standard of 75 parts per billion for human health (horizontal bar).



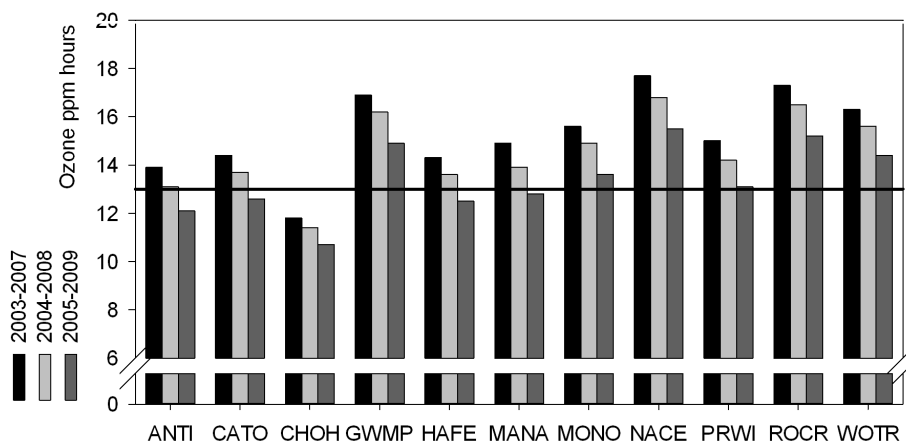
*Ozone trends in the East have improved over the last 10 years and are influenced by the implementation of the NO_x SIP Call rule.



cluded that all parks in the NCRN are at high risk for ozone-induced foliar damage to sensitive plants. More recently the ARD calculated W126 ozone levels for NCRN parks using ozone data collected between 2003 and 2009. The W126 statistic, which is being considered by EPA for a plant health-based standard, provides an index of the cumulative ozone exposure to plants during daylight hours. The W126 weights higher ozone concentrations more heavily because they are more likely to cause injury. The three month period during the growing season with the highest W126 value is used for the annual W126, and a 5-year interpolated value is used by NPS ARD to evaluate condition. W126 values less than 7 parts per million-hours (ppm-hrs) are considered safe for sensitive plants, 7-13 ppm-hrs represents a moderate condition, and >13 ppm-hrs is considered a significant concern for very sensitive plant species. During 2005-

Ozone Exposures to Vegetation in the NCRN

The W126 3-month, 8 am-8 pm, cumulative exposure in ppm-hours. Exposures over 13 ppm hours (horizontal bar) may harm sensitive plants.

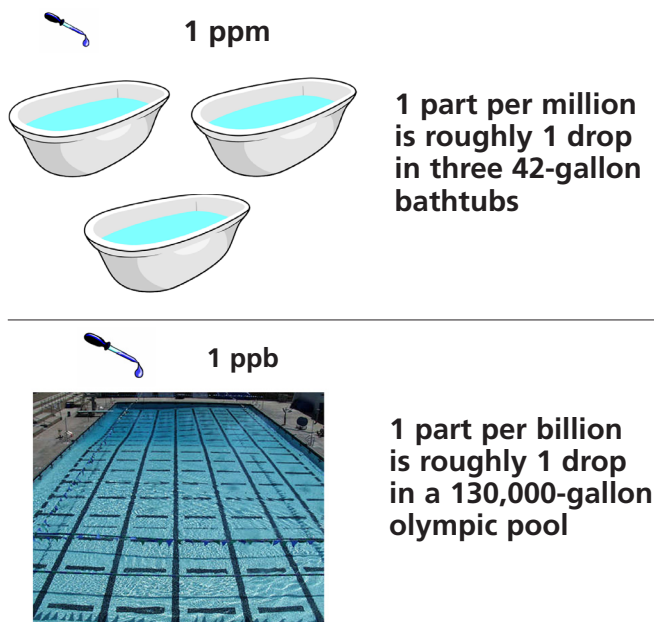


2009, about half of NCRN parks had W126 values above 13 ppm-hrs, indicating a significant risk to very sensitive plants.

Examples of Ozone-Sensitive Plant Species in the NCRN:

Full lists of ozone sensitive species, by park, are available from NPSpecies <http://science.nature.nps.gov/im/apps/npspp/>

Alder (*Alnus rugosa*)
Black Locust (*Robinia pseudoacacia*)
Common Milkweed (*Aesclepias syriaca*)
Fox grape (*Vitis labrusca*)
Green ash (*Fraxinus pennsylvanica*)
Redbud (*Cercis canadensis*)
Sassafras (*Sassafras albidum*)
Sweetgum (*Liquidambar styraciflua*)
Sycamore (*Platanus occidentalis*)
Tulip Poplar (*Liriodendron tulipifera*)
Virginia Creeper (*Parthenocissus quinquefolia*)
Virgin's bower (*Clematis virginiana*)
White ash (*Fraxinus americana*)
White snakeroot (*Eupatorium rugosum*)



References:

National Park Service, Air Resources Division. 2010. Air quality in national parks: 2009 annual performance and progress report. Natural Resource Report NPS/NRPC/ARD/NRR—2010/266. National Park Service, Denver, Colorado.
http://www.nature.nps.gov/air/Pubs/pdf/gpra/AQ_Trends_In_Parks_2009_Final_Web.pdf

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<http://www.nature.nps.gov/air/Pubs/pdf/03Risk/ncrnO3RiskOct04.pdf>

National Capital Region Network Overview page of NPS Air Resources Division Website. (Accessed 9/7/11)
<http://www.nature.nps.gov/air/Permits/aris/networks/ncrn.cfm?CFID=25911290&CFTOKEN=48270183>