United States
Department of
Agriculture

Forest Service

White Mountain National Forest
Monitoring Report
1997

FOREST SUPERVISOR'S ASSESSMENT

As an interested user of the National Forest, we are sending you our Monitoring Report for 1997. In light of the comprehensive Ten Year Monitoring Summary contained in the 1996 Annual Report, we have taken a different approach with the 1997 report. After summarizing several highlight activities of the past year, the 1997 Monitoring Report will focus on new monitoring information and trends that may not have been addressed in recent years.

Our stewardship of the White Mountain National Forest continues to provide effective protection of watershed, recreation and scenic values, wilderness, wildlife and fisheries and sustainable forest management under the guidance of the Forest Plan. Trends identified in last year's report appear to be continuing.

Although we have learned a great deal, not all of our monitoring questions are answered. We have begun working on improved methods of monitoring. Our knowledge of backcountry use continues to grow with implementation of a dispersed recreation monitoring plan. Members of the Committee of Scientists have continued their wildlife monitoring and preliminary results indicate that an assessment of population trends over a much longer period of time will be required.

The Forest Plan Revision outreach and planning group meetings and the Ten-Year Monitoring Summary identified changes that need to be considered. Although we agree that change is needed, we believe that many of them do not require an immediate Forest Plan amendment. We also determined that other needed changes are so interconnected that they can best be resolved only by plan revision. So our course of action will be to secure funding for plan revision and deal with the issues requiring change at that time. In the meantime, we will amend the existing Forest Plan if there are resource protection needs required before the revision. We will continue monitoring and information gathering in preparation for plan revision and look forward to working with all of you as we shape the future of the White Mountain National Forest.

Donna L. Hepp

DONNA L. HEPP
Forest Supervisor

INTRODUCTION

The White Mountain National Forest Land and Resources Management Plan (Forest Plan) was approved in 1986, and implementation began that same year. The National Forest Management Act (NFMA) Planning regulations specify that, "at intervals established by the Plan, implementation shall be evaluated on a sample basis to determine how well objectives have been met and how closely management standards and guidelines have been applied. Based on this evaluation, the interdisciplinary team shall recommend to the Forest Supervisor such changes in management direction, revisions, or amendments to the Forest Plan as are deemed necessary." This report documents the results of Forest Plan implementation in FY 1997 and evaluates these results.

Last year's Monitoring and Evaluation Report presented a Ten-Year Summary of monitoring implementation of the White Mountain National Forest Forest Plan. This year's report deals with monitoring and evaluation efforts taking place since that review and focuses on air quality and Forest productivity monitoring.

Highlights of 1997

FOREST PLAN REVISION ON HOLD

In 1997, Congress specified that no part of the appropriation could be used to fund National Forest Planning until new final or interim planning regulations were in the Federal Register. The action essentially put revision of the White Mountain National Forest plan on hold. Senator Gregg exempted the White Mountain from this language through an amendment of the Commerce Appropriations bill. However, Regional funding was not sufficient to resume plan revision.

While the date for final planning regulations is unknown, and it is unclear if we will be fully funded to resume the revision process, the Forest is planning to continue collecting the information needed to deal with the identified issues. Inventory, monitoring, and evaluation work will also continue.

APPALACHIAN MOUNTAIN CLUB SPECIAL USE PERMIT

Public comments on the Draft Environmental Impact Statement for the Appalachian Mountain Club's (AMC) permit to operate high mountain huts are currently being reviewed. The Impact Statement addresses several public issues such as the special use permit fee, fees charged at the huts, research activities, and resource impacts caused by hut visitors. Many of the concerns may be resolved by requiring more detailed operating plans and thorough, consistent permit administration.

RECREATION FEE DEMONSTRATION PROGRAM

1997 marks the first year of the Fee Demonstration Program enacted by Congress. The 3 year pilot program provides user-produced funding of maintenance and rehabilitation of recreation facilities by allowing the Forest to collect fees from the public. During the first year, 100 percent of the fees were used on the White Mountain National Forest for managing and maintaining recreation opportunities. So far, roughly 70% of the public comments received support the program.

During the first 9 months (May 1997-January, 1998), the Forest collected $465,000 in recreation fees. From that amount, there were one time start-up costs of $76,000 and administrative costs of $111,000. The Forest is using the money to employ 41 summer seasonal employees who maintain trails, repair trail bridges and shelters, keep recreation areas clean, and provide information and interpretation to the over 167,700 visitors at the forest's visitor centers. At the current level of support for recreation programs, existing services will continue and work on a backlog of other recreation projects are underway.

SNAPSHOT OF OUTPUTS AND PRODUCTS

The White Mountain Forest Plan sets goals for meeting human needs by providing products, services and amenities at specified levels. The table below shows a quick snapshot of some products and services generated over the last 10 years.

Accomplishment (Unit of Measure)	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**Total**	**Forest Plan Estimate**
Timber Sold (Million Board Feet)	28	30	30	27	24	19	27	24	25	26	21	281	350
Land Acquisition (Acres)	10422	259	44210	155	235	1745	1400	552	609	197	691	60475	(a)
Wildlife Habitat Improvement (Acres)	330	517	491	472	699	505	77	224	336	141	404	4196	590/yr
Ski Area Use (Thousand Visitor Days)	466	446	432	457	399	461	480	458	474	440	396	4909	444(b)
Trail Construction & Reconstruction (Miles)	19	51	10	10	7	48	7	53	43	27	27	302	9(c)

(a) The Forest Plan did not establish an estimate for land acquisition.

(b) Forest Plan originally showed 344; this was later corrected.

(c) The Forest Plan estimated 9 miles of new trail would be constructed. The accomplishments above show both new trail construction and construction and reconstruction/relocation of badly damaged trails.

Monitoring and Evaluation Report

FOREST PRODUCTIVITY

Monitoring Goals

To determine if forest harvesting has had an effect on long term productivity of the soil.

Monitoring Strategies

The strategy is to monitor changes in forest productivity by a measure known as biomass accumulation, or the weight of wood in the forest, and explain observed differences based on factors such as soil mineralogy. Various tools and models for measurement are being devised with the Northeastern Forest Research Station (Durham, NH) and the University of New Hampshire's Complex Systems Research Center. One such tool is a GIS-based model that uses bedrock geology, lithologic composition and direction of glacier movement to reveal patterns in soil mineral or chemical composition. This model will be used in conjunction with an ecosystem productivity and nutrient cycling model and remotely sensed data to develop methods to more effectively monitor ecosystem status across the WMNF landscape. The hope is to devise a means to identify areas which may be more or less sensitive to nutrient depletion and adjust forest practices accordingly.

Accomplishments/ Findings

Results to date, derived from both field and remotely sensed data, show strong linkages among nitrogen cycling and forest condition. These findings generally support conclusions from other related studies. Significant relationships among foliar chemistry (nitrogen and nutrients) and optical reflectance were found. Optical reflectance is the radiation reflected back toward the atmosphere (at various wavelengths) from the uppermost leaves on trees within the forest canopy. It is important because the amount of reflectance indicates certain aspects of leaf chemistry. Leaf chemistry, in turn, indicates something about soil chemistry, especially the cycling of nitrogen (i.e., nitrogen mineralization) The relationships between nitrogen cycling and forest condition suggest remote sensing of leaf chemistry holds promise for mapping complex ecosystem processes, such as forest productivity.

Forest productivity is a complex area of study dependent on many factors such as atmospheric deposition (i.e., acid rain), forest growth, mineralogy of soils, nutrient cycling and past land use history.

The Forest has a long history of disturbance which left an imprint on species composition, nutrient cycling and productivity. Studies of land use history effects on current nutrient cycling show that extreme events, such as fire, may affect nitrogen cycling rates for over 200 years and that old growth forests may be more likely to leach nitrogen into surrounding streams than young, vigorously growing forests. In addition, it appears that watersheds have a range in nutrient loss and sensitivity to nutrient depletion.

Recommendations/Emerging Issues

These kinds of research efforts represent an important expansion of studies to a broader range of conditions across the Forest. Including a broader range of conditions will improve the application of findings which were often primarily from short range studies at the Bartlett and Hubbard Brook Experimental Forests.

Other factors being examined which may be important to understanding site productivity include the age forest stands reach a steady state in biomass accumulation. Estimates at this point range from 80-90 years based on data from experimental forests to 125-175 years estimated by computer model. The factors affecting attainment of steady state are undoubtedly complex. Findings to date are still inconclusive and continued research is needed in this area.

AIR QUALITY

INTRODUCTION

Under the Clean Air Act as amended, the Forest Service has a specific role as a Federal Land Manager to protect the air quality related values in its Class I areas. Class I areas under Forest Service management are defined as any Congressionally designated Wilderness greater than 5000 acres established prior to 1977. On the White Mountain National Forest, these are the Great Gulf Wilderness and the Presidential Range - Dry River Wilderness. Air quality related values are features or properties that are important for preserving Wilderness character and that could be adversely affected by air pollution. Air quality related values identified in the Great Gulf Wilderness and Presidential Range - Dry River Wilderness are scenic beauty (visibility), vegetation, wildlife, water and odor.

The Forest Service has little direct control over air quality because the greatest contributers are industry and automobile exhaust rather than actions taken by the Forest Service. However, the responsible government agencies, the U. S. Environmental Protection Agency and State air regulatory agencies, consult with Forest Service managers on potential impacts to air quality related values. In turn, the Forest Service is required to review preconstruction applications for air pollution emission permits. Called Prevention of Significant Deterioration (PSD) permits, these are required for major new air pollution emission sources and major modifications of existing sources.

The White Mountain National Forest, in cooperation with several partners, monitors the effects of air pollution on visibility, vegetation and water quality. The intention is to detect trends and to provide a warning system for potential problems. The monitoring information is used as background data in the review of PSD permit applications.

VISIBILITY

Monitoring Goals

Document existing levels and long-term trends in visibility

Identify the pollutants responsible for existing man-made visibility impairment

Determine a threshold level of acceptable visibility impairment in the Class I wilderness areas.

Monitoring Strategies

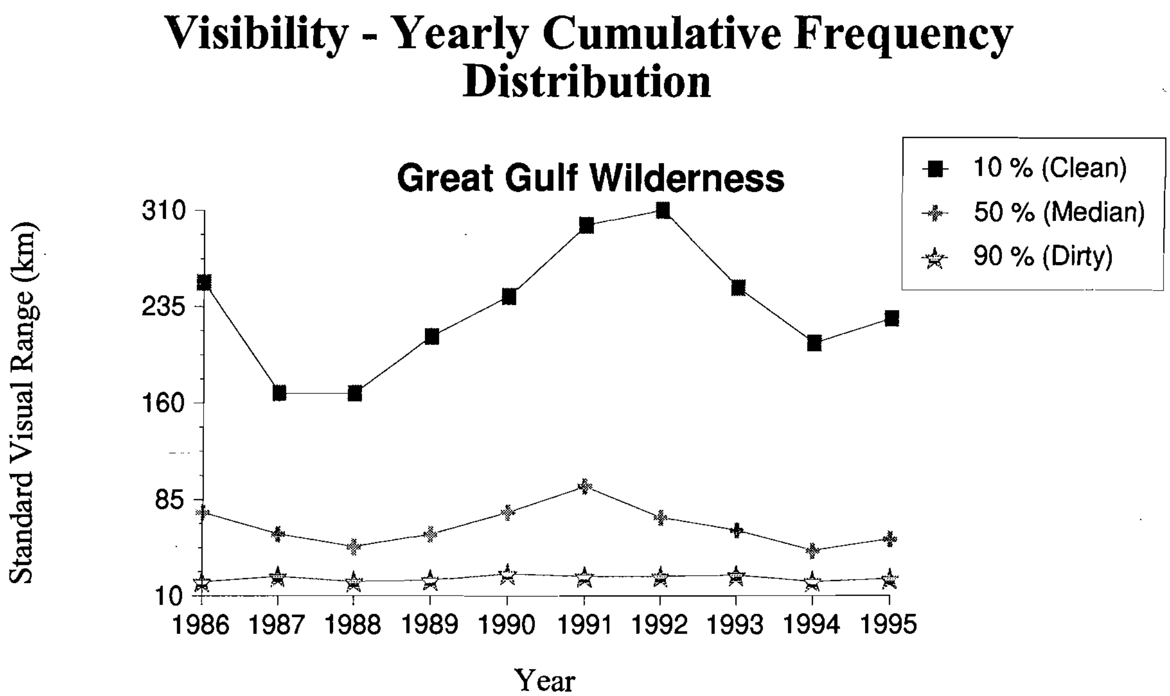
Measure visibility in the Great Gulf Wilderness daily during the spring and summer seasons. Analyze air samples taken concurrently to determine the composition of particles in the air. From 1986 to 1995, visibility was measured using photography. Air samples were collected by the Appalachian Mountain Club (AMC) in cooperation with Harvard School of Public Health and the White Mountain National Forest. In 1995, the methodology was changed to be consistent with the IMPROVE protocol for monitoring visibility. IMPROVE (Interagency Monitoring of Protected Visual Environments) is a cooperative visibility monitoring effort between Federal and State Agencies. The IMPROVE protocol consists of a nephelometer, which is an instrument that measures the scattering of light due to particles in the air and essentially replaces the photographic techniques, and a series of particulate samplers which measure the amounts of sulfate, nitrate, organics and other particles in the air.

In order to understnd peoples' threshold of acceptable visibility impairment, in 1996, AMC and the White Mountain National Forest initiated a pilot study to assess forest visitor's perceptions of visibility. Visitors were asked to view a series of photographs showing a range in visibility conditions and to rate each photograph as "acceptable" or "unacceptable". In 1997, researchers from the University of New Hampshire (UNH) joined the study as it was expanded to explore questions on the economic value individuals place on visibility changes. The study continues this year under the direction of UNH and AMC.

Accomplishments/Findings

From 1986 to 1995, photographs looking out over the Great Gulf Wilderness were taken three times a day during the spring and summer seasons. Standard Visual Range (SVR), which includes scene contrast and sight distance measurements, was determined from the photographs. The theoretical limit to SVR in clean air is imposed by air molecule scattering and results in a maximum potential SVR of approximately 320 kilometers (km). Figure I (Visibility - Yearly Cumulative Frequency Distribution) shows the yearly cumulative frequency distribution of SVR data from 1986 to 1995. The "50 percent (Median)" value is the median SVR for the monitoring season each year. Half of the monitored days had better visibility (larger SVR) and half had worse visibility (smaller SVR). The "10 percent (Clean)" and "90 percent (Dirty)" values represent the SVR each year where 10 percent of the monitored days had cleaner or dirtier, respectively, visibility conditions. For example, in 1986, 10 percent of the monitored days had better visibility conditions than a SVR of 250 km and 10 percent of the days had worse visibility conditions than a SVR of 20 km. As seen in the figure, the median visual range has varied from a low of 48 km in 1988 to a high of 95 km in 1991. The 90th percentile (dirty) has ranged from 21 to 27 km. On a month by month basis, August and July are typically the haziest months. Of those months monitored, November is the clearest with a median SVR of 112 km.

Figure I



Data from Air Resource Specialists

Air sampling by AMC shows there is a statistically significant well-defined relationship between visibility and fine mass particulates. Visibility decreases as concentrations of fine mass particulates increases. Fine mass is particulate matter less than 2.5 microns in diameter. Chemical analysis of the fine mass indicates that it is comprised mainly of sulfate particles (40 to over 50 percent). Nitrate particles are a small component (about 5 percent). These results agree with monitoring results from other New England sites in the IMPROVE network. These sites have shown that fine particulate mass in the Northeast is comprised primarily of sulfate (52.9 %) and organics (30.9 %). Nitrate (7.2 %), light absorbing carbon (5.2 %) and soil (3.8 %) comprise the remainder. Due to a lag time for data analysis and interpretation, information from the Great Gulf IMPROVE monitoring station is not yet available for release.

Results from the initial visibility perception study indicate that a Standard Visual Range (SVR) of about 29 km or less was an unacceptable level of visibility for at least 70 percent of the respondents.

Recommendations/ Implications

Visibility in the White Mountains has the capability to be excellent, as shown by the "10 % (Clean)" values in Figure 1. On the average, natural background SVR is estimated to be 150 +/- 45 km in the Eastern United States. However, our monitoring has shown that during the spring and summer, visibility in the Great Gulf Wilderness is most often less than half of what it could be. We believe visibility in the Great Gulf Wilderness and Presidential Range - Dry River Wilderness has been adversely impacted by regional haze pollution. The pilot perception study shows that visitors can distinguish visibility conditions and that there likely is a threshold value that a majority would consider to be unacceptable.

VEGETATION

Monitoring Goals

To study the effects of air pollutants on vegetation in the Class I areas.

To provide warning of potential problems due to impacts of air pollutants.

Monitoring Strategies

Vegetation surveys - Survey vegetation for symptoms of ozone damage on plots located in and near the Great Gulf Wilderness and Presidential Range - Dry River Wilderness.

Ambient ozone concentrations - Monitor ambient ozone concentration continuously during the growing season (May through September) near the Great Gulf Wilderness. Evaluate ozone concentrations relative to threshold values which indicate the likelihood of impacts to sensitive vegetation.

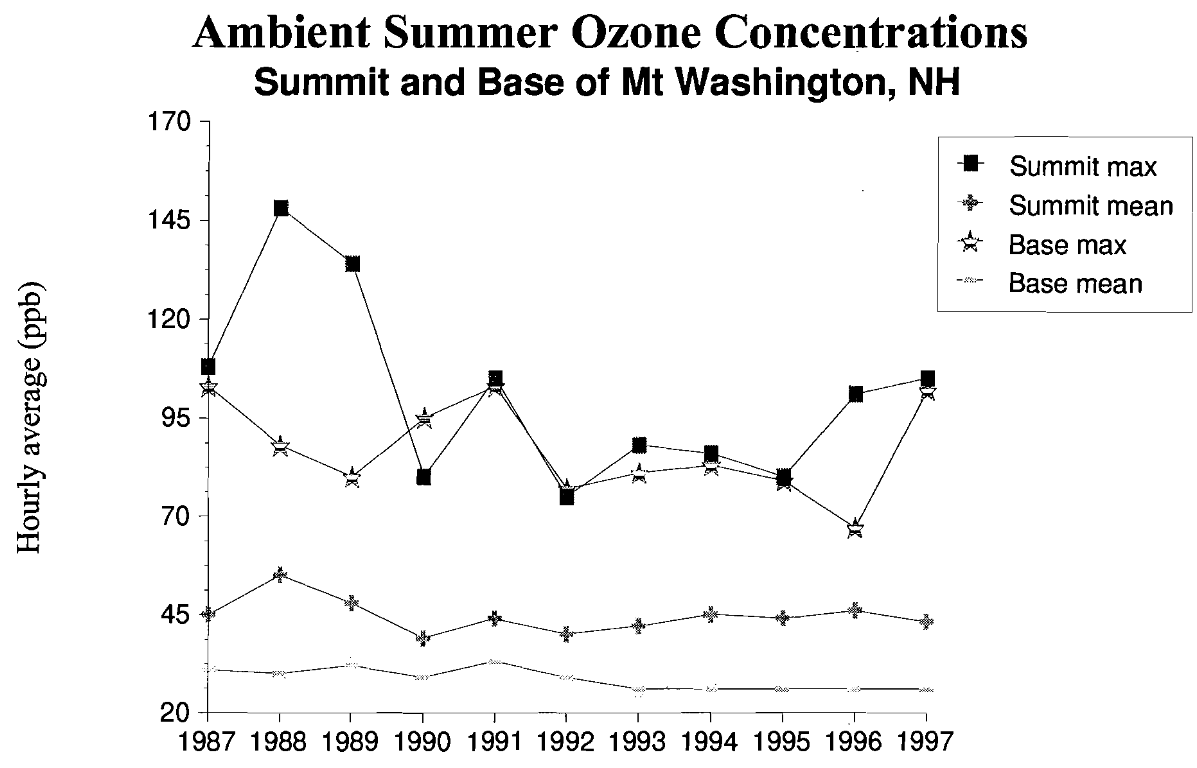
Lichens - Survey the condition of lichens in the wilderness as indicators of overall vegetation health at 5-year intervals. Lichens are composite plants, each made up of a fungus and an algae living together in a symbiotic relationship. Some species are known to be sensitive to low levels of sulfur dioxide, nitrogen oxides and florides, and are therefore good indicators for pollution studies. Moreover, lichens have no protective epidermis, allowing the air within them to be freely exchanged with the atmosphere. They can absorb airborne pollutants, and because they are long-lived, they can accumulate the chemical elements making up the pollutants.

Accomplishments/Findings

Vegetation Surveys - General vegetation surveys were conducted from 1989 to 1995 by the University of Massachusetts-Amherst on plots located in and near the Great Gulf Wilderness and Presidential Range - Dry River Wilderness. Results of the 1989 - 1993 surveys were reported in the 1993 White Mountain National Forest Monitoring Report. In 1994 and 1995, symptoms of ozone injury were found on the foliage of several native tree, shrub and herbaceous species, including black cherry, common milkweed, red-berried elder, white ash and white pine.

Ambient ozone concentrations - Ambient ozone concentrations are currently monitored at the base (Mt. Washington Auto Road or Camp Dodge) and summit (Mt. Washington Observatory) of Mount Washington by AMC, in cooperation with the White Mountain National Forest, State of New Hampshire and EPA. Until 1995, the University of Massachusetts-Amherst operated the base site. Figure II displays the yearly maximum and mean hourly average ozone concentrations measured at the summit and base sites from 1987 to 1997.

Figure II



July - August 1987 - 1997, Data from UMASS-Amherst and Appalachian Mountain Club

This figure shows that ozone concentrations increase with elevation. Ozone concentrations are greater at the summit of Mount Washington than in the valley bottom at the base. This difference is due to two factors. First, mountainous terrain surrounding the base site effectively isolates it from significant man-made sources of ozone. The summit is more strongly influenced by regional transport of pollutants. And second, there is an atmospheric boundary layer, typically at an elevation of 1,000 to 1,200 meters (3,290 to 3940 feet), which further inhibits the mixing of ground and high level air masses.

The monitoring data indicates no clear trends in overall ozone concentrations in the White Mountains. Based on the mean and maximum ozone concentrations at the summit site, there is little evidence of improvement in ozone conditions at higher elevations. The late 1980's were characterized by high peak concentrations during ozone episodes and relatively high mean values, especially at the summit. During the early to mid 1990's, the peak values decreased but the mean values increased, indicating less severe episodes but worsening background concentrations. In 1997, the peak concentrations at both sites were the highest recorded since 1991, while the mean concentration decreased slightly from 1996.

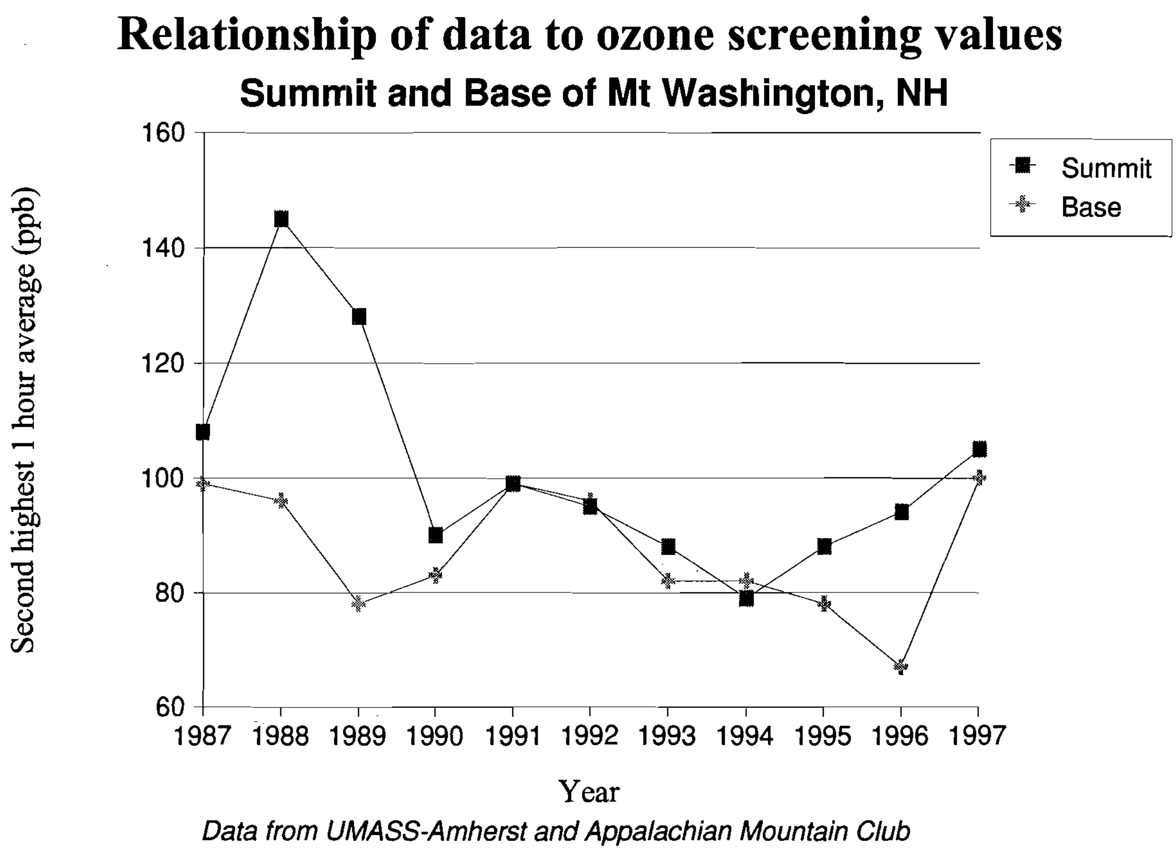
The Forest Service uses a "green line - red line" threshold screening model to evaluate air pollution conditions in Class I areas to protect air quality related values. Green line values were set to be at levels at which it was reasonably certain that **no significant change** would be observed in ecosystems that contain large numbers of sensitive components. Red line values were selected to be at levels at which it was reasonably certain that a significant change **would** occur in both the sensitive and tolerant components of the ecosystem.

The ozone screening values used are the "second highest 1-hour average concentration during the growing season". This index is used rather than the actual ambient ozone concentrations because it isreasonably well correlated with plant response.

The green line threshold for ozone is 80 ppb. No significant change is expected in the ecosystem if "second highest 1-hour" ozone concentrations remain below this level. However, it is reasonable to expect some ozone injury symptom development or leaf senescence (premature aging) on sensitive plants at even this low level. The red line threshold is 120 ppb. At this level, ozone will reduce plant growth and competitive ability of many species.

Figure III shows the relationship of the last 10-years of ambient ozone concentration data to the red line and green line thresholds. As seen in the figure, the green line (80 ppb) has been exceeded at the summit site every year except 1994 and at the base site every year except 1989, 1995 and 1996. Only the summit site has historically exceeded the red line (120 ppb), this occurred in 1988 and 1989.

Figure III



Lichens - An initial survey and elemental analysis of lichen flora in the Great Gulf Wilderness and Presidential Range - Dry River Wilderness was completed in 1988. This initial survey did not show significant voids in the distribution of the more sensitive species that could be attributed to air pollution effects. The elemental analysis did not show accumulations of sulfur or other common pollutant elements indicating that there were probably no local pollution sources causing damage to lichen flora. Levels of all elements were very similar to those found in the Boundary Waters Canoe Area in Minnesota, a known clean area.

In 1993, the elemental analysis was repeated. These results showed that most elemental levels in most species were similar or slightly lower in 1993 than in 1988. The report concluded that there probably had been no degradation in the air quality in the wilderness between 1988 and 1993, and there might have been a slight improvement.

Recommendations/Implications

This monitoring effort shows that ambient ozone continues to be a pervasive and important air pollutant in the Great Gulf Wilderness and the Presidential Range - Dry River Wilderness during the growing season at concentrations high enough to cause foliar plant injury.

OVERALL RECOMMENDATIONS ON AIR QUALITY

From our monitoring efforts, we believe the scenic beauty (visibility), vegetation and air quality related values in the Great Gulf Wilderness and Presidential Range - Dry River Wilderness Class I areas have been, and continue to be, adversely impacted by air pollution. Forest visitors are also affected by air pollution. In a recently published study conducted by Brigham and Women's Channing Laboratory, Harvard School of Public Health and the Appalachian Mountain Club, low level exposures to ozone, fine particulate matter and acid aerosols were associated with decreases in lung function among hikers on Mt. Washington.

The 1990 Amendments to the Clean Air Act have resulted in significant reductions in sulfur emissions, a contributing factor in acid rain and visibility impairment, but problems still remain. Recent changes to national air quality standards for ozone and fine particulate matter, and proposed regional haze regulations, should bring about improvements in air quality. However, the new natural gas pipeline through Northern New England has stimulated a wave of natural gas fired power plant proposals, many of which constitute New Sources under the Prevention of Significant Deteriorationm(PSD) regulations, which have the potential to affect our Class I areas.

The monitoring efforts underway by the Forest and our partners should help monitor trends in the condition of the air quality related values and help us be more effective in responding to PSD applications.

STREAM CHEMISTRY

Monitoring Goals

To study the effects of air pollutants on stream water chemistry in the Class I areas.

To provide warning of potential problems due to impacts of air pollutants.

Monitoring Strategy

Evaluate the chemistry of streams in the Great Gulf Wilderness and Presidential Range-Dry River Wilderness through water sampling. Water samples were collected from the West Branch Peabody River in the Great Gulf Wilderness and the Dry River and Rocky Branch in the Presidential Range-Dry River Wilderness. Samples were collected at several sites along the main stream as well as from two tributaries to each stream. Samples were collected bi-weekly or monthly during May through September in 1995 - 1997. Our partners in this study are the Appalachian Mountain Club and the Forest Service Northeastern Research Station.

Accomplishments/Findings

Table 1 shows the range in average concentrations of sulfate, nitrate, calcium and magnesium and the average pH measured in the West Branch Peabody River, Dry River and Rocky Branch. The West Branch Peabody River and Dry River are poorly buffered and acidic with mean pH for all sites of 4.8 and 4.9, respectively. Compared with data from 156 streams that drain small upland, forested watersheds throughout New England, these two streams had lower pH than 85 percent of the streams in this regional database and lower calcium concentrations than 90 percent of the database. Magnesium, another base cation that helps buffer stream water, is also low relative to other streams throughout New England. Sulfate is the dominant ion in both streams but is on the lower end of concentrations found throughout New England. Rocky Branch is less acidic, with a mean pH of 6.0. This falls in the middle of the streams that comprise the regional database. Sulfate, calcium and magnesium concentrations in Rocky Branch are similar to the other two streams. The upper elevation portions of the West Branch Peabody River had some of the highest nitrate concentrations observed in New England. Only 5 percent of the streams in the regional database had higher nitrate concentrations. The lower elevation sample sites had nitrate concentrations in the middle of those observed in the region. Nitrate concentrations in Dry River and Rocky Branch are low relative to other streams in New England.

	West Branch Peabody	Dry River	Rocky Branch
Sulfate	50 - 60	40 - 80	40 - 78
Calcium	25 - 75	28 - 43	25 - 72
Magnesium	20 - 45	12 - 25	20 - 25
Nitrate	5 - 40	< 5	< 5
pH	4.6 - 5.3	4.7 - 5.6	5.6 - 6.5

Table 1. Average stream water chemistry for summer months, 1995 - 1997 for three streams draining Class I Wilderness Areas. Sulfate, calcium, magnesium and nitrate concentrations are in micro equivalents per liter (ueq/L). pH is in pH units.

Recommendations/Implications

From air pollution deposition studies conducted at Hubbard Brook Experimental Forest in Thornton, NH, we believe that the aquatic resources within the Great Gulf Wilderness and Presidential Range - Dry River Wilderness have been adversely impacted by acid deposition. Sulfur and nitrogen deposition measured at Hubbard Brook exceeds the "red line" threshold value, indicating the potential for significant effects to aquatic resources. The acid neutralizing capacity (ANC), which is a measure of the buffering capacity of a water body, measured in ponds and streams in these wilderness areas also exceed the "red line" threshold.

Preliminary analysis of the data from this study indicates a need to better understand some of the ecosystem processes that might be affected by acid deposition. The drainage waters from these three watersheds are dilute with limited buffering capacity. Small changes in biogeochemical processes within these watersheds could result in significant changes in stream water quality. There is a need to better understand factors controlling nitrogen and sulfur cycling in the West Branch Peabody River and the Dry River.