Ambient Air Quality and Effects Monitoring

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♦ The 1977 Clean Air Act amendments direct the NPS to protect air quality specifically in 48 designated Class I air quality areas (all other NPS units are designated Class II). However, because the NPS Organic Act, the Wilderness Act, and some parks' Enabling Legislation provide the basis for air quality protection in all NPS units, NPS *Management Policies* make no distinction in the level of air quality protection afforded to Class I versus Class II NPS areas. Further, the *Management Policies* state that the Service will monitor and document the condition of air quality and related values, *i.e.*, resources, in NPS units.

♦ There are certain "responsibilities" associated with Class I air quality areas. For example, state permitting authorities are required to send permit applications for new air pollution sources proposed near Class I areas to the managers of those areas. The managers are expected to comment on whether or not the new source emissions will adversely affect air quality and/or resources in the Class I areas. Consequently, to help address permit application-related questions and other air quality issues, Class I areas typically conduct one or more types of ambient air quality monitoring. In addition to the NPS, the U.S. Fish and Wildlife Service (FWS) and the U.S.D.A. Forest Service (FS) also manage Class I areas. Class II areas can benefit from the monitoring data collected by, and the permit application reviews conducted for, nearby Class I areas. A map of NPS Class I areas can be found at http://www2.nature.nps.gov/ard/parks/npscl1b.pdf; a map of FWS Class I areas is at http://www2.nature.nps.gov/ard/fws/fws.pdf; and a map of FS Class I areas is at http://www2.nature.nps.gov/ard/parks/fscl1b.pdf.

♦ For years, the Air Resources Division (ARD) focused on monitoring ambient concentrations and effects of the following air pollutants in parks: fine particles (less than 10 micrometers in diameter), ozone, and nitrogen and sulfur deposited in both dry and wet form. Recently, the ARD has also started to play a role in monitoring toxic compounds such as persistent organic pollutants (POPs) and heavy metals like mercury, lead, zinc, and cadmium.

♦ Fine particles reduce visibility. Not only do they decrease the distance one can see; they also decrease the color and clarity of a scene. Because visibility is often cited as an important reason for a visit to many parks, reduced visibility can make a visit less enjoyable.

♦ Ozone is a significant human health concern in many urban areas, and unfortunately, also in many parks. It causes respiratory problems, and has recently been linked to an increased incidence of childhood asthma. Ozone also affects vegetation. Sensitive species exhibit foliar injury (*i.e.*, yellow spots or chlorosis on needles of conifers; purple/black spots or stipple on upper surfaces of leaves of deciduous plants), reduced growth, and early leaf drop. Affected plants also appear to be more susceptible to other stressors such as drought and disease.

♦ Sulfur and nitrogen compounds deposited in dry and wet form can acidify soils and surface waters, with resulting effects on biota. Acidified soils tend to increase aluminum availability, which can be toxic to plants and animals. Many fish, amphibian, and invertebrate species are not able to survive in lakes and streams with low pH. Deposited nitrogen can cause a shift in plant community composition, increasing the number of nitrophilic species. Too much nitrogen can also eutrophy soils and surface waters.

♦ Concern about potential impacts of POPs and heavy metals in national parks increases as we gain more information about their effects and their persistence in the environment. These compounds can be toxic at low concentrations; many of them increase in concentration as animals age; they can accumulate in key body tissues; and they can biomagnify in the food chain. A workshop was held in June 2001 to develop a strategy for monitoring POPs and heavy metals in some western U.S. national parks. Results of the workshop are available at http://www2.nature.nps.gov/ard/aqmon/air_toxics/. Many states do some toxics monitoring, though most is done in urban areas, and most monitoring does not involve POPs or heavy metals. Nevertheless, it is worthwhile to contact state air agencies to find out if they are conducting any toxics monitoring that would be of interest to national parks. State air contact information is available at http://www.cleanairworld.org/scripts/stappa.asp.

♦ It is often not obvious whether or not air pollution is an issue in a national park. It is sometimes helpful to look at a state emissions inventory to see how much air pollution is being emitted by sources in the area. There are three types of air pollution sources. Stationary sources, like power plants, paper mills, or factories, typically have a smokestack. Mobile sources include cars, trains, airplanes, boats, *etc*. Area sources are almost everything else. They include feedlots, construction sites, quarries, and forest fires. The following website lists the amount of air pollution emitted by state, on a county-by-county basis, in 1996: http://www.epa.gov/ttnotag1/areas/. Because some pollutants can travel hundreds of miles from their source, a better way to get a handle on the importance of air pollution for a particular park is to examine relevant ambient monitoring data.

♦ Ambient air monitoring is conducted in a number of national parks, and many more have representative monitoring data collected outside the park. The NPS is a partner in national monitoring programs, and the ARD advocates using data collected through these programs. The advantages of the national monitoring networks are: 1) the sites use the same monitoring protocols, 2) the data have high QA/QC requirements, 3) the data are easily accessible and 4) national data roll-up is simplified. The monitoring networks include:

Visibility - Interagency Monitoring of Protected Visual Environments (IMPROVE) - http://vista.cira.colostate.edu/improve/

Ozone – State and federal ozone monitoring sites that enter their data into the U.S. Environmental Protection Agency (EPA) AIRS Database - http://www.epa.gov/air/data/

Wet deposition - National Atmospheric Deposition Program/National Trends Network (NADP/NTN) - http://nadp.sws.uiuc.edu/

Dry deposition - Clean Air Status and Trends Network (CASTNet) - http://www.epa.gov/castnet/

Determining the location of existing monitoring sites relative to parks, and evaluating how well those sites represent air quality conditions in parks, will allow Network staff to identify any ambient air quality monitoring needs.

♦ Air Inventory products prepared by the ARD and the University of Denver provide Network staff with estimated ambient concentrations in parks for a number of air quality parameters (see Air Inventory handout for more information). ARD can help Network staff determine if these concentrations pose a potential threat to park resources.

♦ The Clean Air Act directs the NPS to protect air quality related values (AQRV) from the adverse impacts of air pollution. Air quality related values are generally defined as visibility, flora, fauna, soils, water, and cultural resources. The ARD assumes that visibility is a value that every NPS unit would want to protect, and therefore, may want to monitor (if representative monitoring is not being conducted). From an ecological standpoint, ARD recommends reviewing all available information for Network parks including: water quality pH and acid neutralizing capacity (ANC) data (including Water Resources Division Horizon reports), NPSpecies vascular plant lists (to compare to lists of known ozone sensitive species), and reports from any air pollution effects projects conducted in or near the parks (or relevant to the parks). Hopefully this information will help Network staff identify air pollution sensitive resources in parks. Combining information on sensitive resources with that on pollution levels will indicate the need for air pollution effects monitoring.

♦ Some things to remember about the process:

- Air quality monitoring includes ambient monitoring and effects. There's not much point in monitoring air pollution if you don't know what effect it's having on the resources.

- Ambient air quality monitoring is expensive. It's still necessary to identify needed monitoring in the event that others (*e.g.*, EPA, states) may be able to fund a monitoring site.

- ARD is advocating foliar injury surveys for ozone for a number of reasons. First, ozone is a widespread pollutant. Second, levels are high enough in many parks that injury may be observed. Third, many parks have species, such as black cherry or ponderosa pine, which show well-defined symptoms of ozone injury. Fourth, fairly well developed protocols already exist for ozone injury surveys. Finally, foliar injury surveys are relatively inexpensive compared to other types of ozone effects monitoring. Network staff should be aware, however, that there is controversy regarding foliar injury surveys. Plants can have growth effects without displaying foliar injury. Conversely, plants with foliar injury don't necessarily have reduced growth.

- ARD recommends monitoring surface water, rather than soil, effects from deposition, because surface water monitoring is easier and less expensive. If surface water acidification is a concern for Network parks, Networks need to add ANC to their suite of water chemistry parameters, because simply monitoring pH will not provide sufficient information about deposition.

- Network staff should look for opportunities to coordinate air quality effects monitoring with other monitoring programs, *e.g.*, forest health, to reduce monitoring costs.

Plant Species Very Sensitive to Ozone

These species would be expected to produce distinctive foliar injury when exposed to "normal" levels of ambient ozone. This list was developed for the AIR Synthesis Project and is considered a work in progress. This version is dated September 20, 1999.

Scientific Name	Common Name	Family
Ailanthus altissima	Tree-of-heaven	Simaroubaceae
Amelanchier alnifolia	Saskatoon serviceberry	Rosaceae
Apocynum androsaemifolium	Spreading dogbane	Apocynaceae
Artemisia douglasiana	Mugwort	Asteraceae
Aster acuminatus	Whorled aster	Asteraceae
Aster engelmannii	Engelmann's aster	Asteraceae
Asclepias exaltata	Tall milkweed	Asclepiadaceae
Aster macrophyllus	Big-leaf aster	Asteraceae
Aster puniceus	Purple-stemmed aster	Asteraceae
Asclepias quadrifolia	Four-leaved milkweed	Asclepiadaceae
Asclepias syriaca	Common milkweed	Asclepiadaceae
Aster umbellatus	Flat-toppped aster	Asteraceae
Fraxinus americana	White ash	Oleaceae
Fraxinus pennsylvanica	Green ash	Oleaceae
Gentiana amarella	Northern gentian	Gentianaceae
Liquidambar styraciflua	Sweetgum	Hamamelidaceae
Liriodendron tulipifera	Yellow-poplar	Magnoliaceae
Oenothera elata	Evening primrose	Onagraceae
Parthenocissus quinquefolia	Virginia creeper	Vitaceae
Physocarpus capitatus	Ninebark	Rosaceae
Philadelphus coronarius	Sweet mock-orange	Hydrangeaceae
Pinus jeffreyi	Jeffrey pine	Pinaceae
Pinus ponderosa	Ponderosa pine	Pinaceae
Pinus pungens	Table mountain pine	Pinaceae
Pinus taeda	Loblolly pine	Pinaceae
Platanus occidentalis	American sycamore	Platanaceae
Populus tremuloides	Quaking aspen	Salicaceae
Prunus pensylvanica	Pin cherry	Rosaceae
Prunus serotina	Black cherry	Rosaceae

Rhus copallina	Flameleaf sumac	Anacardiaceae
Rubus allegheniensis	Allegheny blackberry	Rosaceae
Rudbeckia hirta	Black-eyed susan	Asteraceae
Rudbeckia laciniata	Cut-leaf coneflower	Asteraceae
Sassafras albidum	Sassafras	Lauraceae
Sambucus canadensis	American elder	Caprifoliaceae
Sambucus mexicana	Blue elderberry	Caprifoliaceae
Sambucus racemosa	Red elderberry	Caprifoliaceae
Senecio serra	Tall butterweed	Asteraceae
Vaccinium membranaceum	Thin-leaved blueberry	Ericaceae
Vitis labrusca	Northern fox grape	Vitaceae

SOURCE: National Park Service, Air Resources Division and Pennsylvania State University, Department of Plant Pathology, June 1999.

Plant Species Slightly Sensitive to Ozone

These species would show distinctive foliar injury only when exposed to "extremely high" levels of ambient ozone. This list was developed for the AIR Synthesis Project and is considered a work in progress. This version is dated September 20, 1999.

Scientific Name	Common Name	Family
Acer macrophyllum	Bigleaf maple	Aceraceae
Acer negundo	Boxelder	Aceraceae
Acer rubrum	Red maple	Aceraceae
Aesculus glabra	Ohio buckeye	Hippocastanaceae
Aesculus octandra	Yellow buckeye	Hippocastanaceae
Betula alleghaniensis	Yellow birch	Betulaceae
Betula populifolia	Gray birch	Betulaceae
Bromus tectorum	Cheatgrass	Poaceae
Cercis canadensis	Redbud	Fabaceae
Cladrastis lutea	Yellowwood	Fabaceae
Cornus florida	Flowering dogwood	Cornaceae
Glyceria nubigena	Manna grass	Poaceae
Krigia montana	Mountain dandelion	Asteraceae
Larix decidua	European larch	Pinaceae
Larix leptolepis	Japanese larch	Pinaceae
Pinus nigra	Austrian pine	Pinaceae
Pinus radiata	Monterey pine	Pinaceae
Pinus rigida	Pitch pine	Pinaceae
Pinus virginiana	Virginia pine	Pinaceae
Rhus glabra	Smooth sumac	Anacardiaceae
Rhus trilobata	Skunkbush	Anacardiaceae
Rhus typhina	Staghorn sumac	Anacardiaceae
Robinia pseudoacacia	Black locust	Fabaceae
Rubus idaeus	Red raspberry	Rosaceae
Rugelia nudicaulis	Rugel's ragwort	Asteraceae
Saxifraga arguta	Saxifrage	Saxifragaceae
Salix gooddingii	Gooding's willow	Salicaceae
Salix scouleriana	Scouler's willow	Saliaceae

Spiraea x vanhouttei	Vanhoutte spirea	Rosaceae
Symphoricarpos albus	Common snowberry	Caprifoliaceae
Syringa x chinensis	Chinese lilac	Oleaceae
Syringa vulgaris	Common lilac	Oleaceae
Tilia americana	American basswood	Tiliaceae
Tilia euchlora	Crimean linden	Tiliaceae
Tilia platyphyllos	Bigleaf linden	Tiliaceae
Toxicodendron radicans	Poison-ivy	Anacardiaceae
Verbesina occidentalis	Crownbeard	Asteraceae
Vitis californica	California grape	Vitaceae
Vitis girdiana	Wild grape	Vitaceae
Vitis riparia	Riverbank grape	Vitaceae
Vitis vinifera	European wine grape	Vitaceae

SOURCE: National Park Service, Air Resources Division and Pennsylvania State University, Department of Plant Pathology, December 1998.