

Roundup

Acid Precipitation Research and Monitoring in the NPS

By R. Herrmann

The phenomenon of "acid rain" or, more properly, acid deposition, is widely recognized as a matter of broad public concern. Increased acidity has effects on fish reproduction, has been hypothesized to be responsible for declines in aquatic life in a number of remote Canadian, European and northeastern U.S. lakes, and has been linked to forest decline in West Germany, Central Europe and Eastern U.S. In addition, air pollution is known to accelerate the deterioration of building materials, including historic buildings and cultural monuments.

There are vast differences in the state of our knowledge in the various aspects of acid precipitation research. Much of what we know about the effects of acidification and atmospheric deposition cannot be directly applied to park environments and resources. In reference to parks, we can say: 1) Parks are receiving acidic deposition with loadings highest in the east and southeast; 2) there is a potential for irreversible damage to sensitive cultural and natural resources in parks across the country; 3) these effects could be potentially catastrophic for high elevation lake and stream systems particularly those with salmonid (trout) populations, high elevation boreal forests, and sensitive cultural resources; and 5) the NPS through its strong tie to the interagency research program will get the needed answers over time.

The National Acid Precipitation Assessment Program (NAPAP), was proposed to improve our understanding of the causes, effects and possible mitigation of the "acid rain" problem. The NPS program includes a coordinated and focused set of research, monitoring and assessment activities that emphasize both natural and cultural resources, involving National, Regional and Park Staff (Table I). Natural resources research supported through NAPAP began in FY '82-'83 in Isle Royale, Sequoia/Kings Canyon, and Rocky Mountain National Parks and in FY '84 in Olympic NP. Currently, NPS is cooperating through the interagency task force with the EPA, USDA, USGS, and US Fish and Wildlife Service to study the sensitivity of natural resources in the parks. Since 1980 the Service has established and operated National Atmospheric Deposition/National Trends Network (NADP/NTN) "acid rain" monitoring sites in 26 NPS areas and during FY '85 in cooperation with BLM has added 2 additional sites.

Cultural resources research is focused on determining cause and effect links between atmospheric deposition and deterioration of historic materials, particularly marble, limestone, and statuary bronze. This effort includes laboratory research, and in situ monitoring of cultural resources in parks, and controlled field exposures at several sites selected to represent the range of potentially impacted environments. Long-term research sites have been established at Mesa Verde NP in Colorado at Independence National Historic Park in Pennsylvania. Additional sites will be added in future years. NPS research has begun to identify sensitive cultural resources in the U.S., both in parks and privately owned historic properties. Finally, laboratory and field re-

search is underway to evaluate potential strategies to protect cultural resources from damage that results from acid deposition.

Deposition Monitoring

The NAPAP operating research plan states that documenting the temporal and spatial trends of the chemical composition of atmospheric deposition in the United States is fundamental to assessing the problem of acid deposition. The National Trends Network (NTN) in which NPS participates is designed to provide a record that will allow the detection of chemical trends in atmospheric deposition. The network is operated consistently nationwide, and data collected are stored in a single computerized data base that is available on request. Wet deposition (rain and snow) is presently monitored at 150 wet deposition monitoring sites nationwide. Each site is considered to be representative of precipitation over a broad region as sites are required to be located to minimize significant influence of local atmospheric emission sources. Plans to monitor dry deposition (gases, aerosols, and particulate matter) on a pilot scale will be implemented beginning in 1986.

At present wet deposition samples are collected weekly and analyzed for major cations, anions, pH and acidity at the Illinois Water Survey, Central Analytical Laboratory. Data are presented in the form of national scale maps of concentration and deposition. Operation of NTN sites will extend to FY '92 and beyond as long as the need for information remains. Long-term monitoring of the chemistry of atmospheric deposition is being conducted at 28 NTN/NADP sites by NPS in cooperation with USGS (Table II), BLM, NOAA and state agencies. Data available at the Na-

Table 2
NPS Areas Operating
NADP/NTN Atmospheric Monitoring Sites

1. Denali (McKinley) NP, Alaska
2. Grand Canyon NP, Arizona
3. Buffalo River NP, Arkansas
4. Organ Pipe Cactus Nat'l. Mon., Arizona
5. Yosemite NP, California
6. Sequoia-Kings Canyon NP, California
7. Rocky Mountain NP, Colorado
8. Everglades NP, Florida
9. Isle Royale NP, Michigan
10. Glacier NP, Montana
11. Theodore Roosevelt NP, North Dakota
12. Great Smoky Mountains NP, Tennessee
13. Big Bend NP, Texas
14. Shenandoah NP, Virginia
15. Olympic NP, Washington
16. Yellowstone NP, Wyoming
17. Indiana Dunes NL, Indiana
18. Mesa Verde NP, Colorado
19. Cape Cod NS, Massachusetts
20. Hawaii Volcanoes, Hawaii
21. Craters of the Moon NM, Idaho
22. Acadia NP, Maine
23. Guadalupe Mountains NP, Texas
24. Custer Battlefield NM, Montana
25. Lehman Caves NM, Nevada
26. Capulin Mountain NM, New Mexico
27. Bryce Canyon NP, Utah
28. Bandelier NM, New Mexico

tional Park Service operated and maintained sites for the period of record are too short to draw any conclusions.

Park Studies

The National Program of studies, as a component of NAPAP, expands the nationally available data base by emphasizing ecosystem studies. To accomplish this the National Park Service has established a limited number of research sites which correspond to

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Table 1
NPS Acid Precipitation Research Activities (to 1985)

Area	NPS/Univ	Region	Effects (Terrestrial Air Water)
Acadia NP	U Maine/College of the Atlantic	NA	Surface waters
Cape Cod	U Wisconsin	NA	Paleo-limnology
Cape Cod	NPS	NA	Salamanders
Mt. Rainier	NPS/USGS	PN	Lake water chemistry
Shenandoah	U Virginia	MA	Stream & water-shed acidification
Delaware Water Gap	Rutgers University	MA	Lakes chemistry
Mt. Catocin	USGS	MA	Calibrated watershed
Isle Royale	NPS/Met Tech University	MW	Long term watershed & ecological study
Great Lake Basin Parks	NPS	MW	Long term water quality monitoring
Great Smoky Mountains	EPA/TVA/EPRI/NPS	SE	Water chemistry, stream effects, forest effects
Blue Ridge Parkway	NPS	SE	Forest effects
Rocky Mountain	NPS/USGS/CSU	RM	Lake & soil chemistry, long term ecological research
Yellowstone, Glacier & Rocky Mountain	USFWS/NPS	RM	Surface water sensitivity survey
Sequoia NP	NPS/USGS/CA State/ NASA/USDA/U of Ca	WR	Long term ecological research
North Cascades	NPS/USGS	PN	Lake water chemistry
Olympic	NPS/U of Wash/U of Ore	PN	Long term ecological baseline research
Mesa Verde	NPS/U of Ill/ASU	RM	Long term ruins monitoring
Independence	NPS/Airline & Assoc.	MA	High resolution photogrammetry
Washington, D.C.	NPS/USGS	NC	Detailed deterioration, stone decay in monuments

nationally representative ecological regions along the deposition gradient from east to west. Sites include the "cleanest" continental area (Olympic NP) with little potential for serious impact as well as areas (Sequoia NP, Isle Royale NP, Rocky Mountain NP) that, while still thought to be relatively unimpacted, contain places and resources highly sensitive to acid precipitation. Our intent is to obtain a basic understanding of the structure and function of these ecosystems relative to anthropogenic atmosphere deposition. In order to achieve these broad goals it is necessary that each study site collect a prescribed set of information to address selected core questions. Another use of these data is to answer ecologically important questions about system response. These measurements emphasize background data acquisition required for analysis and that will be of value for inter-site and intra-site comparisons.

The core requirements are intended to provide information necessary to address the following objectives:

1. Quantify seasonal inputs of atmospheric deposition in the form of rain and snow.
2. Take steps to initiate the monitoring of dry deposition, including ozone, sulfur dioxide, nitrogen oxides, particulates, and quantify potential impacts of dry and wet deposition.
3. Characterize local climatological parameters.
4. Establish a long-term data base for detection of variations in surface water chemistry.
5. Establish a long-term data base on the biology (composition, structure, phenology and population dynamics) of selected plant and faunal population thought to be potentially sensitive to acid deposition.
6. Develop watershed (input/output) measurements for water and selected inorganic chemical constituents.

Our approach is based on the precept that ecosystems undergo long-term change in response to incremental alteration by natural and anthropogenic factors. Relatively few studies underway in North America will have the longevity necessary to detect the often subtle effects of such factors in natural ecosystems. As a component of the National Acid Precipitation Assessment Program, the National Park Service's ecosystem studies program can make a unique and significant contribution. Units of the National Park System encompass a diverse array of the nation's ecological diversity and the natural resources within these units are protected in perpetuity by law. As a result most are relatively undisturbed and many contain outstanding examples of mature ecosystems. Those with disturbed sites became such due largely to natural perturbation and represent successional ecosystems. Such conditions provided a unique opportunity to undertake long-term ecosystem studies.

The long-term management goals and the protected nature of the National Park System provide a unique basis for long-term studies to develop the background information against which to document relationships between ecosystem effects and atmospheric deposition of potentially toxic substances. In this way the NPS program makes it possible to assess the nature of changes in representative unmanipulated and protected ecosystems and provides a basis for comparison with the efforts of other agencies such as the National Lake Survey, National Terrestrial Survey and National Soils Survey.

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