

TESTIMONY OF
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BAR HARBOR, MAINE
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INTERIOR AND INSULAR AFFAIRS COMMITTEE
U.S. HOUSE OF REPRESENTATIVES
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Mr. Chairman and members of the Subcommittee, my name is Janet Lee Andersen. I am a professor at College of the Atlantic in Bar Harbor Maine with a Ph.D. in Forest Pathology. The College is located on the Atlantic Ocean two and a half miles from the headquarters of Acadia National Park. Since the fall of 1981, I have conducted research on the effects of air pollution and acid precipitation on Acadia National Park (ANP).

Acadia National Park covers approximately 30,000 acres on Mount Desert Island, Schoodic Peninsula, and Isle au Haut. All of the park property is within Hancock County on the central Maine coast. The goals for management for ANP are different from those of a commercial forest. Lower timber productivity due to air pollution is of little concern compared with shifts in species composition that might reduce the richness of the visitor experience. Even more obvious to visitors is looking out at the spectacular vistas through a bluish or brown haze or seeing browning pine trees along the roads and trails..

A variety of natural habitats occur within ANP supporting a wide diversity of species. Mount Desert Island is the northernmost limit of many temperate plants and the southernmost limit for some arctic species. In many sites throughout the park,

soils are thin and patchy and there are steep slopes with exposed bedrock. The granitic bedrock which dominates on Mount Desert Island has poor acid buffering capacity. However, at lower elevation (below 40 meters) glacio-marine sediments found in some stream beds and soils increase the acid buffering capacity for these watersheds. The alkalinity (measurement of the buffering capacity) of surface waters in ANP is low (<100 ueq/l) and is an indication that these waters are vulnerable to acidic deposition. ANP is frequently enveloped in fog and receives close to 50 inches of rainfall annually. At the National Atmospheric Deposition Program (NADP) monitoring site at ANP, an annual volume-weighted pH value of 4.3 to 4.4 has been recorded each year since monitoring began in 1980. This means that ANP is receiving acid deposition with some rainfall having a higher pH (less acid) and some rainfall having a lower pH than the annual average.

There is relatively little industry on Mount Desert Island, but there are some major sources of sulfur dioxide and other pollutant within 100 km of ANP. The four million tourists which visit ANP every year contribute to levels of lead and other pollutants associated with gasoline consumption. In addition, long distance transport of pollutants such as ozone are impacting park resources.

Air Pollution and Acid Deposition Monitoring Projects

Several pollution monitoring projects are conducted on Mount Desert Island. The park personnel conduct visibility studies by photographing the view from the highest mountain on the island

(Cadillac, elevation 1530 feet) three times a day. Sulfur dioxide levels are not currently monitored, but at the park headquarters, ozone is monitored continuously and recorded every hour. Rainfall amounts and wet deposition are measured weekly as part of the NADP. After field tests are conducted for pH and conductivity, the sample is sent to a central laboratory for analysis of pH, conductivity, sodium, potassium, magnesium, calcium, chloride, ammonium, nitrate, and sulfate. Since October, 1984 the park has switched from monitoring dry deposition for the NADP and is now part of a Maine State program that measures total suspended particulates, sulfate, and inhaleable particulates (fine particle fraction). These dry deposition tests are conducted by park personnel every six days and analysis is conducted by the Maine Department of Environmental Protection.

The NADP equipment does not detect fog water which may be a significant portion of the moisture reaching vegetation in ANP. In the summer of 1984, Dr. Donald Cass also of the College of the Atlantic faculty and I joined with researchers across North America from Puerto Rico to Alaska to monitor cloud and fog water at eleven different sites. Our monitor at College of the Atlantic operated in 1984 from June 8th to November 30th. It is taken down to prevent ice and snow from damaging the equipment. We anticipate this monitor to be operational by the first of June this year.

Surveys of Impacts of Pollution on ANP

In addition to the monitoring projects, there have been several surveys made to evaluate the impact of air pollution and acid precipitation on resources of ANP. Mary Foley, Research Forest Ecologist from the North Atlantic Regional Office of the National Park Service has been conducting the field work for the FORAST Project at ANP. This is a regional project for the eastern United States designed to quantify the effects of acid deposition and air pollution on the growth of eastern forest trees by using tree ring analysis to evaluate historic growth patterns.

In October, 1982, I began a cooperative project with two geologists from the University of Maine that included a two year comprehensive study of the current status of the surface waters of ANP and an analysis of sediment cores from three ANP lakes for inferred historic trends of precipitation pH. The 18 lakes and ponds, and 23 first- and second-order streams included in this project were sampled during all seasons, especially during spring snow-melt. Chemical analysis of water samples included pH, conductivity, alkalinity, color, and determination of the concentrations of calcium, magnesium, potassium, sodium, iron, zinc, manganese, aluminum, sulfate, nitrate, and chlorine.

In 1983 and 1984, Dr. Clifford Wetmore and Thomas Sullivan conducted a survey of the lichen flora of ANP. Included in their study was an analysis of lichen specimens for sulfur content to estimate if current sulfur dioxide levels were high enough to be causing physiological injury to sensitive lichen species where no visible injury could be observed.

Effects of ozone on park resources were surveyed in 1984 by Dr. Michael Treshow. His efforts concentrated on eastern white pine (Pinus strobus) as this species is one of the most susceptible to ozone injury. Mary Foley (NPS) and I will be conducting a follow-up study this spring and summer. We will monitor 45 pines every two weeks in an attempt to correlate ozone events with injury (chlorosis and necrosis) on needles of eastern white pine.

Results of Monitoring and Survey Projects in ANP

ANP is receiving precipitation which on an annual volume-weighted basis has a pH of 4.3 and 4.4. Weekly collections have been as low as 3.2; single rain events are not monitored at NADP stations. The pH values recorded at ANP are close to or lower than the pH values recorded at the three inland Maine NADP sites. As coastal sites receive more rainfall than inland sites, it would be expected that pH values would be higher at ANP than at the inland sites. As this is not the case, ANP may actually be receiving more acid particles than inland Maine sites.

Fog water samples collected in the summer of 1984 averaged two to three times more acidic than rain water samples collected for the same event. This means that the pH of fog moisture is not being buffered by marine aerosols. The exception to more acidic fog water occurred on August 13th when a low level fog bank coming in from the relatively unpolluted northeast enveloped the island (pH 5.32) while a high elevation rain storm came across the island from the southwest (pH 4.14). The rainfall was more than 16 times as acidic as the fog bank coming in from the

northeast. However, a week earlier on August 7th, we recorded a fog event with a pH of 2.90 and elevated sulfate and nitrate concentrations. That same day ozone levels exceeded the Maine State Standard for 6 hours. The polluted air mass moved southwest and over the next few days was detected in New Hampshire, New York, and as far south as Virginia with cloud/fog water pH values ranging from 2.80 to 3.09. Another acidic fog event was detected on November 27th. The pH of this sample was 2.42 (three times more acidic than the August collection) and the sample was actually gray in color. Unfortunately other monitoring stations has already taken down their equipment for winter so we don't know the full extent of this event. Further analysis is still underway on this sample, but it should be noted that while ozone levels were not elevated during this period, the suspended particulates level was higher than any collection since September 9th and the sulfate particulates level was higher than any time since August 16th.

The importance of acid deposition to ANP depends on whether there is a negative impact to park resources. Here scientists, myself included, become cautious. Spring rainstorms may be responsible for small pools where salamanders and other amphibians might breed. Precipitation pH levels are low enough to effect breeding success of spotted salamander (Ambystoma maculatum) and the northern leopard frog (Rana pipens), but I am unaware of any studies to determine if such is the case in ANP.

The surface water study of which I was a part, found that current seasonal fluxes in pH and aluminum in ANP's lakes and major streams are not severe enough or of long enough duration to be of major consequence to aquatic organisms. However, the small first-order brooks are more vulnerable to chemical fluctuation and pH levels may be low enough to cause problems for fish reproduction in the spring. During spring snow-melt the average pH of small brooks declined by half a pH unit and alkalinity declined by 38 percent. The average pH for a brook in mid-March, 1984 was 5.3 which is low enough to inhibit hatching for some fish species. However, most studies on fish reproduction are performed at pH values lower than those of most of ANP's lakes, streams, or brooks. There is one small, high elevation pond in ANP that is acidic with a pH of 4.6 and a negative alkalinity (no buffering capacity). Due to its location, this pond probably never had a fish population and it would not support one now even if stocked.

My major concern for the fresh water aquatic responses of ANP comes from their vulnerability to continued acidification. Alkalinities are low ($<100 \mu\text{eq/l}$) for ANP surface waters and other chemical analysis or rating systems always rank ANP surface waters as sensitive to acidification. It can not be accurately predicted when major lakes and streams might be acidified to the point of preventing fish reproduction or shifting species composition of invertebrates and plant life, even if it is assumed that precipitation pH levels remain constant. Sediment records from the three ANP ponds suggest a gradual pH and alkalinity decline in the ponds over the last 100 years. Current

alkalinities are low and can average in the teens for lake water in the spring. The possibility does exist that a rapid drop in pH and alkalinity may happen though this would probably be apparent in the brooks before it was evident in the lakes and streams. A reduction in pH and alkalinity is not easily reversed. I believe it is in the best interest of the natural resources of ANP to instigate those actions necessary to reduce the sulfuric and nitric acid inputs into the environment.

With reference to gaseous pollutants, the early attempts at determining sulfur dioxide levels in ANP were ambiguous. The lichen survey of 1983 reports the presents of ten lichen species in ANP that are very sensitive to elevated sulfur dioxide (usually absent with SO₂ levels above 50 ug per cubic meter average annual concentration) and three more species sensitive to intermediate in their response to sulfur dioxide (50-100 SO₂ ug per cubic meter).

Wetmore and Sullivan's report implies that there are no air quality problems in ANP since sulfur dioxide sensitive lichens are present. However, Wetmore and Sullivan do state that lichens are poor indicators of acid deposition and elevated ozone. One lichen genus (Umbilicaria) is at least somewhat sensitive to acid precipitation does show injury symptoms with dead margins of the lichen thallus in several locations throughout the park. Eastern white pine is a much more sensitive bio-indicator of ozone levels than are lichens. Eastern white pines vary in their sensitivity to ozone and this variation has been linked to genetic variability. Samples of eastern white pine collected in the

summer of 1983 were confirmed to have ozone injury. In 1983 the Maine State Standard for ozone was violated 101 times and the Federal Standard was violated two times.

Dr. Treshow established 20 permanent eastern white pine plots in the summer of 1984. He ranked the 300 trees in these plots for the amount of ozone injury to the needles as well as rating overall tree condition. At a meeting in November 1984, Treshow gave a preliminary estimate that 40 to 50 percent of the 1984 foliage of these trees was effected by ozone. A final report of this study should be issued shortly. In 1984 the Maine State Standard was violated 87 times; the Federal Standard was not violated in 1984.

A few eastern white pines in ANP are severely affected by ozone. If ozone continues at its present level, such trees will be stressed by the repeated injury and death of needle tissue and the trees will become susceptible to attack by insects and pathogens. If ozone levels are not reduced, it is certain there will be losses in the eastern white pine population of ANP. Ozone also reduces visibility, is an eye irritant, and causes breathing difficulty for people with respiratory problems. Therefore elevated ozone can mean reduced visitor enjoyment of ANP. It is estimated by the State of Maine that one-third of ozone is natural background, one-third is from local sources inside the state, and one-third is from long-distance transport. Controlling both local emissions and long-distance transport will be needed to solve the ozone problem.

As I stated in the beginning of my testimony, management practices for Acadia National Park are different from those of a commercial forest. Scenic beauty, bird watching, berry picking, fishing, and even the bugs are part of the experience. Visitors expect a high quality and safe experience. Their concern is not with lower timber productivity due to air pollution, but with possible loss of certain aquatic species, finding browning or dying trees, or just obstructed views due to a polluted haze. Acadia National Park is a valuable resource for the people of the United States and should be protected.