United States
Department of
Agriculture

Forest Service

White Mountain National Forest
Monitoring Report
1999

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Forest Supervisor's Message

Hello,

I'm pleased to issue the 1999 White Mountain National Forest Monitoring Report. In this year's report, we are featuring an array of activities in various areas. Much of this work is the result of efforts by cooperators, scientists, and college and university programs involved with the White Mountain National Forest. This cooperation along with information gathered by our own employees provides us with the essential building blocks to continually adapt our management of the forest to meet Forest Plan objectives.

This year's monitoring report illustrates the diversity of management opportunities on the White Mountains. In this report, you will find discussions on timber activities, air quality, fire history, water quality recreation use, fisheries, and wildlife among others.

This report highlights a subset of the information that is being gathered for use in revising our Forest Plan. Additional information is being gathered through assessments we contracted for last year to provide information on the available science that relates to our Forest Plan Revision Topics. These assessments were done in four topic areas, terrestrial, aquatic, social, and recreation. The social assessment is completed and available on our web site. The terrestrial and aquatic assessments will be available there soon. The recreation assessment will be available later this year. These assessments along with information from our monitoring report will provide important background information for Forest Plan Revision.

We look forward to working with you on the Forest Plan Revision as we address the complicated and controversial decisions that are required to improve our Forest Plan.

Donna L. Hepp

Forest Supervisor

Table of Contents

Air

Under the Clean Air Act, the Forest Service has a role 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 5,000 acres established prior to 1977. On the White Mountain National Forest, there are two Class I areas: Great Gulf Wilderness and 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 White Mountain National Forest, in cooperation with several partners, monitors air quality near the Great Gulf Wilderness. The intention is to determine effects on air quality related values, detect trends and to provide a warning system for potential problems. In 1998 and 1999, we continued our monitoring of ground-level ozone and visibility.

Ozone

Ozone is the most prevalent chemical found in smog. It is formed in the atmosphere by a series of complex chemical reactions of nitrogen dioxide and volatile organic compounds in the presence of sunlight. The concentration of ozone in a given location is influenced by many factors, including the concentration of nitrogen dioxide and volatile organic compounds in the area, the intensity of sunlight, and local weather conditions. The "ozone season" in New England is late spring through early fall.

Tropospheric, or "ground-level", ozone is known to cause harmful effects in both humans and plants. Forest species in the White Mountains sensitive to ozone include white ash, white pine, black cherry, and common milkweed. Symptoms of ozone damage in sensitive plants are visible injury to foliage, reduced photosynthesis and growth, and premature leaf senescence.

Our ground-level ozone monitoring project is a joint effort of the Appalachian Mountain Club, White Mountain National Forest, New Hampshire Department of Environmental Services Air Resources Division, U.S. Environmental Protection Agency Region I, Harvard School of Public Health, and the Mount Washington Observatory. Ozone concentrations have been monitored near the Great Gulf Wilderness since 1987. There are two monitoring stations, one currently at the Mount Washington Observatory on the summit of Mount Washington and one at Camp Dodge at the base of Mount Washington. These stations are operated during the "ozone season" (May through September) as weather allows.

Figure 1 shows the maximum and mean hourly ozone concentrations measured at the summit of Mount Washington and at Camp Dodge from 1987 through 1999. As seen in the graph, ozone concentrations measured in 1998 and 1999 are consistent with levels seen over the last 10 years. The maximum hourly concentration in 1999 was up slightly over 1998 at both sites, but below the maximums observed in 1987 – 1990. The July-August mean values at both sites have remained fairly constant since 1993.

Figure 1. **Maximum and mean hourly ozone concentrations measured at the summit (Mt Washington Observatory) and base (Camp Dodge) of Mount Washington. Maximum values are the maximum of all months monitored (May through September). Mean values are for July and August only. Data is from Appalachian Mountain Club and UMASS-Amherst.**

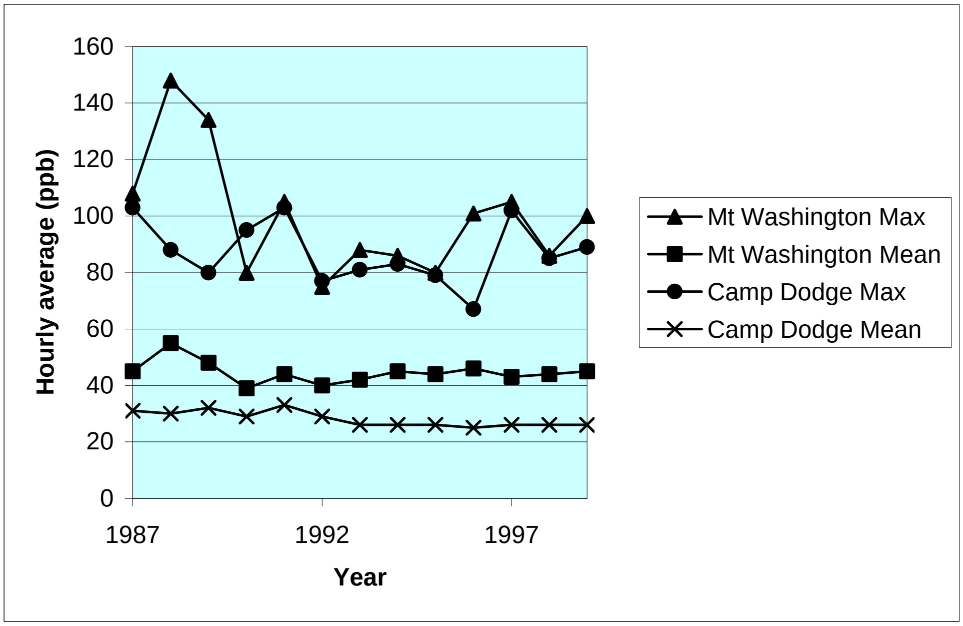


Figure 2 shows the average diurnal, or daily, pattern of ozone concentration measured at the summit of Mt. Washington and at Camp Dodge in 1999. Ozone concentrations at the summit are not influenced by increased sunlight, but remain fairly constant, and consistently higher, throughout the day. This indicates that the summit is affected by regional transport of ozone at night when peak concentrations are typical. The Camp Dodge site is strongly influenced by solar radiation cycles with the highest ozone concentrations each day associated with the peak solar radiation. This indicates that the lower elevations are affected by local ozone formation rather than regional ozone transportation.

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 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 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 because research has shown it to be reasonably well correlated to plant response. The "green line" threshold for ozone is 80 ppb. No significant change is expected in the ecosystem if the "second highest 1-hour" ozone concentration remains below this level. However, it is reasonable to expect some ozone injury symptom development on sensitive plants even at this low level. The "red line" threshold is 120 ppb. At this level, it is likely that ozone will reduce plant growth and the competitive ability of many plant species.

Figure 2. Diurnal pattern of ozone concentration at the summit of Mt. Washington and Camp Dodge during 1999. Data is from Appalachian Mountain Club.

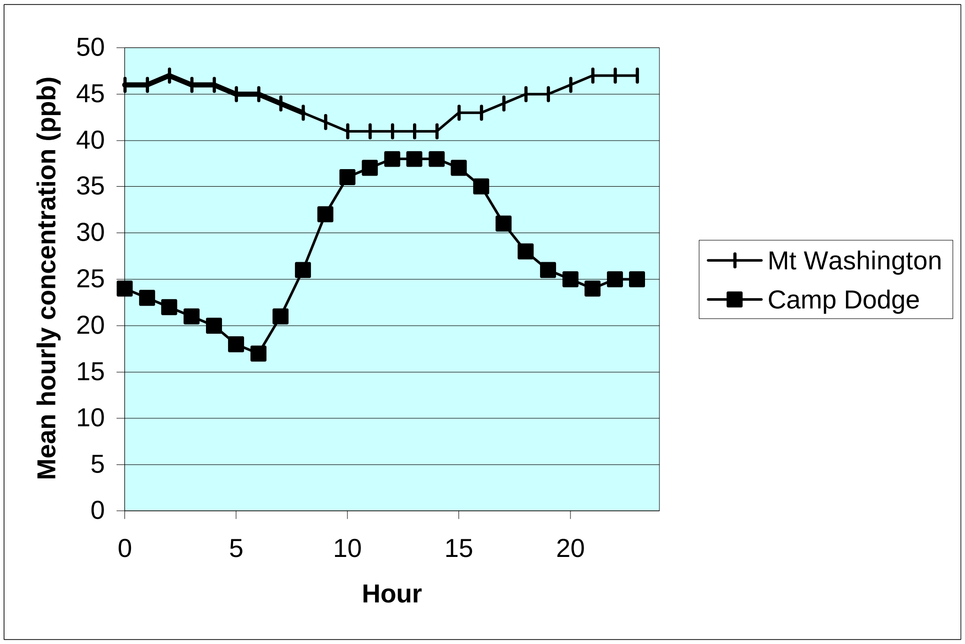
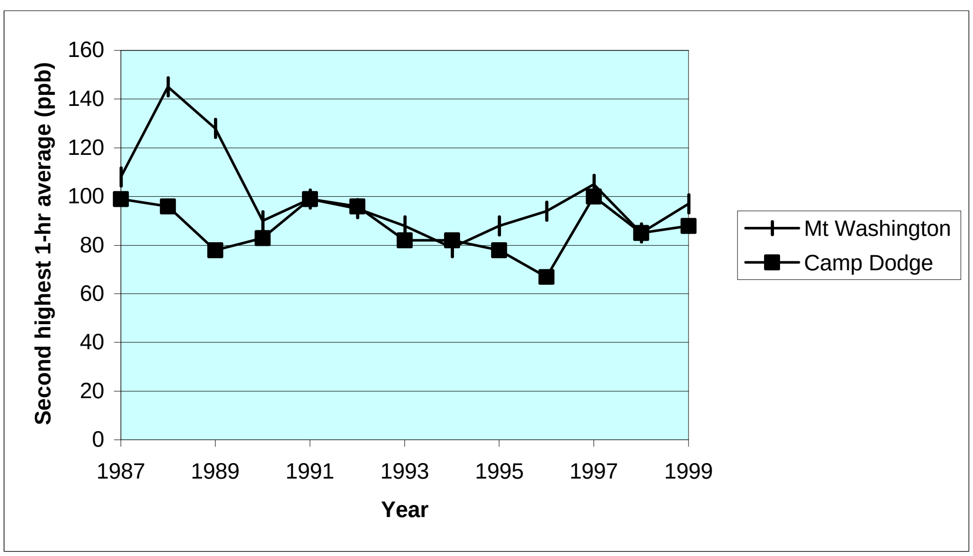


Figure 3 shows the “second highest 1-hour average” ozone concentrations measured at the summit of Mount Washington and at Camp Dodge from 1987 through 1999. As shown in the figure, both the summit and Camp Dodge had ozone levels above the “green line” but below the “red line” in 1998 and 1999. *This monitoring effort shows that ambient ozone continues to be a pervasive air pollutant in the Great Gulf Wilderness and Presidential Range – Dry River Wilderness during the growing season at concentrations high enough to cause foliar plant injury.*

Figure 3. Comparison of measured ozone concentrations at Mt. Washington and Camp Dodge to the “green line” (80 ppb) and “red line” (120 ppb) screening values. Data is from the Appalachian Mountain Club and UMASS-Amherst.



Visibility

Visibility is reduced by the presence of aerosols, which are mixtures of fine particles in the air. These aerosols scatter light into and out of the line of sight and absorb light along the line of sight, thus degrading visibility. Visibility is usually characterized either by visual range (the greatest distance that a large dark object can be seen) or by the light-extinction coefficient (the attenuation of light per unit distance due to scattering and absorption by gases and particles in the atmosphere).

Aerosols, which are also called "particulates" or PM_{10}, are particles less than 10 microns in size. Aerosols are divided into "coarse mass" and "fine mass". Coarse mass is particles 2.5 to 10 microns in size and is composed mostly of soil particles. Fine mass, also called $PM_{2.5}$, is particles less than 2.5 microns in size. It is these fine particles that are responsible for most particle induced visibility impairment. The components of fine mass are classified into five major types: sulfates, nitrates, organics, elemental carbon (soot), and soil. Other fine particles that may also be in the air, such as nonsoil potassium, or sea spray, and other trace elements, are less important from a visibility standpoint. The common sources of particulate pollution are:

Sulfate:	Coal/Oil fired power plants, refining and smelting activities
Nitrate:	Automobiles, any combustion source
Organics:	Biogenics (natural emissions), smoke, industrial solvents
Soot (carbon):	Diesel exhaust, smoke
Coarse particles:	Dust, smoke, pollen

Prior to 1995, visibility in the Great Gulf Wilderness was monitored using photographic methods. A camera located at Camp Dodge took photographs of Mount Jefferson three times a day during the spring and summer seasons. Standard Visual Range, which includes scene contrast and sight distance measurements, was determined from these photographs.

In the summer of 1995, an IMPROVE protocol site was established at Camp Dodge to monitor visibility in the Great Gulf Wilderness. IMPROVE, which is short for "Interagency Monitoring of Protected Visual Environments" is a national visibility-monitoring program conducted cooperatively by the U.S. Environmental Protection Agency, federal land management agencies and state air agencies. The goals of the IMPROVE effort are to: 1) establish current background visibility in Class I areas; 2) identify chemical species and emission sources responsible for existing man-made visibility impairment; and 3) document long-term trends. Other IMPROVE sites in New England include Lye Brook Wilderness in Vermont, and Acadia National Park and Moosehorn National Wildlife Refuge in Maine.

The Great Gulf IMPROVE protocol site is operated from the beginning of May through the end of September each year. Our site is an "IMPROVE protocol site" because, although it uses the IMPROVE sampling methodologies, it is not operated year 'round as full IMPROVE sites are. Data are summarized by calendar quarter: winter (December, January, February), spring (March, April, May), summer (June, July, August) and fall (September, October, November).

The IMPROVE methodology consists of two parts. The first is an integrating nephelometer that measures light scattered by aerosols and gases in the air. The nephelometer computes hourly averages of the scattering coefficient (b_{scat}) for the period it is operating. A low value of b_{scat} indicates "cleaner" air, while high values indicate greater amounts of particles in the air are scattering light (ie reduced visibility). The units of b_{scat} are inverse megameters (Mm^{-1}). The data is statistically analyzed to determine the mean of the "cleanest" 20 % of observations ("Clean"), the mean of all observations ("Middle"), and the mean of the "dirtiest" 20 % of observations ("Dirty"). Figure 4 shows the "Clean", "Middle" and "Dirty" b_{scat} measured at the Great Gulf site during the summer quarter (June, July, August) from 1995 to 1999. This graph shows that the visibility in the "Clean" and "Middle" days has remained fairly constant over the last 5 years.

The second part of the Great Gulf IMPROVE protocol site is the aerosol sampler. This sampler consists of four separate particle sampling modules and provides direct measurements of aerosol species present in the air. Data from the sampler can be used to suggest probable sources of visibility impairment. The samplers are operated for two 24-hour periods each week (Wednesday and Saturday) during the monitoring season (May through September).

Figure 4. Scattering coefficient (b_{scat}) measured at the Great Gulf IMPROVE protocol site in the summer quarter (June, July, August) from 1995 to 1999. Data is from Air Resource Specialists, Inc.

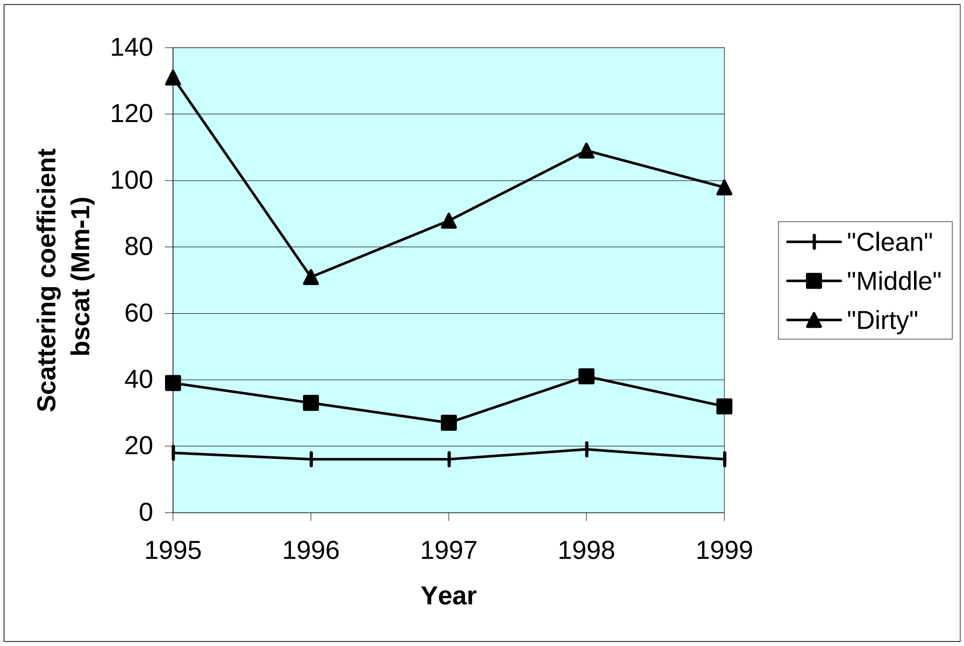


Figure 5 shows the seasonal average concentrations of particulate matter (PM_{10}) and fine mass ($PM_{2.5}$) measured at the Great Gulf IMPROVE protocol site from 1995 through 1999. This graph shows that there is an increase in particulate matter concentration during the summer months as compared to the spring or fall. This is consistent with our previous findings from the camera monitoring which showed July and August are typically the "haziest" months.

To provide some perspective on the particulate concentration levels measured at the Great Gulf, Figure 6 shows the seasonal average concentration of particulates measured during the summer of 1998 at several IMPROVE sites. Concentrations measured at Great Gulf are commensurate with other sites in New England (Lye Brook, Acadia and Moosehorn). The Washington DC site consistently has the highest particulate concentrations (poorest visibility) measured in the IMPROVE network. Denali National Park in Alaska consistently has the lowest particulate concentrations (highest visibility).

Figure 5. Seasonal average concentration of particulate matter (PM_{10}) and fine mass ($PM_{2.5}$) at Great Gulf IMPROVE protocol site from 1995 to 1999. Winter quarter is not included because the site is not operated in the winter months. Data is from University of California – Davis.

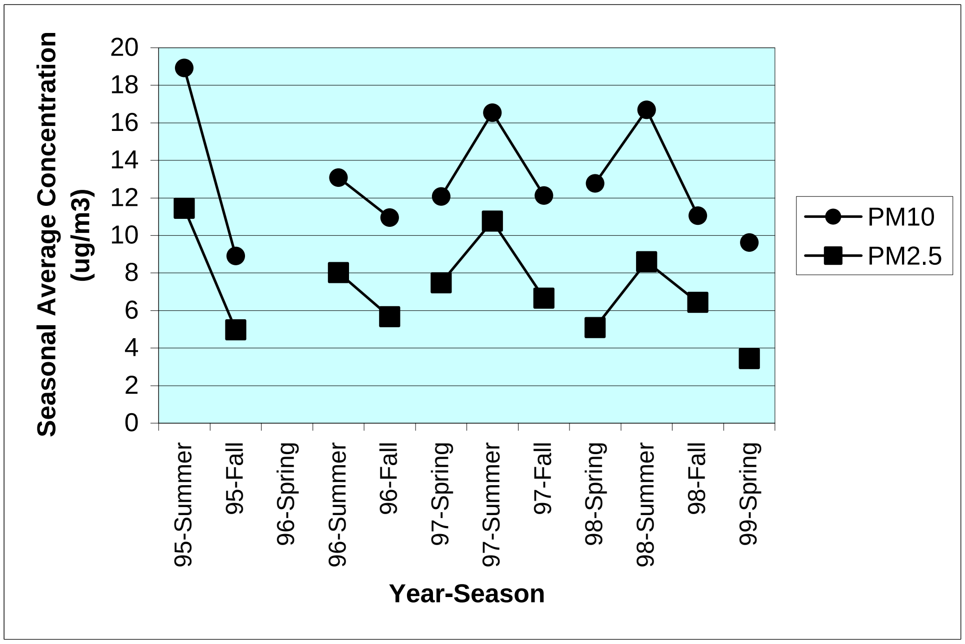
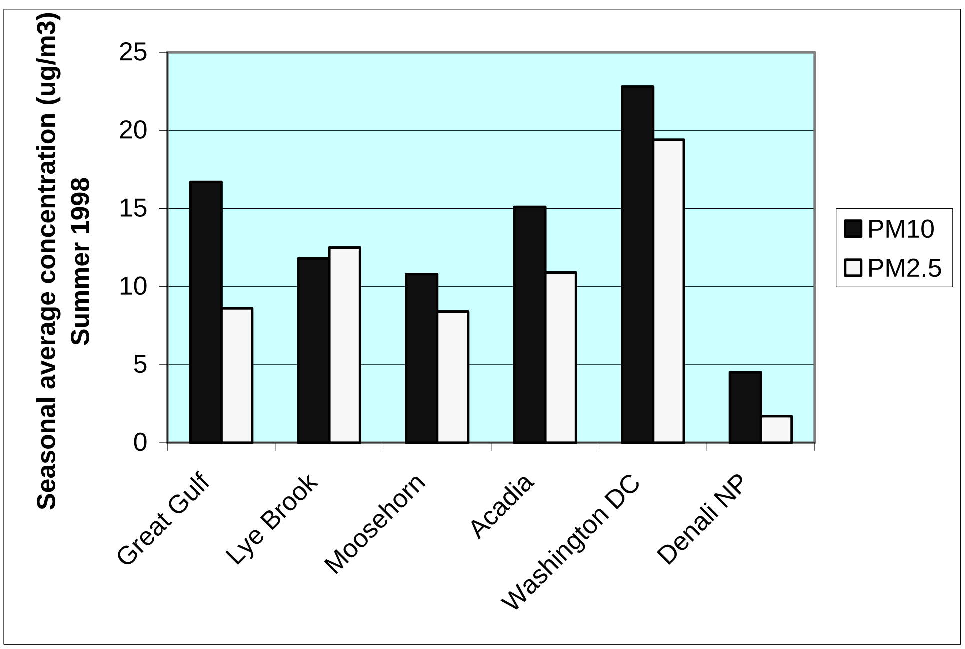
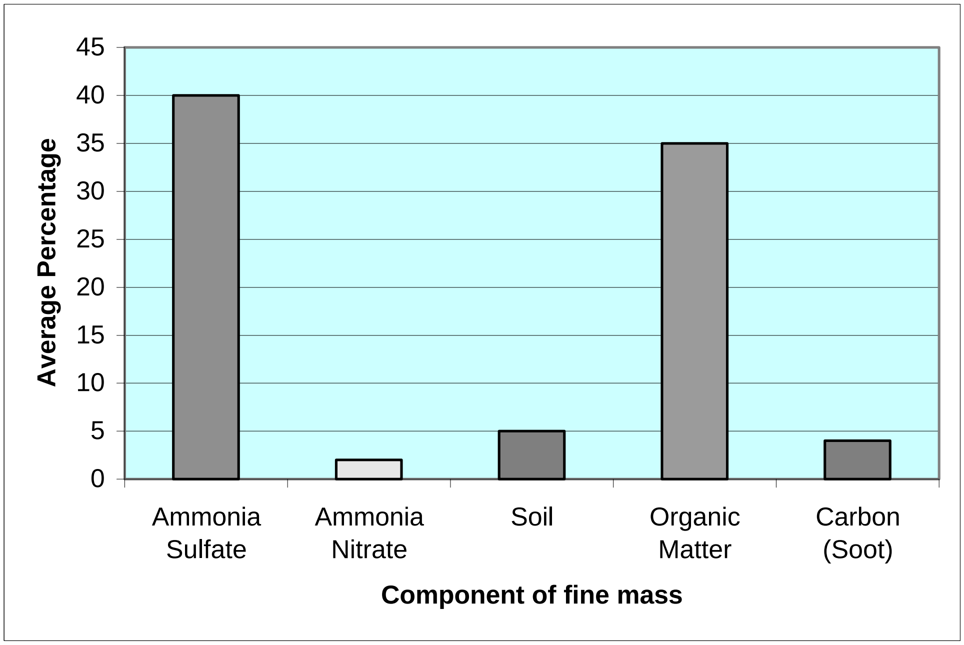


Figure 6. Seasonal average particulate matter concentrations measured at IMPROVE sites in the summer of 1998. Data is from University of California – Davis.



The four particle sampling modules in the IMPROVE methodology provide the ability to determine the relative abundance of the different components in the fine mass ($PM_{2.5}$). It is these particles that are responsible for most of visibility impairment. Figure 7 shows the average composition of fine mass measured at the Great Gulf IMPROVE protocol site from 1995 to 1999. Fine mass is primarily comprised of sulfate particles and organic matter. Nitrate particles comprise a very small percentage. The other IMPROVE sites in New England show similar results.

Figure 7. Average composition of fine mass at Great Gulf IMPROVE protocol site measured from 1995 to 1999. Data is from University of California – Davis.



Visibility in the White Mountains has the capability to be excellent. *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 our Class I areas has been adversely impacted by regional haze pollution, comprised mostly of sulfates.* The Great Gulf IMPROVE protocol site is scheduled to be modified to a full IMPROVE site sometime in the spring of 2000. It will be operated year ‘round and will provide monitoring data in support of the Regional Haze regulations.

Fire

A contract was awarded to the University of Massachusetts to conduct a fire history study of the White and Green Mountain National Forests. The final report was completed in January 2000.

The specific objectives of the research were to develop a fire history data base and narrative fire history summaries for the White Mountain National Forest in New Hampshire and the Green Mountain National Forest in Vermont within the context of the states and regions where they occur. These two national forests cover approximately 6% of the land area of Vermont (GMNF) and 12% of that of New Hampshire (WMNF) and are the largest protected areas of natural vegetation in New England. They thus serve as natural models for the larger landscapes of which they are a part.

Conclusions

Vermont and New Hampshire, with their mountainous terrain, moist climate, numerous natural fire breaks (streams, rivers, & lakes), and low amounts of available fuel are unlikely to support naturally occurring, large-scale fires. Portions of these states do contain fire-susceptible vegetation (such as pine stands on dry or shallow soils and xeric oak-pine communities near the coast), but the larger matrix of northern hardwood forests may only experience natural, stand replacing fires[1] every 1,000 years or more. Fire history studies of these unique communities may determine if fire is important to their long-term maintenance. Fire occurrence in the late 19th and early 20th century was greatly increased from presettlement times due to human activities. The decreased fire incidence on the landscape in the later half of the 20th century suggests that forests of the region may be returning to a fire regime more typical of presettlement conditions, when large fires were rare on much of the landscape. Management of these areas should reflect the change in fire regime and may not require the large-scale reintroduction of fire as has been suggested for ecosystems outside northern New England.

The White Mountain and Green Mountain National Forests are the largest protected natural areas in their states. These forests have experienced usage by humans for millennia but especially during the earlier part of the 20th century. This use changed the landscape as well as the processes that occur there. With the return of a fire regime characterized by less frequent fire, the forests may return to their presettlement vegetation composition, although other factors such as disease or insect outbreaks and climate change could alter this prediction. Fire may be a useful tool in this landscape to manage for specific communities or to attain specific management objectives, but frequent, large-scale fire is not required for the preservation of the northern hardwood forest as a whole.

[1] A stand replacing fire is one the kills the majority of the trees in a forested stand.

Table 1. 1999 Local Wildfire Activity

Forest-WMNF	Date	Acres	Cause	District
Osseo Trail	5-1-99	13.3	campfire	Pemi
Sandwich Delight	5-2-99	0.1	campfire	Pemi
Powerline	5-12-99	0.1	miscellaneous	Ammo
West Royce	6-24-99	0.2	lightning	Andro
Bald Ledge	9-1-99	2.5	campfire	Pemi

Total # fires: 5 **Total Acres: 16.2**

Wildfire Support Off-Forest

One 20-person New England National Forest crew and 25 single resources were mobilized during the 1999 fire season. The GMFL also provided a squad to the National Park Service in Nov 1998.

Management Ignited Prescribed Fire

The Androscoggin District conducted 6 prescribed burns totaling 24 acres.

Fish

Inland Fish Management

Heritage Brook Trout Genetics Project

Final results from the genetic analysis of trout collected in the White Mountains have not yet been completed. Due to funding and staffing constraints, Guelph University has not been able to test tissues from the entire sample of brook trout. We hope to receive the results of the study by the middle of year 2000. This project will provide some baseline information for learning about the genetic diversity of brook trout in New Hampshire streams.

Fish Passage at Stream Crossings

Forestwide standards state that fish passage in streams will not be blocked or prevented unless done in conjunction with prescribed fisheries management. In 1999, surveys of stream crossings on tributaries to the Swift River were conducted to determine the potential for fish barriers. Surveys were done in August when brook trout may need to migrate upstream to cooler waters. Crossings are generally of two types: bottomless boxes and arches which have natural stream beds; or box culverts, round pipes, and squash pipes which may or may not have natural bed materials on their bottoms. The most visible potential fish barrier is a “perched” culvert outlet, which creates a drop from the culvert to the streambed. The number of culverts surveyed and the number believed to be passable during low flows are listed below:

Table 1 Results of survey to determine whether culverts are passable by fish.

Crossing Type	# Surveyed	# Perched	# Passable by Brook Trout
Box/Pipe with bottoms	15	9	8
Bottomless Box/Arch	9	1	8

Conclusions:

Box, round, and squash pipe culverts are prone to creating perches at the downstream end of the culvert. These drops may or may not be a fish barrier depending on the height of the drop and the depth of the pool below the culvert. In this survey, 7 of the 9 perched culverts were predicted not to be passable because pool depth was less than twice the drop height.

Bottomless box and arch culverts are much less prone to creating perches. Only one bottomless culvert was associated with a perch (Hobbs Brook). This culvert is not a true bottomless culvert because there is a concrete lip at the downstream end of the box that caused the perch. True bottomless culverts, sized appropriately for the width of the stream, appear to ensure fish passage.

The Forest Plan standard, which requires fish passage at all stream crossings, may not be met in the Swift River watershed. These results would also suggest that the problem could be occurring Forest-wide. However, assumptions made regarding minimum values of perch height and pool depth needed by brook trout need to be tested on the WMNF. Also, more information is needed to determine what portions of watersheds are most critical for ensuring fish passage.

Recommendations:

1. Continue with culvert surveys in other watersheds to determine if the problem is more widespread. Surveys should encompass a diversity of stream orders.
2. Conduct fish surveys above and below a variety of culverts to better quantify parameters that create fish barriers.
3. Create a prioritized list of stream crossings which need to be corrected to ensure fish passage.
4. Consider using bottomless culverts at new stream crossings to prevent future fish barriers. If round or squash pipes are used, create backwater pools at culvert outlets using the appropriately sized boulders.
5. At existing culverts with perched outlets, create backwater pools using boulders of the appropriate size during maintenance operations at the site.

Brook Trout Index Site Monitoring

Beginning in the early 1990's, index sites were established to monitor the effects of land management activities on the eastern brook trout, a management indicator species on the WMNF. Index sites were established within the Androscoggin and Saco watersheds with sites occurring in both New Hampshire and Maine.

Nine sites were monitored between 1992 and 1999. Five to seven years of data were collected for each site. Within the Saco watershed, sites were located at Rob Brook and Oliverian Brook, tributaries of the Swift River (Albany); Lower Stairs Brook, a tributary of the Rocky Branch of the Saco (Jackson); Slippery Brook, a tributary of the East Branch of the Saco (Chatham); and Great Brook which flows into Kezar Lake in Maine (Stoneham). Within the Androscoggin watershed, sites were located at Thompson Brook and the upper Peabody River (Pinkham's Grant); and Morrison Brook and Evans Brook which flow into the Wild River in Maine (Batchelders Grant).

Fish were collected with backpack electroshockers within each index site. Each site had a set stream length to sample and multiple shocking passes were conducted. Fish from each pass were held captive until after the final pass. All fish were measured, weighed, and released. Population estimates were derived by age class (defined by length frequency histograms) using the Zippin method, an estimator that is based on the depletion rate of fish over multiple shocking passes.

Wild fish production was assessed by estimating the number of yoy (young-of-the-year) brook trout per 100 square meters at each site. Average yoy for each site were calculated for all years combined and compared to productivity classes established by the New Hampshire Fish and Game based on wild trout assessments in southwest New Hampshire. Although adult trout data was collected, estimates are not currently available which separate hatchery from wild fish.

Results:

None of the sites showed any trend of increasing or decreasing densities over the sampling years. In fact, estimates from 1995 and 1996 suggest that environmental factors may strongly influence production during the study years. In 1995, densities of young brook trout were elevated at most sites. The average density calculated from combining all sites was the highest for all years while the variation (CV) was the lowest, suggesting that environmental conditions may have provided more optimal conditions for egg and fry survival throughout the White Mountains. In 1996, yoy densities were much reduced at all sites. A large flood in the fall of 1995 may have reduced the numbers of spawning fish or washed eggs downstream.

Table 2 Assessed wild fish production as by estimating the number of YOY (young-of-the-year) brook trout per 100 square meters.

Stream Name	Numbers of YOY brook trout / 100 square meters								Average Density	CV
	1992	1993	1994	1995	1996	1997	1998	1999		
Rob		59.0	61.8	59.6	22.6	77.3	41.8	84.2	48.8	42.7
Lower Stairs		37.7	32.1	55.3	15.5	25.8	12.6		23.8	55.8
Thompson			5.4	20.7	6.9	7.2	22.1	16.6	8.9	48.9
Morrison			1.0		0.6	2.8	2.9	4.7	2.4	61.5
Evans		0.0	2.0	6.3	0.4	0.4	0.5	4.4	2.0	112.8
Great			5.1	42.2	5.6	2.7	7.9	7.1	11.8	116.5
Slippery	10.9	13	5.7	27.5	1.7	7.2	5.5		10.2	76.8
Oliverian		4.4	6.4	23.0	3.7	1.7	7.1	28.4	10.7	91.4
Peabody			4.2	8.6	0.7	6.2	4.1	14.6	6.4	68.3
Average density	10.9	19.4	10.3	27.8	4.4	13.9	9.3	21.0		
CV	-	106.7	131.0	66.7	109.5	170.8	103.5	121.2		

Two of the smaller streams had the highest densities of wild juvenile brook trout. Rob Brook qualified as a high productivity juvenile stream based on the NHF&G assessment, while Lower Stairs was just below the lower threshold for the high rating. If 1999 data had been collected at Lower Stairs, the average density across all years most likely would have been higher. Four of seven sites surveyed in 1999 had their highest densities relative to other years.

Brook trout are known to spawn in headwater areas, however, juvenile densities do not decrease consistently with increasing width across the index sites. This suggests that some brooks have more potential for natural reproduction of brook trout than others, or habitat conditions in some smaller brooks have been degraded. Despite low pH levels and elevated aluminum concentrations in portions of the Swift River watershed, Rob Brook ranked highest in brook trout natural reproduction.

Table 3 Comparison between average YOY for sites and productivity classes established by the New Hampshire Fish and Game.

Stream Name	Stream Width (ft)	YOY Brook Trout/ 100 sq. meters	Productivity Class*
Rob	8	49	High
Lower Stairs	10	24	Moderate
Thompson	10	9	Moderate
Morrison	10	2	Low
Evans	13	2	Low
Great	18	12	Moderate
Slippery	19	10	Moderate
Oliverian	22	11	Moderate
Peabody	38	6	Low

* low = <10; moderate = >10 to 25; high = >25

Conclusions:

1. Data on brook trout abundance collected at index sites in the 1990's does not show any evidence that land use activities are influencing fish populations perhaps due to the apparent larger influence of environmental factors (floods, mild winters, etc.).
2. The data does not provide any insight into the impact of land use activities that occurred before the index sites were established.
3. Index site data shows that White Mountain region streams exhibit a similar range of juvenile trout productivity as waters in southwestern New Hampshire.
4. The data provides excellent baseline data on wild brook trout populations for comparison in future years.

Recommendations:

1. Do not continue monitoring all of these sites in FY2000. Consider new sites where water chemistry data collected in 1999 indicates low pH and elevated concentrations of aluminum. These conditions are known to reduce hatching success of salmonids.
2. Index sites should be revisited in ten years to establish trend data.
3. Investigate factors limiting wild juvenile brook trout production as part of fish surveys.

Anadromous[1] Fish Management

Merrimack River Restoration

The WMNF continued participation in the interagency Merrimack River Anadromous Fish Restoration Program. Monitoring of adult fish returns is done to measure success of restoration efforts. Also, telemetry studies on adult salmon released in the upper Merrimack River system allow us to monitor habitat preferences of spawning salmon.

Anadromous Fish Returns

Numbers of anadromous fish species returning to the Merrimack River in 1999 increased for all species as compared to the last two years. Return numbers are based on fish counted at the Essex dam fish-lift in Lawerence, MA. A total of 191 adult Atlantic salmon were counted in 1999, up from 123 in 1998 and 71 in 1997. Adult salmon returns have slowly increased each year after reaching an all-time low in 1994. Sixty percent of the 1999 returning adults were from hatchery-raised smolts and 37% were from stocked fry. This changed from 1998, where 56% of returning adults were from stocked fry. American shad returned in record numbers (56,465), nearly doubling the record set in 1998 (27,891). A total of 7898 river herring returned in 1999, up substantially from 1362 fish in 1998. Numbers of herring are still well below the historic high returns of 1988-1991 when several hundred thousand herring returned to Essex dam.

Movement and Spawning Activity of Adult Sea-run Atlantic Salmon

In 1999, the WMNF continued its cooperative agreement with the US Fish and Wildlife Service to monitor and evaluate spawning activity of adult salmon released above dams located in the

[1] Anadromous – fish that migrate up rivers from the sea to breed in fresh water.

Merrimack watershed. In 1998, the study examined the movements of hatchery broodstock while in 1999, adult sea-run salmon were released.

On October 13, 1999, thirty sea-run and one broodstock Atlantic salmon were released into spawning habitat on the Baker River, a major tributary of the Pemigewasset River. Seven sea-run females and the one broodstock were equipped with radio transmitters. All radio-tagged sea-run fish immediately moved downstream, leaving Baker Creek, and reached the first dam at Ayers Island within four days (distance of 33 to 38 miles from release site). Four of these fish moved through the fish bypass system and continued downstream. Another of the tagged sea-run fish then proceeded to move upstream past the mouth of Baker River, 18 miles from the dam up to Livermore Falls. The only domestic broodstock released, held position over the spawning gravel near the release site for one month.

Conclusions:

Current studies suggest, at least for the Baker River, there is a difference in movement behavior associated with origin of the released fish. Domestic broodstock appear to stay close to spawning habitat near their release site, as observed in 1998 and 1999. Sea-run adults of fry stock origin appear to move upstream. Sea-run adults of hatchery smolt origin appear to have a net downstream movement and become widely distributed.

Recommendations:

Future studies should focus on tracking both adult sea-run salmon of fry stock origin adult broodstock salmon to determine the potential of these fish to create river spawning populations.

Heritage Resources

Our Heritage Resource Site Survey Strategy was originally developed when The White Mountain National Forest (WMNF) Heritage Program began in 1979. Our survey strategy was designed for historic sites only since, at that time, no Native American sites were known to exist in the White Mountains. Even the academic archaeological community showed little interest in the higher elevations and few believed that American Indians used the mountains to any great extent. Indicative of this attitude is the widely recited story of Darby Field being the first person to ascend Mount Washington in 1642, having been guided by Indians who would not or could not accompany him to the summit.

In 1994, the WMNF entered into a partnership with Plymouth State College and The NH State Conservation and Rescue Archaeology Program (SCRAP) to undertake prehistoric site survey and shovel testing in areas on forest around ponds and stream junctions. Prehistoric lithic scatter (sites) were located in many locations tested and this proved that American Indians did use the mountains. In 1995 a significant find was made in the vicinity of Jefferson, NH. A multicomponent Paleo-Indian site complex was discovered along a major East-West travel corridor very close to WMNF managed lands. Now we knew that humans lived and worked in the mountains some 10,000 years ago just after the last glaciations. This find, the 1994 work on The WMNF, and the discovery of what appears to be a Paleo-Indian site in one of The WMNF Wilderness Areas in 1999, make it necessary to reevaluate our heritage survey strategy. We now need to include prehistoric focused survey and shovel testing into our forest heritage survey approach. Currently we are working with the NH Division of Historic Resources and SCRAP to formalize a Memorandum of Understanding and prehistoric survey training for all active Heritage Resource Paraprofessionals and Professionals working on the forest. This training will occur in the summer of 2000.

Insects

Spruce Bud Worm Surveys

Forest Service Research monitors spruce budworm levels in New England to assist managers in anticipating potential insect epidemics. Below are the results from the 1999 Spruce budworm pheromone-trapping program. Other than the one Kilkenny Loop site, it looks like the spruce budworm on trap sites in the White Mountain National Forest was low in 1999 and is likely to be low in 2000. These results do not indicate any widespread increase in spruce budworm populations on the Forest.

Figure 1. Spruce Budworms Trapped 1999 – Graph showing average spruce budworms catches in pheromone trap clusters on the White Mt. National Forest, by site.

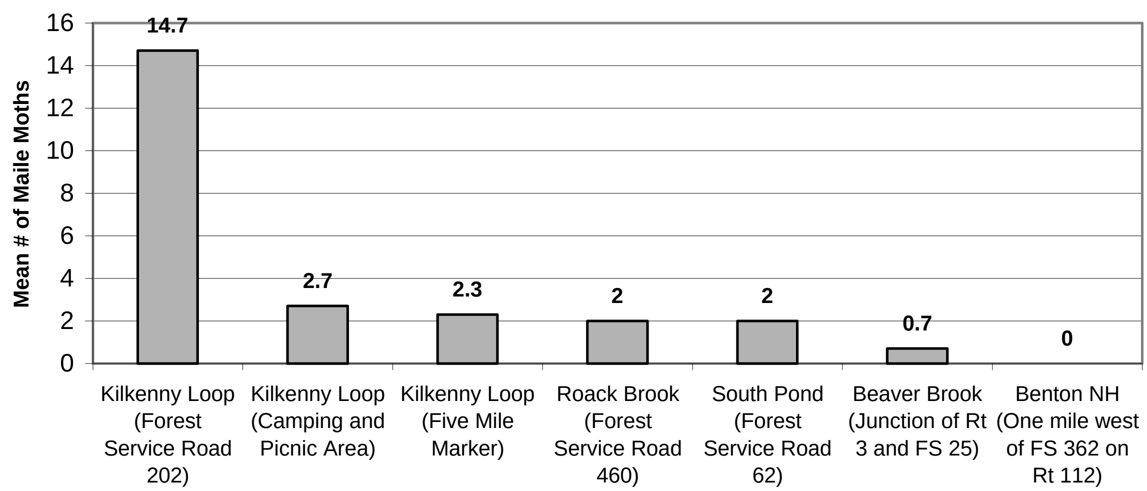
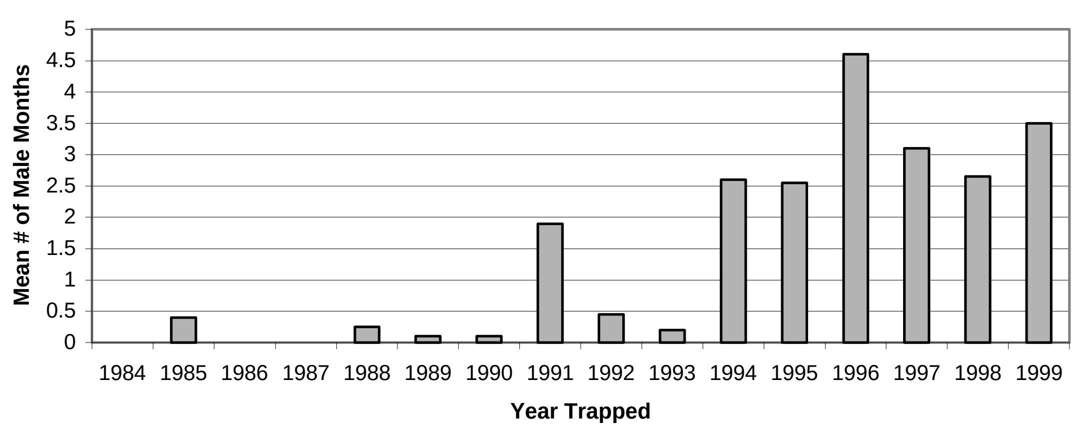


Figure 2. Spruce Budworms Trapped 1984-1999 – Graph showing average spruce budworms catches in pheromone trap clusters by Year on the White Mt. National Forest



Recreation

The White Mountain National Forest provides opportunities for a wide range of recreation. Those opportunities are generally divided into two broad categories: developed and dispersed recreation. Developed recreation includes picnic areas, campgrounds and ski areas. These opportunities are generally associated with relatively large developed facilities. Dispersed recreation is considered to be that which occurs away from roads in backcountry settings. This may vary from extended backcountry trips with overnight stays at cabins, shelters, or AMC huts to winter snowmobile trips of varying lengths. The White Mountain National Forest is unique with its extensive trail network, its long recreation history, and position as a large mountainous public land base. As a result, non-motorized dispersed recreation, especially primitive and semi-primitive recreational opportunities, is an important part of the Forest recreational program.

Campground customer satisfaction Forest Service operated compared to concessionaire operated.

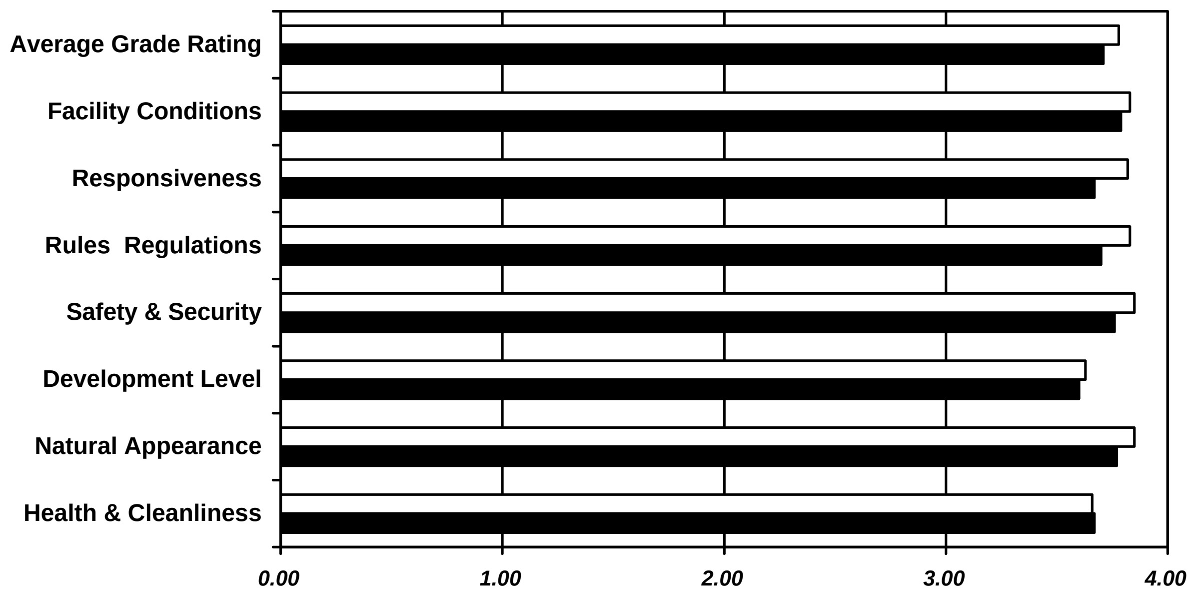
The Forest monitored user satisfaction at National Forest campgrounds in 1995 when they were still operated by the Forest and in 1999 when they were operated under concession permit. The questionnaires were identical, providing us with an opportunity to measure the user satisfaction under two methods of operation. The comparison showed that White Mountain operations and concessionaire operations satisfaction levels varied only slightly and for the most part a little better with the current, concession operations.

The satisfaction measures used in the questionnaire were:

- Health and cleanliness - the campground is litter-free, tables and toilets are clean, and there are no unhealthful or unpleasant conditions.
- Setting, natural surroundings – the facilities fit into the natural surroundings, and don't create unacceptable environmental impacts.
- Setting, level of development – the level of development of this site meets your needs.
- Safety and Security, feel safe – campers feel safe, unthreatened and find no safety hazards.
- Safety and Security, rules and regulations – employees are on duty and inform campers in a friendly and positive manner about campground rules and what is expected of them.
- Responsiveness – camper information needs are being met, and any complaints have been handled to their satisfaction.
- Condition of Facilities – facilities are functional, safe, and well maintained.

The ratings for each of the questions ranged from "0" to "4." The ratings are shown in the chart below. The numbers show very little difference between 1995 and 1999 satisfaction levels. With the exception of the Health and Cleanliness category, all user satisfaction measures were higher in 1999 than in 1995. The differences were all small. They ranged from a low of minus .01 (1995 operations had a higher level of user satisfaction than 1999 in the Health and Cleanliness category) to a high of plus .15 (1999 operations had a higher level of user satisfaction in the Responsiveness category). The average for all the satisfaction measures was 3.71 in 1995 and 3.78 in 1999.

Figure 1. Results of 1998 and 1999 campground user satisfaction surveys on the White Mt. national Forest.



	Health & Cleanliness	Natural Appearance	Development Level	Safety & Security	Rules Regulations	Responsiveness	Facility Conditions	Average Grade Rating
□ 1999	3.66	3.85	3.63	3.85	3.83	3.82	3.83	3.78
■ 1995	3.67	3.77	3.60	3.76	3.70	3.67	3.79	3.71

Rating

Growth of rock and ice climbing on the Forest

The impression is that rock climbing on the Forest has grown rapidly in the last few decades. The Forest has not done specific counts for this activity, but assuming that the identification of opportunities has some correlation with levels of use some indication of the growth can be obtained through a review of rock climbing guidebooks.

The 1987 (second) edition of, “Rock Climbs in the White Mountains of New Hampshire” by Ed Webster lists 49 climbing sites (cliffs) of which more than half (28) are on the White Mountain National Forest. On these 28 cliffs on the Forest 336 different climbing routes are listed. Anecdotally, he also indicated a 1969 rock climbing guidebook by Joe Cote listed 18 climbing routes on Cathedral Ledge. In 1987, this same cliff had 240 routes and variations.

Comparing the 1987 edition of Ed Webster’s “Rock Climbs in the White Mountains of New Hampshire” against the 1998 (east volume) edition for sites on National Forest land shows the following growth in rock climbing activities. This doesn’t include growth on National Forest land in areas around Rumney (7 sites, 50 climbs in 1987), in Franconia Notch (1 site, 3 climbs on NF land in 1987) and the Zealand Area (2 sites, 18 climbs in 1987), as the "west volume" of the 1998 rock-climbing guide is not yet published.

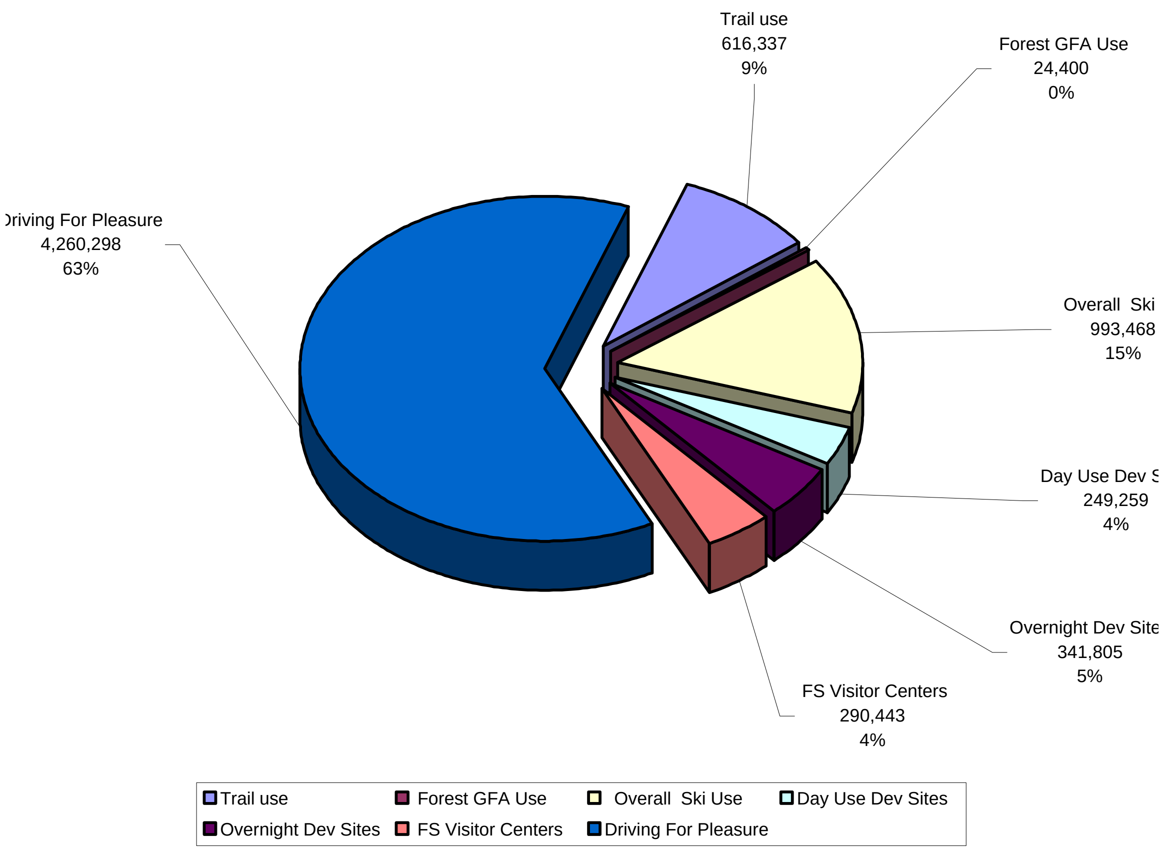
Table 1. Comparison of rock climbing opportunities in 1987 and 1998 on the east side of the White Mt. national forest.

General Location	Number of sites in 1987	Total climbs at the sites in 1987	Number of sites in 1998	Total climbs at the sites in 1998
Kancamagus Highway area	13	224	19 46 percent increase	384 71 percent increase
Bartlett	2	18	6 200 percent increase	57 217 percent increase
Jackson	1	7	2 100 percent increase	13 86 percent increase
Mt Washington/ Pinkham Notch	3	23	3 No increase	27 17 percent increase
Wild River	0	0	1	17

Recreation Use

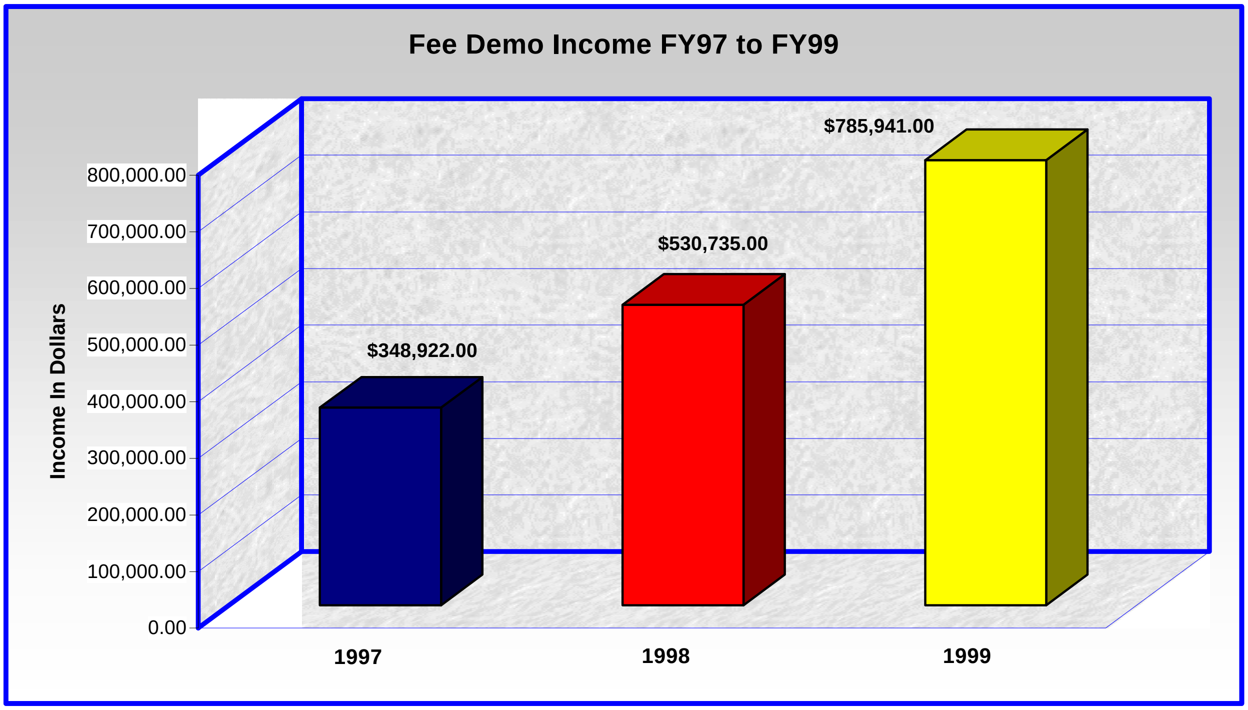
As reported in the 1998 Monitoring Report, recreation use since 1988 showed a steady increase with a total reported recreation use in 1997 of 6.35 million visitors. Our estimated recreation use in 1999 totals 6.84 million visits. As shown in the chart below, the majority of our use is driving for pleasure, including sightseeing. Ski areas (downhill and cross country permits) account for about 15 percent of use and trail use almost 10 percent.

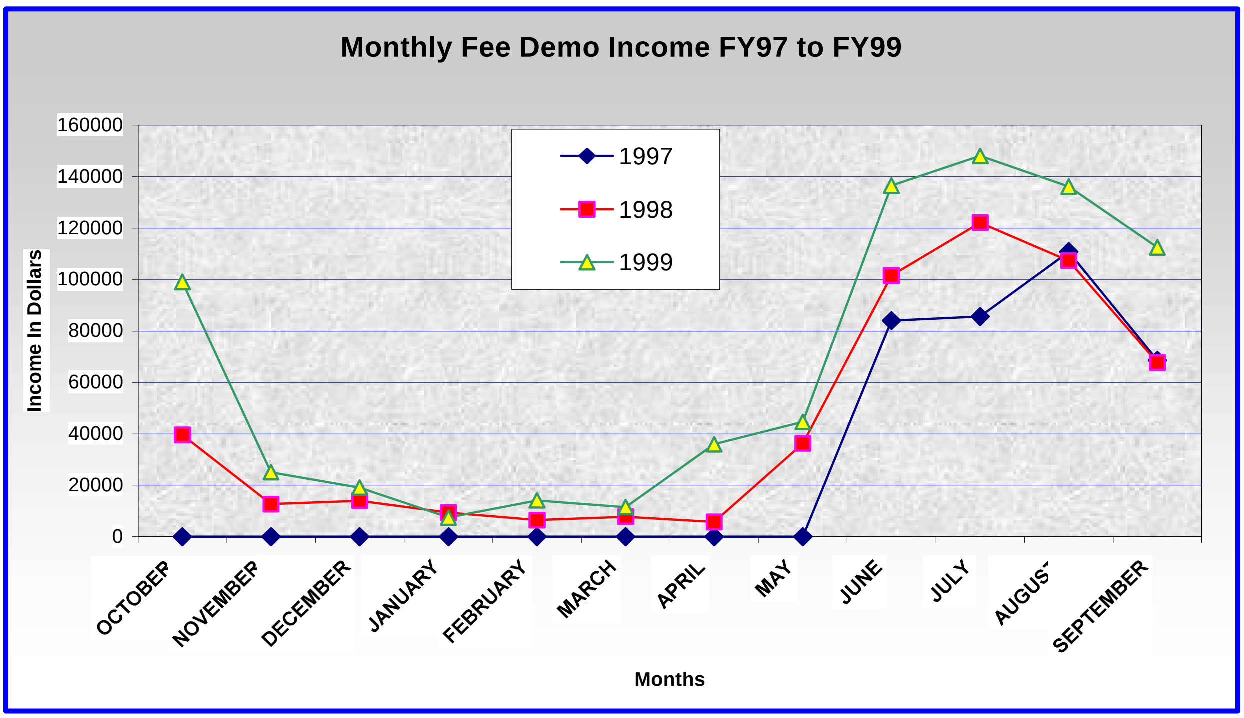
Figure 2. White Mountain National Forest FY 99 Visits (6,837,710 visits).



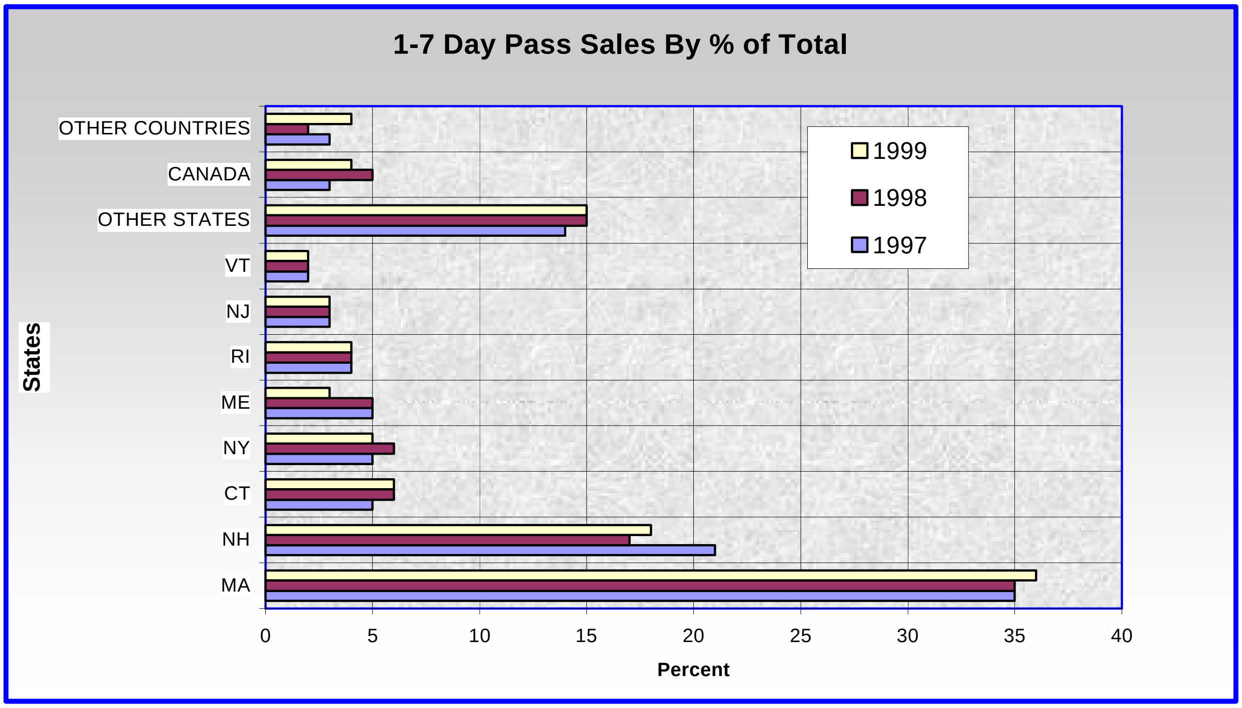
Note: Forest "GFA" means "general forest area" and is defined as those lands outside of developed sites and trails. It is reported use of undeveloped sites and includes such activities as hunting, and backcountry camping at other than identified sites.

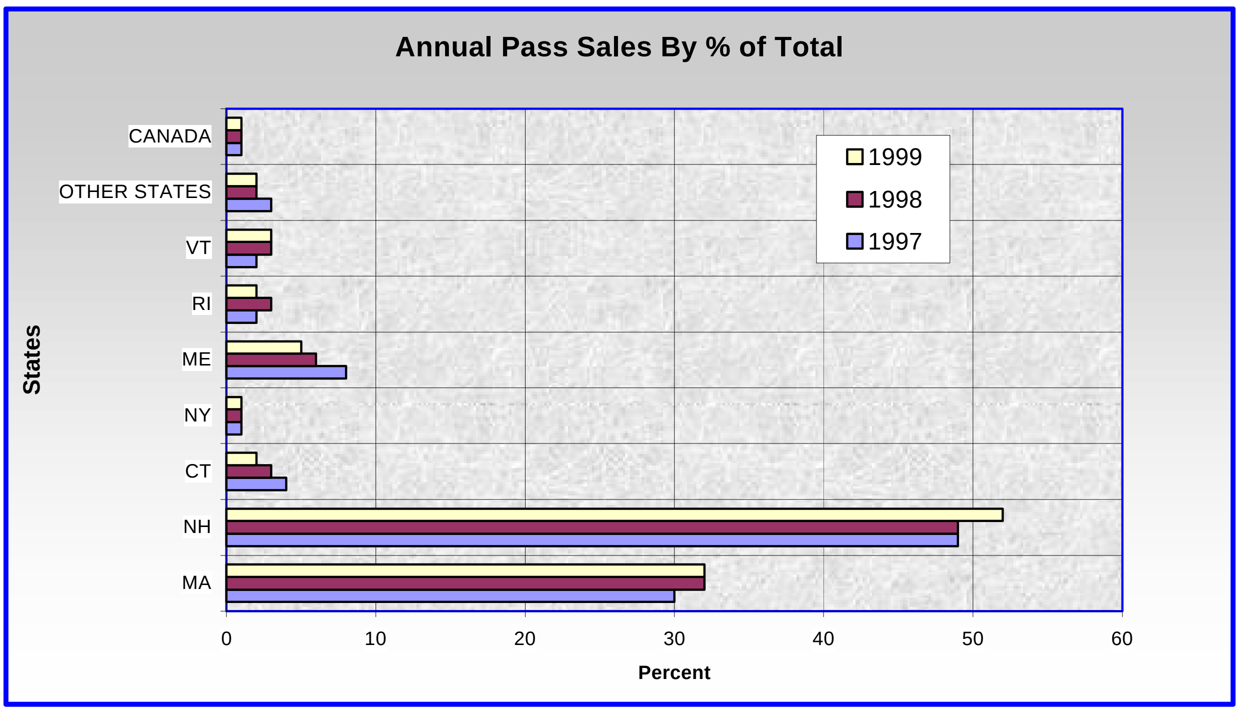
Recreation Fee Pilot Program

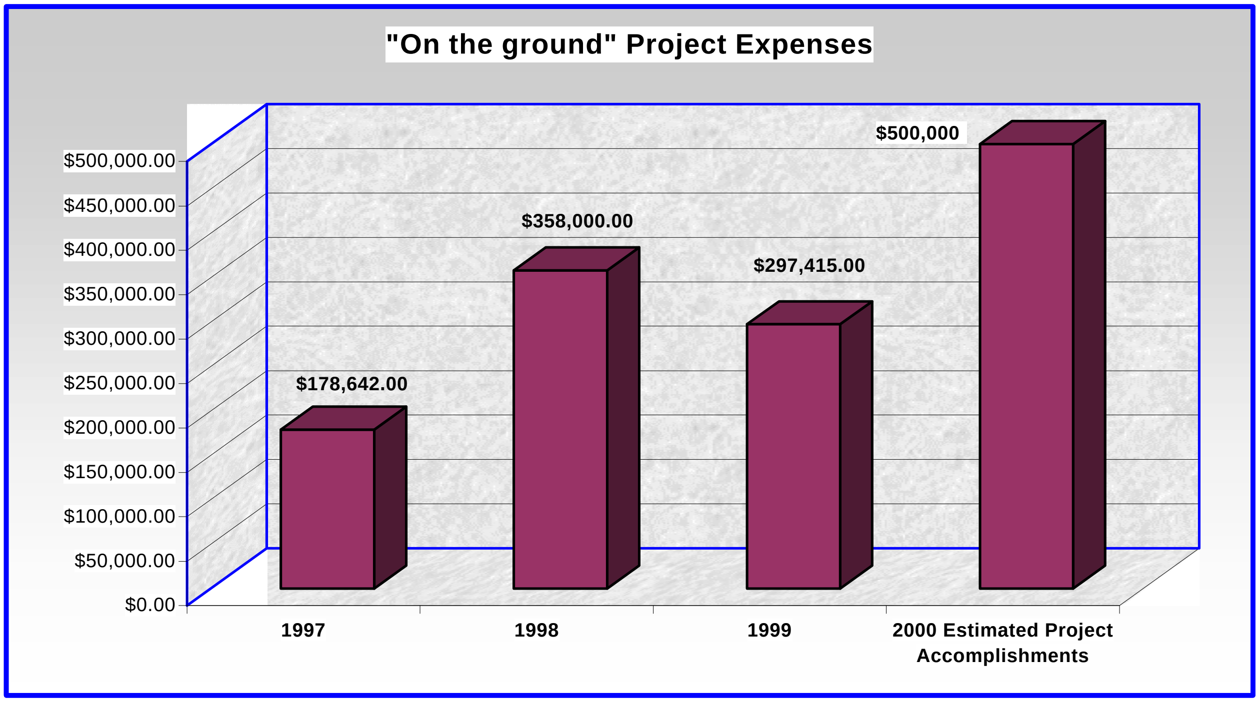


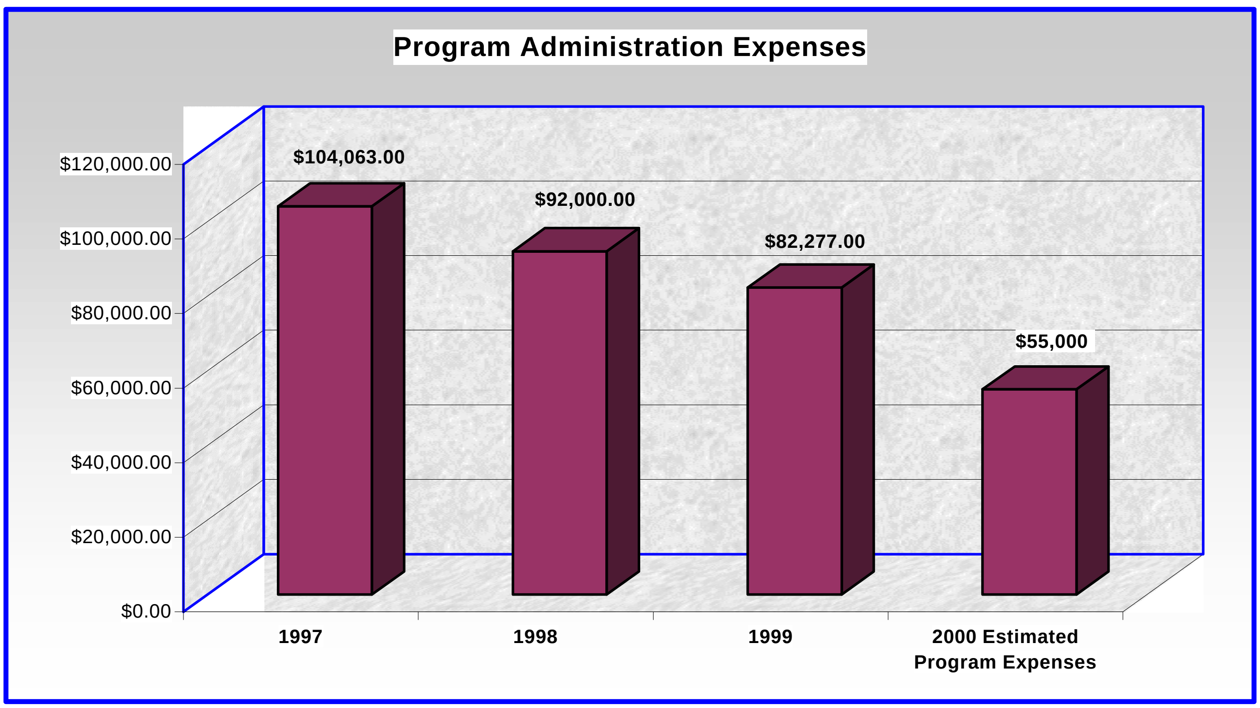


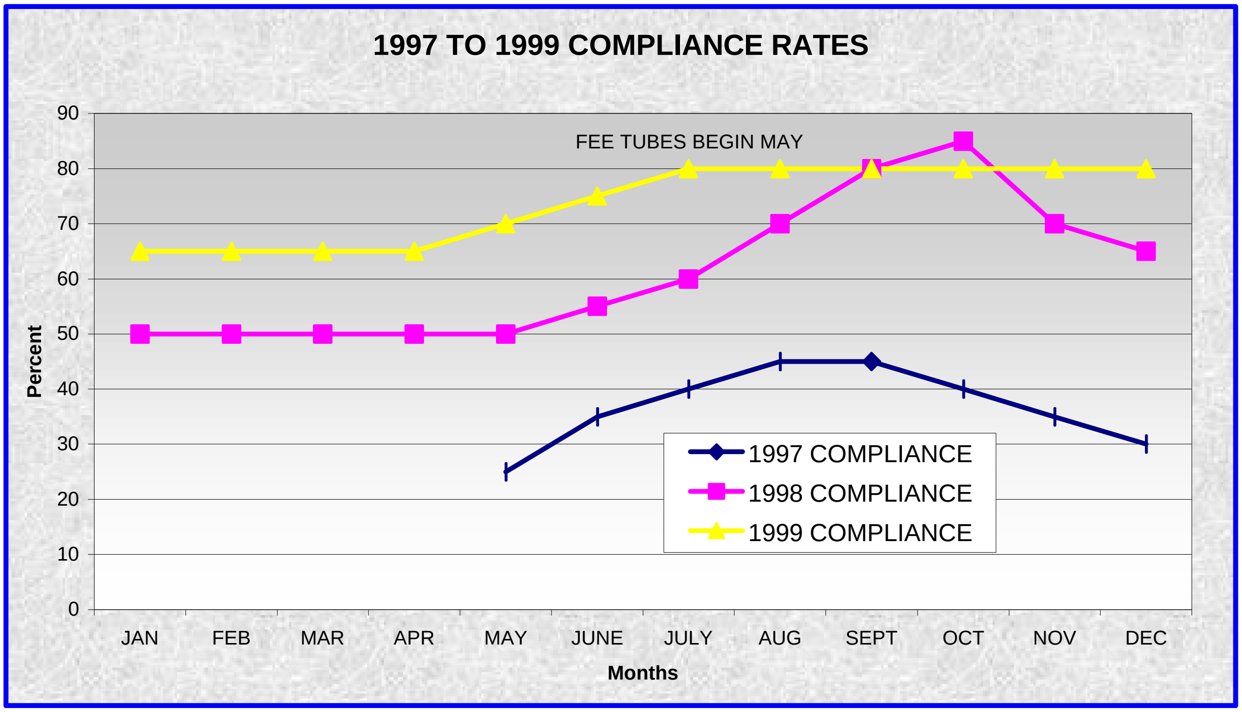
1997-1999 Program Accomplishments






"On the ground" Project Expenses
$500,000.00
$450,000.00
$400,000.00
$350,000.00
$300,000.00
$250,000.00
$200,000.00
$150,000.00
$100,000.00
$50,000.00
$0.00
$178,642.00
$358,000.00
$297,415.00
$500,000
1997
1998
1999
2000 Estimated Project Accomplishments


Program Administration Expenses
$120,000.00
$100,000.00
$80,000.00
$60,000.00
$40,000.00
$20,000.00
$0.00
$104,063.00
$92,000.00
$82,277.00
$55,000
1997
1998
1999
2000 Estimated Program Expenses


1997 TO 1999 COMPLIANCE RATES
FEE TUBES BEGIN MAY
Percent
90
80
70
60
50
40
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
Months
1997 COMPLIANCE
1998 COMPLIANCE
1999 COMPLIANCE

Soils & Ecology

The Soils and Ecology Program cooperates with experiment stations and universities for long-term inventory and monitoring. The general goal is to support forest plan revision, and better estimate environmental effects for single projects. A variety of efforts are underway.

The need to monitor long-term soil productivity originates from the National Forest Management Act. It seeks for the Forest Service to monitor long-term productivity of the land in the broadest sense. This requirement was translated into the Forest Plan monitoring chapter, which seeks to document significant changes in land productivity, and to keep abreast of ongoing related research, especially at the Hubbard Brook and Bartlett Experimental Forests.

The Soils Program has been participating in two significant lines of inquiry related to long-term productivity of the land. First, we are cooperating with Dr. Marie-Louise Smith of the Northeast Research Station (Durham, NH) and scientists at the Complex Research Center at the University of New Hampshire to remotely sense ecosystem structure and function, including forest productivity, a possible indicator of long-term soil productivity. This effort estimates nitrogen and lignin concentrations in forest foliage from imagery taken from a U-2 aircraft that has traversed the White Mountain National Forest. At the same time, foliage was taken from known locations in the forest to confirm the estimates. Tree measurements were also taken at these known locations. Nitrogen concentration is highly affiliated with forest biomass accumulation based on studies at Harvard Forest, and that has proven to be true here, too, based on detailed study at the Bartlett Experimental Forest. This work has now been extended across the White Mountain National Forest, and field verified. This research is showing that the forest is continuing to accumulate carbon, and no apparent diminishment of productivity has occurred. This is not a simple matter, and will be the subject of continuing measurements across the Forest. A further step is underway to examine if the same imagery can be used to successfully estimate stream chemistry, thereby completing a better understanding of the cycling of elements that may affect forest productivity.

The second line of inquiry has to do with acid deposition, and the susceptibility of the forest and its soils to this possible impact, including decline in forest growth. Many believe acid deposition leads to calcium depletion from the soil, which in turn may affect forest productivity. Other long-term forest growth studies relying on long term plots measured since the 1930’s do not support that acid deposition is a factor affecting forest growth in northern hardwoods. Acid deposition is also believed to mobilize aluminum in the soil, which may lead to toxic concentrations in streams, affecting productivity there, too. Dr. Scott Bailey from the Hubbard Brook Experimental Forest has been working to resolve a significant issue related to this concern, and that is the extent to which soils are able to buffer the impacts of acid deposition, and the spatial arrangement across the Forest of differing buffering capacities. This is known as the “till source model”, and it represents mineral weathering across the forest. This is a significant link in understanding possible impacts to forest soils and streams. In this sense, it bears a relationship to the remotely sensed data in depicting the whole picture of forest productivity. A first approximation map of the Forest has been devised showing calcium and magnesium concentrations across the forest in the original soil deposits. The Forest has been helping facilitate this effort by funding field verification work, and computer support from the University of Wisconsin. This winter the forest has assembled the values necessary to support a computer model of forests and soils that may help make the till source model information become useful at a larger scale, say areas less than one thousand acres, as compared to many thousands of acres.

The remotely sensed imagery and till source model are long term efforts to better understand the sustainability of forest productivity, including impacts from atmospheric deposition and timber harvesting. They are part of a continuing effort to better understand the basic biogeochemistry of this forested ecosystem. Hopefully, this will ultimately lead to general direction, standards and guidelines about forest harvesting that have a meaningful connection to forest soils, and those factors that may cumulatively affect its productivity.

The Ecology Program has an interest in continuing to characterize the flora of the Forest, especially as it relates to old growth forest, and research natural areas, and to monitor long-term changes. This past summer, Leslie Teeling, a postgraduate botany student at the University of New Hampshire, did an intense survey of ground floras in old growth northern hardwood forest at the Bowl Research Natural Area. She is doing a similar inventory at an old growth hardwood forest near Shingle Pond this summer. Previously, she studied ground floras at Hubbard Brook Experimental Forest that had had varying degrees of timber harvest, including none in the past eighty years. At the Bowl, she found the flora to be relatively diverse, including many of the same species previously discovered at Hubbard Brook, though the abundance values are higher. Some species were found only at the Bowl, possibly related to soil conditions. A final summary of all this work will hopefully provide useful baseline information on the impacts of timber harvest on flora, which may also prove important in understanding the overall biodiversity of the forest, and the importance of ecological reserves.

In related work, Dr. Gary Wade from the Northeast Research Station (Burlington,Vt) is also funded by the Forest to establish a set of permanent, unmarked plots inside and nearby the Bowl Research Natural Area. The goal is for these plots to serve as long-term reference sites, one of the reasons for establishing Natural Areas. These plots have been established, and plant surveys are soon to begin. Hopefully, these plots will help understand the impacts of timber harvest on ground flora's, thereby supplementing the effort by Leslie Teeling, and, equally important, improve understanding of species migrations as may be affected by factors such as global climate change.

In addition to the above-mentioned inventory and monitoring work directly related to Forest Plan requirements, other important efforts have taken place. The New Hampshire Natural Heritage Inventory Program recently submitted to the Forest its report entitled "Alpine and Sub-Alpine Vegetation of the White Mountain, New Hampshire" done by ecologists Daniel Sperduto (NHNHI) and Charles Cogbill. Alpine and sub-alpine communities are an important part of the biodiversity of the White Mountain National Forest. The goal was to document communities outside the Presidential Range, which has been the most significant study area for alpine communities. Thirty-five peaks outside the Presidentials are documented, all at least an acre in size, and most greater than five acres. Twenty-four of the peaks are above 4000', and eleven are lower between 3500' and 4000'. More than six hundred acres alpine and sub-alpine communities were identified. About seventy alpine plant species occur in the White Mountains that are either rare in New Hampshire or restricted to alpine or sub alpine habitats.

Also, Dr. Ray Spear from SUNY Geneseo collected core sediment samples last year from three moderate to high elevation ponds on the Forest. This is a continuation of earlier core studies on seven ponds across the Forest. Since sampling, he has begun the painstaking analysis. Results, to date, indicate a cool period, or climate reversal, at the end of the last glacial period. While the main thrust of this work relates to global climate change, we are hopeful it will shed some further light on historical changes in vegetation on the Forest landscape, and may provide insight into natural fire regimes.

Timber

In fiscal year 1999 the WMNF (White Mountain National Forest) vegetation management included timber management projects, reforestation and harvest projects. Table 1 shows the acres of reforestation and timber stand improvement done on the Forest in FY 1999 including stocking surveys to determine the establishment of regeneration in previously harvested stands (the first and third years after cutting), site preparation to promote natural stand regeneration, individual tree release of potential crop trees from un-merchantable or un-desirable competition, and pre-commercial thinning to promote growth in the best formed trees and most valuable species from others in a stand. Adequate stocking was found in all stands surveyed in fiscal year 1999 on the WMNF.

Table 2 displays the acres of specific harvest treatment accomplishments and compares the amounts of harvesting done under even-aged management and uneven-aged management. Even-aged cutting methods shown in Table 2 include clearcutting, shelterwood, commercial thinning, and salvage cuts. The selection cutting acres listed under uneven-aged management includes single-tree selection, group selection, and the acres done using a combination of single-tree and group selection.

Table 1 White Mountain National Forest FY 1999 Acres of Reforestation and Timber Stand Improvement Activities

	Activities*			
Districts	**Stocking Surveys**	**Site Prep - Nat Regen**	**Release**	**Precomm Thin**
Ammo	1245	0	0	0
Andro	587	62	0	51
Pemi	573	122	22	0
Saco	312	48	38	0
Forest	***2717***	***232***	***60***	***51***

*Reforestation Activities include stocking surveys and site preparation; TSI activities include release (from non-commercial competition) and precommercial thinning.

Table 2. White Mountain National Forest FY 1999 Acres of Timber Harvest Activities

	Harvest Activities*						
	Even-Aged Management					Uneven-Aged Management	
Districts	Clearcutting	Shelterwood	Thinning	Salvage	Even-Aged Sub-Total	Selection	Grand Totals
Ammo	0	0	21	156	177	768	945
Andro	62	284	201	0	547	591	1138
Pemi	88	54	38	0	180	394	574
Saco	92	13	255	0	360	893	1253
Forest Totals	***242***	***351***	***515***	***156***	***1264***	***2646***	***3910***

*Clearcutting (activity codes 111 & 113); Shelterwood (121 & 131); Selection (151, 152, 153, & 210); Thinning (220); Salvage (232).

Figure 1, Figure 2, and Figure 3 are graphical displays of information in Table 2. Figure 1 shows a comparison of the acres cut on the Forest in 1999, using even- and uneven-aged harvest treatments.

Figure 1. FY 1999 WMNF comparison of timber management systems.

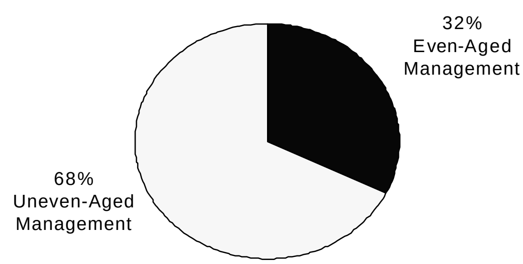


Figure 2. FY 1999 WMNF uneven-aged management.

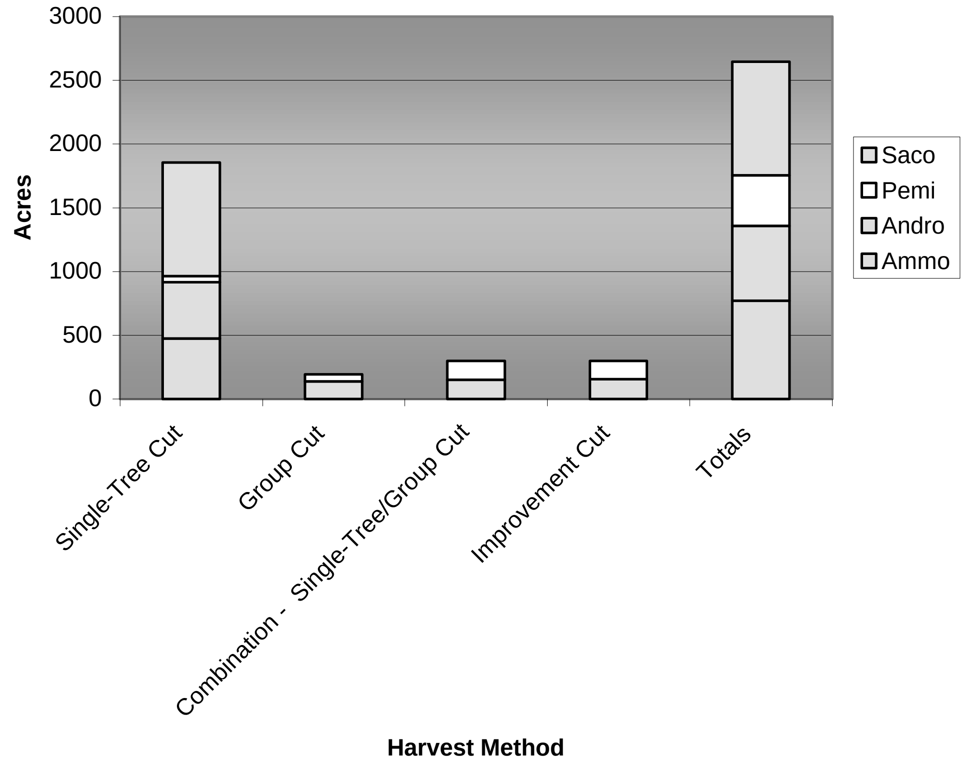
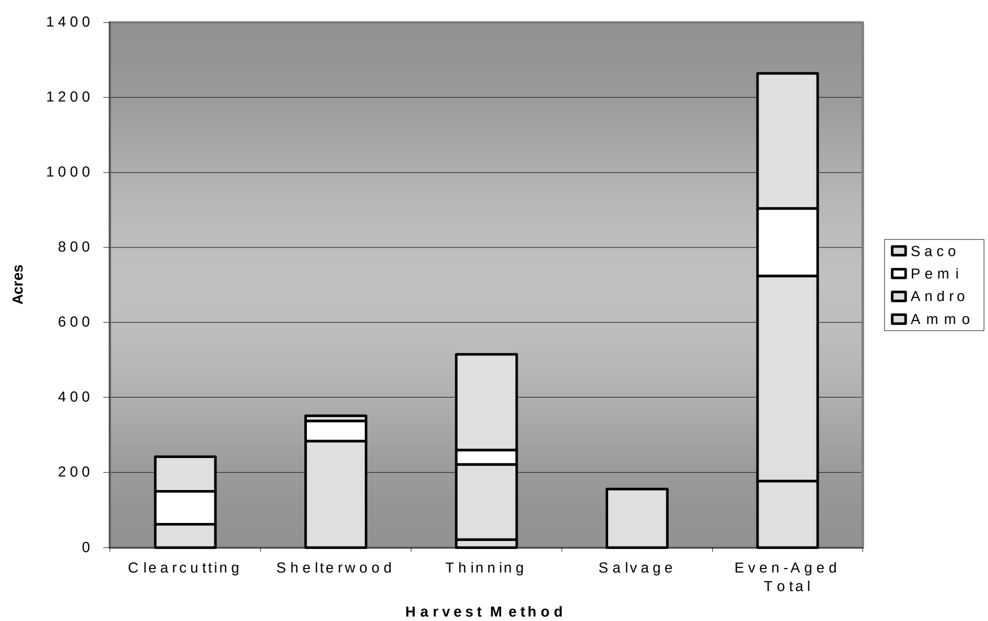


Figure 3. FY 1999 WMNF even-aged Management.



Watershed

The National Forest Management Act and Chapter 4 of the Land and Resource Management Plan provide direction for water quality monitoring on the White Mountain National Forest. These documents say to: 1) characterize existing and background water quality; 2) analyze trends to ensure maintenance of water quality and prevent decline; and 3) evaluate impacts of forest management activities on water quality.

The White Mountain National Forest has monitored water quality at various locations across the Forest at various times since the 1970's. This large database, and other available datasets, provides a characterization of background water quality in White Mountain streams. This information will be compiled and published in a General Technical Report by the Forest Service Northeastern Research Station in 2000. Table 1 shows "typical" water chemistry as determined from analysis of this large database. As seen in the table, the cations in the water are predominantly calcium and the anions are predominantly sulfate. A hydrogen ion concentration of 0.01 mg/l equates to a pH of 5.0.

Table 1. "Typical" water chemistry in White Mountain streams.

	Cations	**Anions**
	mg/l	**mg/l**
Calcium	1.54	
Sodium	1.26	
Magnesium	0.38	
Aluminum	0.26	
Hydrogen ion	0.01	
Potassium	0.31	
Ammonia	0.03	
Sulfate		5.07
Total Alkalinity		3.20
Chloride		1.35
Nitrate/Nitrite		0.72
Total Phosphate		0.04

In 1999, we resumed water quality monitoring on the Forest after a hiatus of several years (monitoring was deferred for several years because of limited dollars and other monitoring priorities). Three watersheds, Swift River, Wildcat River and Upper Ammonoosuc River, were selected for monitoring to analyze trends and to evaluate the impacts of management activities on water quality. Monitoring objectives, sample locations, parameters and sample frequency for each of these watersheds is described below. These three watersheds will be monitored for three calendar years (1999, 2000, and 2001) in order to obtain information on variability in water quality. After these three years, a decision will be made to continue monitoring in these three watersheds or to select other watersheds to monitor.

Forest personnel collected water samples. Temperature, pH, specific conductance, turbidity, bacteria, and alkalinity were measured in the field. The Forest Service Northeastern Research Station completed analysis of the samples for metals and nutrients. Data will be entered into the EPA STORET database and available to the public.

Swift River

The Swift River was chosen to examine the overall effectiveness of Forest Plan Standards and Guidelines in protecting water quality. The Swift River runs easterly from Kancamagus Pass to the Saco River in Conway, NH. This watershed is heavily used and has a variety of activities occurring within it, including timber harvest, campgrounds, day use areas, hiking, mountain biking, swimming, private residences, and a popular State highway. This provides an opportunity to look at cumulative effects on water quality. In addition, water quality in this watershed was monitored in 1968 - 1971, giving us an opportunity to look at trends in water quality over time. Sample points and frequency were chosen to give a fairly intensive look at water quality in this watershed. Samples were collected monthly from March to November at the following nine locations:

Station Number	Description
220001	Swift River at Dugway
220002	Swift River at Church Pond Road
220100	Swift River at Lower Falls
220102	Swift River at Annis Field
220104	Douglas Brook at Bear Notch Road
220157	Swift River at Rocky Gorge
220188	Steam Mill Brook above Kancamagus Highway
220202	Swift River at Sawyer River Trail
220239	Sabbaday Brook above falls

Table 2 and Table 3 show a summary of the water quality data collected from the Swift River Watershed in 1999. Data is summarized by season. While it is difficult to make conclusions from one year's worth of data, several interesting patterns are apparent. In Table 2, water temperature is higher in the Swift River (220001, 220002, 220100, 220102, 220157 and 220202) compared to the tributaries (220104, 220188 and 220239). Water temperature increases going downstream as the river gets wider and is less shaded by riparian vegetation.

Conductivity, which is a measure of the amount of ions in the water, is also higher in the Swift River than in the tributaries. Sabbaday Brook, which drains out of the Sandwich Range Wilderness, and Steam Mill Brook, a relatively undeveloped tributary, had the lowest conductivity, averaging about 20 umhos. Douglas Brook, another tributary, had slightly higher conductivity, perhaps indicating the influence of the houses nearby. Conductivity at the main stem stations was generally in the high 20's to mid-30 umhos, indicating the influence of the Kancamagus Highway and other developments along the river. Conductivity was the highest, by far, at the upstream-most station on the Swift River (Swift River at Sawyer River Trail 220202). Table 3 shows this station had extremely high concentrations of sodium (Na) and chloride (Cl) compared to the other stations, thus explaining the high conductivity readings.

Table 2. Average seasonal water quality data for the Swift River Watershed in 1999. Spring season is average of March – May samples, Summer season is average of June – August samples, and Fall season is average of September – November samples. Bacteria is fecal coliform counts.

Season	Station	Water Temp ° F	Conductivity umhos	pH	Turbidity NTU	Alkalinity mg/l $CaCO_3$	Bacteria cts/100 ml
Spring	220001	45	28	6.0	< 1	1.4	1
Summer	220001	68	35	6.8	< 1	3.2	9
Fall	220001	47	29	6.4	< 1	2.2	7
Spring	220002	40	35	5.8	< 1	1.7	10
Summer	220002	61	41	6.5	< 1	3.1	6
Fall	220002	46	33	6.2	< 1	2.2	4
Spring	220100	43	29	5.9	< 1	1.4	2
Summer	220100	68	35	6.8	< 1	3.3	26
Fall	220100	47	28	6.4	< 1	2.1	5
Spring	220102	44	28	5.9	< 1	1.8	8
Summer	220102	64	35	6.4	< 1	3.6	14
Fall	220102	46	29	6.2	< 1	2.3	5
Spring	220104	41	22	6.1	< 1	2.2	66
Summer	220104	61	29	6.9	< 1	6.0	14
Fall	220104	46	24	6.6	< 1	3.3	9
Spring	220157	42	28	5.9	< 1	1.4	5
Summer	220157	67	34	6.8	< 1	3.3	6
Fall	220157	47	29	6.4	< 1	2.2	3
Spring	220188	41	21	5.4	< 1	0.7	1
Summer	220188	59	19	6.2	< 1	1.5	4
Fall	220188	46	20	6.0	< 1	0.9	3
Spring	220202	38	61	5.6	< 1	1.3	1
Summer	220202	60	59	6.3	< 1	2.3	8
Fall	220202	45	49	6.0	< 1	1.5	5
Spring	220239	39	18	5.9	< 1	1.3	0
Summer	220239	57	21	6.6	< 1	2.5	15
Fall	220239	45	19	6.4	< 1	1.8	1

Water in this watershed is slightly acidic, as shown by the pH measurements in the 6's. Not unexpectedly, pH in the spring is slightly lower than during the summer or fall, as there is a flush of acidic snowmelt runoff. Turbidity in the watershed was very low. In fact, there was only one sample collected the whole year that had turbidity greater than 1 NTU. That sample, which had a turbidity reading of 4.7 NTU, was collected in May from the Swift River at Lower Falls (220100). At the time, there was some construction activity occurring on the Kancamagus Highway near the Lower Falls parking lot. That reading is still within the State standard of 10 NTU for Class B watersheds.

Bacteria concentrations are fairly low. The highest readings were in the summer, which is expected as higher water temperatures are more conducive to bacteria survival. The highest average readings in the summer were at Lower Falls (220100), which is not unexpected due to the high recreation use. High bacteria readings were also recorded for Douglas Brook (220104) and the Swift River at Annis Field (220102), which is just downstream of where Douglas Brook enters the Swift. These could indicate the influence of the houses near Douglas Brook.

Table 3 shows the summary of the metals and nutrients sampled in the Swift River Watershed. In general, the concentrations in the Swift are comparable to the "typical" water chemistry in the White Mountains shown in Table 1. The dominant cations are calcium (Ca) and sodium (Na) and the dominant anions are sulfate (SO_4) and chloride (Cl). The concentrations of sodium and chloride are high compared to the "typical" values and sulfate is lower than the "typical". The high concentrations of sodium and chloride could show the influence of the Kancamagus Highway on water quality in the Swift River. The tributaries stations (220104, 220188 and 220239), which are not influenced by the highway, show the lowest concentrations of sodium and chloride. Sabbaday Brook (220239), which drains the Sandwich Range Wilderness, consistently had concentrations of chloride less than 1 mg/l. As noted previously, the Swift River at Sawyer River Trail (220202) had extremely high concentrations of sodium and chloride compared to the other stations. These concentrations were fairly consistent over the year, so the seasonal average was not influenced by an extreme reading. This result is curious. This site was chosen, along with Sabbaday Brook (220239) to serve as a "control" point, given its location upstream of most of the activity in the watershed. Apparently, there is some sodium and chloride source, perhaps road salt from the Kancamagus Highway, located in the upper portion of the watershed above this sample point. The location in the headwaters does not provide the water to dilute the concentrations. Note that concentrations of sodium and chloride at the next sample point downstream (Swift River at Church Pond Road 220002) are about half of what they are at Sawyer River Trail.

When comparing these data to State of New Hampshire water quality standards and criteria, only one parameter, aluminum (Al), raises a concern. The criterion for freshwater aquatic life chronic exposure for aluminum is 0.087 mg/l. The concentrations of aluminum measured in the Swift River Watershed are consistently greater than this criterion. These concentrations are likely indicative of the influence of acid deposition in the watershed, which is known to affect aluminum movement through the environment.

Table 3. Average seasonal water quality data for the Swift River Watershed in 1999. Spring season is average of March – May samples, Summer season is average of June – August samples, and Fall season is average of September – November samples.

Season	Station	Al mg/l	Ca mg/l	K mg/l	Mg mg/l	Na mg/l	P mg/l	NH_4 mg/l	SO_4 mg/l	NO_3 mg/l	Cl mg/l
Spring	220001	0.30	1.61	0.43	0.19	2.08	0.00	0.01	3.12	1.42	2.80
Summer	220001	0.11	2.12	0.61	0.24	3.12	0.00	0.02	2.93	0.87	3.66
Fall	220001	0.22	1.81	0.47	0.22	2.08	0.00	0.00	3.48	1.27	1.92
Spring	220002	0.38	1.69	0.41	0.18	2.98	0.00	0.00	3.17	1.06	4.49
Summer	220002	0.18	2.26	0.59	0.25	3.73	0.00	0.02	3.02	1.18	3.45
Fall	220002	0.28	1.89	0.45	0.22	2.60	0.00	0.00	3.55	0.93	2.91
Spring	220100	0.38	1.63	0.45	0.19	2.18	0.00	0.01	3.12	1.43	2.91
Summer	220100	0.13	2.16	0.63	0.24	3.00	0.00	0.03	2.99	0.97	3.84
Fall	220100	0.25	1.83	0.49	0.22	2.09	0.00	0.01	3.55	1.25	1.87
Spring	220102	0.32	1.61	0.44	0.18	2.07	0.00	0.02	3.11	1.04	2.63
Summer	220102	0.19	2.22	0.65	0.24	2.85	0.01	0.04	2.93	0.93	2.38
Fall	220102	0.28	1.85	0.49	0.22	2.07	0.00	0.00	3.60	1.06	1.91
Spring	220104	0.17	1.76	0.47	0.19	1.21	0.00	0.02	3.04	1.25	0.89
Summer	220104	0.10	2.59	0.69	0.27	1.77	0.00	0.03	2.54	0.58	1.63
Fall	220104	0.14	2.05	0.52	0.24	1.35	0.00	0.01	3.42	0.93	0.53
Spring	220157	0.34	1.59	0.43	0.18	2.02	0.00	0.02	3.12	1.40	2.63
Summer	220157	0.15	2.17	0.64	0.24	3.00	0.00	0.03	2.94	0.96	3.46
Fall	220157	0.27	1.84	0.49	0.22	2.08	0.00	0.00	3.43	1.27	1.89
Spring	220188	0.30	1.30	0.34	0.18	1.03	0.00	0.01	2.78	2.86	0.89
Summer	220188	0.19	1.30	0.34	0.18	1.45	0.00	0.02	2.96	1.36	1.44
Fall	220188	0.26	1.40	0.35	0.22	1.12	0.00	0.00	3.03	2.76	0.40
Spring	220202	0.69	2.18	0.51	0.14	6.32	0.00	0.00	3.66	1.25	11.04
Summer	220202	0.47	3.12	0.70	0.18	5.97	0.00	0.01	3.42	1.28	10.24
Fall	220202	0.64	2.29	0.51	0.15	4.68	0.00	0.00	4.22	1.22	6.90
Spring	220239	0.24	1.36	0.24	0.21	0.82	0.00	0.01	3.14	1.18	0.45
Summer	220239	0.07	1.71	0.27	0.29	1.20	0.00	0.03	3.41	0.69	0.38
Fall	220239	0.14	1.59	0.24	0.27	0.92	0.00	0.01	3.38	0.71	0.23

Water quality was monitored at two points in the Swift River from 1968 through 1971. These two locations were near Dugway (220001) and below Sabbaday Brook near the Grafton-Carroll County line, (near Church Pond Road 220002). Figure 1 and Figure 2 show the annual average concentration of eight water quality parameters that were measured in 1968 through 1971 and again in 1999 (Calcium (Ca) was not measured in 1968. Sodium (Na) and potassium (K) were not measured in 1971). As shown in the figures, the annual average concentrations of sulfate (SO_4), calcium (Ca), potassium (K), magnesium (Mg), and ammonium (NH_4) measured in 1999 are approximately the same as that measured in 1968 through 1971. The annual average concentration of nitrate-nitrogen (NO_3-N) appears to have increased slightly in 1999 compared to thirty years ago. The concentration of sodium (Na) and chloride (Cl) were much higher in 1999 than in 1968 through 1971.

Figure 1. Comparison of Annual Average Concentration of selected water quality parameters in the Swift River at Dugway (220001) from 1968 – 1971 and 1999.

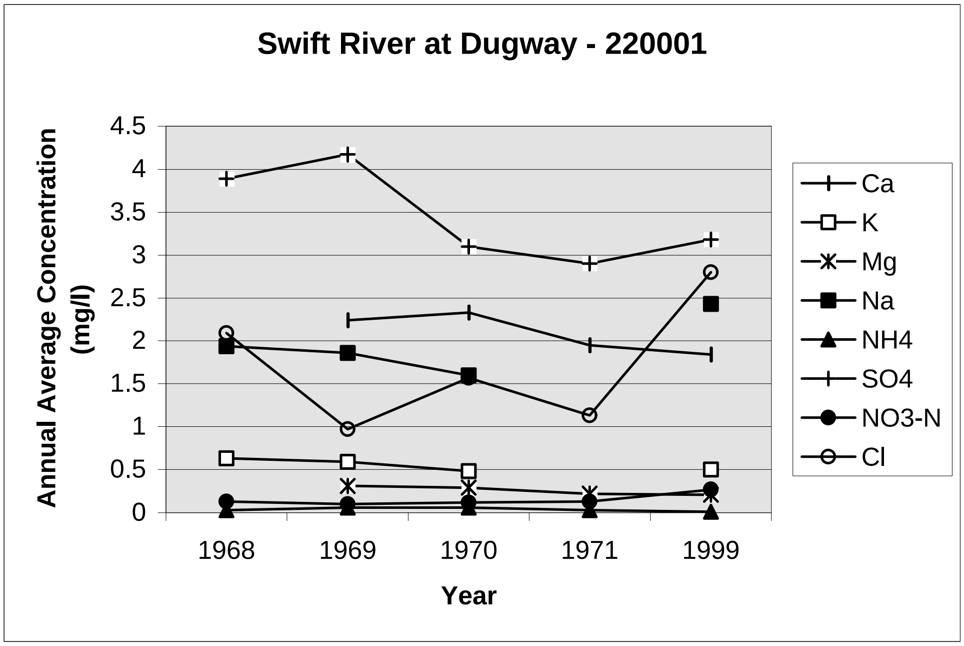
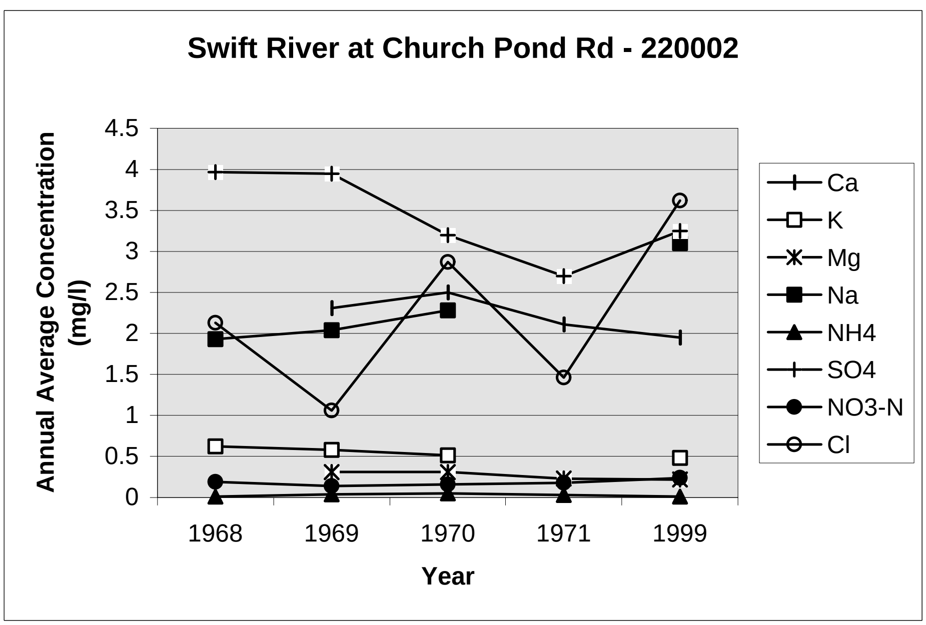


Figure 2. Comparison of Annual Average Concentration of selected water quality parameters in the Swift River at Church Pond Road (220002) from 1968 – 1971 and 1999.



Wildcat River

The Wildcat River was chosen to evaluate water quality and overall effectiveness of Forest Plan Standards and Guidelines in protecting water quality in a designated Wild and Scenic River. This monitoring complements the Wildcat River Conservation Plan. The Wildcat River runs south from Carter Notch to the Ellis River in Jackson, NH. Water quality in this watershed was monitored from 1988 to 1995, providing an opportunity to look at trends in water quality over time. Sample points and frequency were chosen consistent with the previous monitoring in the watershed. Samples were collected in spring, summer and fall at the following seven locations:

Station Number	Description
220261	Bog Brook at Forest Road 233
220262	Wildcat River at Forest Road 233
220262	Wildcat River at road to Black Mountain Trailhead
220264	Wildcat River at Rte. 16B
220265	Great Brook at Wilson Road
220266	Wildcat River at Valley Cross Road
220267	Wildcat River upstream of confluence with Ellis River

Table 4 and Table 5 show water quality data collected in the Wildcat River watershed in 1999. The data shows similar patterns to that seen in the Swift River data. Conductivity is low, near 20 umho's in the upper part of the watershed and increasing to the high-30's umhos in the lower part of the watershed where there is private land developments. The water is slightly acidic, with pH's in the high 6's. The spring samples had lower pH, reflecting the more acidic snowmelt runoff. Turbidity was very low. Bacteria, which was measured as fecal coliform, was higher at the downstream stations.

Table 4. Water quality data measured in Wildcat River Watershed in 1999. Bacteria is fecal coliform counts.

Season	Station	Water Temp ° F	Conductivity umhos	pH	Turbidity NTU	Alkalinity mg/l $CaCO_3$	Bacteria cts/100 ml
Summer	220261	55	19	6.7	< 1	2.4	11
Fall	220261	39	21	6.4	< 1	2.5	3
Summer	220262	55	19	6.7	< 1	2.6	14
Fall	220262	40	20	6.5	< 1	2.5	2
Spring	220263	35	20	6.2	< 1	1.4	5
Summer	220263	60	19	6.8	< 1	2.8	10
Fall	220263	40	21	6.5	< 1	2.7	4
Spring	220264	37	18	6.2	< 1	1.4	1
Summer	220264	62	21	6.8	< 1	2.8	1
Fall	220264	42	22	6.4	< 1	2.9	5
Spring	220265	38	25	6.4	< 1	1.9	11
Summer	220265	62	34	7.1	< 1	4.9	41
Fall	220265	43	34	6.7	< 1	4.4	20
Spring	220266	39	32	6.2	< 1	1.8	12
Summer	220266	66	26	6.9	< 1	3.6	45
Fall	220266	42	28	6.5	< 1	3.8	18
Spring	220267	40	30	6.2	< 1	2.2	2
Summer	220267	67	31	7.0	< 1	4.0	30
Fall	220267	43	42	6.6	< 1	4.0	21

Metals and nutrients results are shown in Table 5. Water chemistry is similar to the "typical" water chemistry of the White Mountains shown in Table 1. Cations are predominantly calcium

(Ca) and sodium (Na) and the dominant anions are sulfate (SO_4) and chloride (Cl). However, the concentrations of most ions in the Wildcat are lower than the "typical" values, particularly sodium, chloride, sulfate and aluminum (Al). Although the aluminum concentrations are lower than the "typical" value, they are near the water quality criteria for freshwater aquatic life chronic exposure value of 0.087 mg/l.

Table 5. Metals and nutrients measured in the Wildcat River Watershed in 1999.

Season	Station	Al mg/l	Ca mg/l	K mg/l	Mg mg/l	Na mg/l	P mg/l	NH_4 mg/l	SO_4 mg/l	NO_3 mg/l	Cl mg/l
Summer	220261	0.10	1.34	0.35	0.56	0.84	0.01	0.01	3.63	0.09	0.47
Fall	220261	0.07	1.29	0.37	0.59	0.79	0.00	0.02	4.11	0.09	0.30
Summer	220262	0.08	1.18	0.33	0.62	0.83	0.00	0.01	3.55	0.09	0.38
Fall	220262	0.07	1.16	0.32	0.63	0.77	0.00	0.02	4.02	0.04	0.29
Spring	220263	0.11	1.15	0.29	0.46	0.72	0.01	0.01	3.76	0.13	0.64
Summer	220263	0.09	1.36	0.36	0.56	0.94	0.01	0.01	3.42	0.04	0.48
Fall	220263	0.08	1.28	0.38	0.58	0.92	0.01	0.01	4.08	0.04	0.40
Spring	220264	0.10	1.08	0.26	0.42	0.75	0.00	0.01	3.38	0.09	0.76
Summer	220264	0.09	1.46	0.35	0.61	0.98	0.01	0.03	3.54	0.04	0.70
Fall	220264	0.07	1.43	0.43	0.59	1.13	0.00	0.02	4.17	0.04	0.63
Spring	220265	0.09	1.27	0.29	0.36	1.64	0.00	0.02	3.25	0.13	2.35
Summer	220265	0.08	2.16	0.58	0.60	2.75	0.01	0.00	3.07	0.40	3.34
Fall	220265	0.07	2.07	0.58	0.59	2.51	0.01	0.01	3.73	0.04	2.79
Spring	220266	0.10	1.35	0.31	0.44	1.38	0.00	0.01	3.48	0.18	1.96
Summer	220266	0.09	1.79	0.46	0.61	1.54	0.00	0.03	3.56	0.09	1.46
Fall	220266	0.07	1.86	0.50	0.64	1.83	0.00	0.01	4.13	0.09	1.82
Spring	220267	0.09	1.51	0.35	0.47	2.09	0.00	0.02	3.53	0.22	3.38
Summer	220267	0.09	1.94	0.54	0.63	2.21	0.01	0.02	3.61	0.09	2.61
Fall	220267	0.07	2.11	0.59	0.68	2.83	0.01	0.00	4.18	0.18	3.67

Water quality in the Wildcat River Watershed was monitored from 1991 through 1995 at these same sampling stations. Figure 3 shows the annual average conductivity measurements at these stations in 1991 through 1995, and 1999. As shown in the figure, it appears that conductivity, which is a general measure of water quality, was approximately the same in 1999 as it was in 1991 through 1995 at all stations within the watershed. The only station that shows an apparent difference is 220265 (Great Brook at Wilson Road), which shows a decrease in conductivity in 1999 compared to 1991 through 1995. This figure also shows that conductivity increases in the lower part of the watershed, showing the influence of development on water quality. Stations 220261, 220262, 220263 and 220264 are located in the upper part of the watershed on streams that drain primarility White Mountain National Forest land. These stations all show an average conductivity of about 20 umhos. Stations 220265, 220266 and 220267 are located in the lower part of the watershed, near or in the Town of Jackson. These three stations all have conductivity readings greater than 25 umhos.

Figure 3. Annual average conductivity in the Wildcat River Watershed in 1991 – 1995 and 1999.

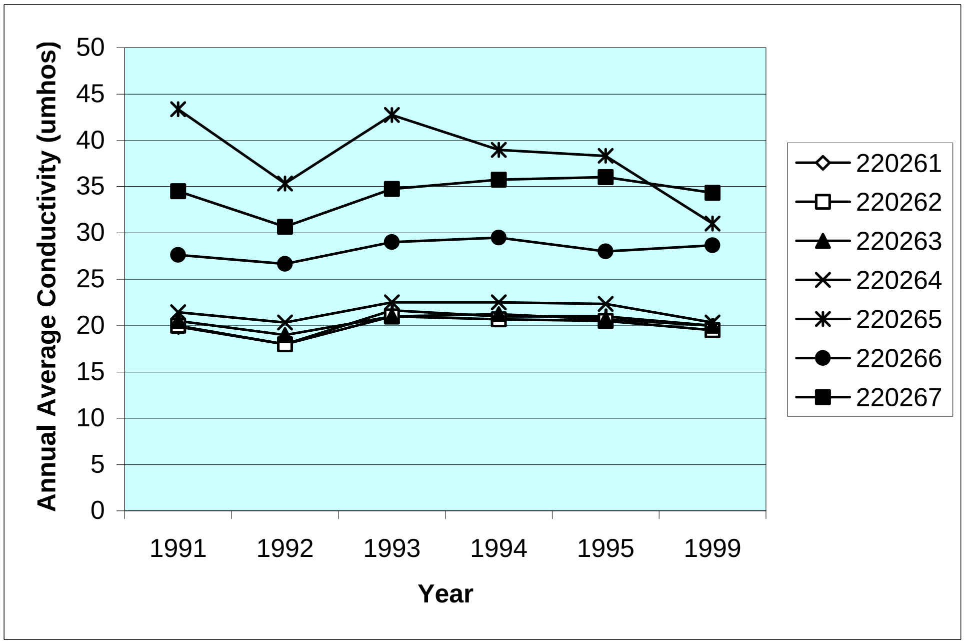


Figure 4 shows the annual average concentrations of the major metals and nutrients in the water at station 220265 (Great Brook at Wilson Road) in 1991 through 1995 and 1999. As seen in the figure, the annual average concentration of sulfate (SO_4), sodium (Na), and chloride (Cl) were each about 1 mg/l lower in 1999 compared to that measured in 1991 through 1995. This would explain the decrease in conductivity seen in 1999. As seen in Figure 5, conductivity appears to be strongly related to the concentrations of sodium and chloride, but not to concentrations of sulfate. The other constituents remained about the same in 1999 compared to 1991 through 1995.

Figure 4. Annual average concentrations of metals and nutrients at Station 220265 (Great Brook at Wilson Road) in 1991 – 1995 and 1999. Open symbols (Al, K, Mg, and NO3-N) are plotted against the left y-axis and closed symbols (Ca, Na, SO4, and Cl) are plotted against the right y-axis. Values shown for 1992 may not be truly representative of annual average water quality conditions as there were only two samples taken at each station, whereas in the other years, there were three or more.

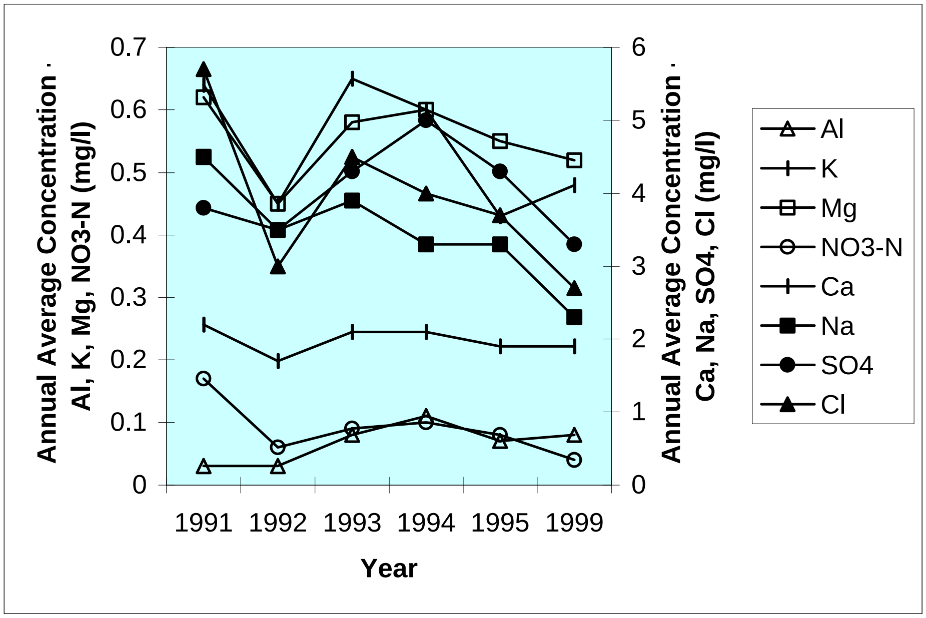
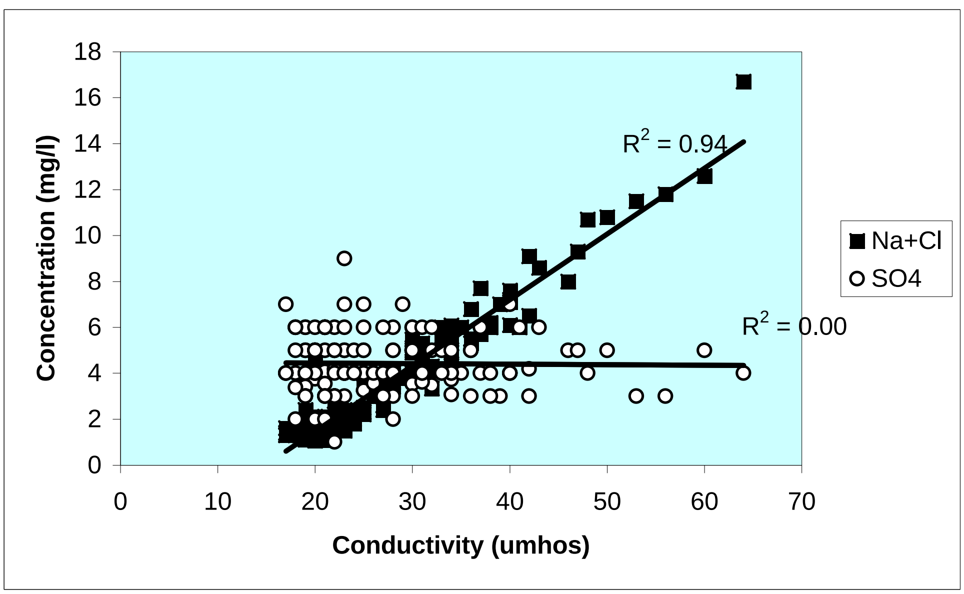


Figure 5. Relationships between the concentration of Sodium + Chloride (Na + Cl) and Sulfate (SO4) versus Conductivity in the Wildcat River Watershed. Plot is all data collected in the Wildcat River watershed from 1991 through 1999.



Upper Ammonoosuc River

The headwaters of the Upper Ammonoosuc River was chosen to evaluate water quality and overall effectiveness of Forest Plan Standards and Guidelines in protecting water quality in a municipal watershed. A tributary of the Connecticut River, the headwaters of the Upper Ammonoosuc River in the Kilkenny provides municipal water to Berlin, NH. The Management Area assignment in this watershed is primarily 3.1, which allows timber harvest. Sample points and frequency were chosen primarily to evaluate the effects of timber harvest and associated activities on water quality. Samples were collected in spring, summer and fall at the following four locations:

Station Number	Description
220075	Upper Ammonoosuc River at Forest Road 15 near 8 mile mark
220076	Upper Ammonoosuc River at Upper Ammonoosuc Trail
220093	Upper Ammonoosuc River above Godfrey Reservoir
220094	Brandy Brook at Forest Road 15

Table 6 and Table 7 show water quality data measured in the Upper Ammonoosuc River Watershed in 1999. The Upper Ammonoosuc River flows through a broad wetlands area partially maintained by beaver activity and this is reflected in the water quality. This is the first year of data from these sample points, so it is difficult to make any conclusions from the data. It appears conductivity is lower in the spring than in the summer or fall. This could be the high volume of snowmelt runoff diluting the ions in the water. The water is slightly acidic, with pH in the 6's. Turbidity is very low. Bacteria is fairly high, which is probably due to the animal activity in the watershed.

Table 6. Water quality data measured in the Upper Ammonoosuc River Watershed in 1999. Bacteria is fecal coliform counts in summer and fall samples, Eschericia coli in the spring samples.

Season	Station	Water Temp ° F	Conductivity umhos	pH	Turbidity NTU	Alkalinity mg/l $CaCO_3$	Bacteria cts/100 ml	Comments
Spring	220075	52	15	6.5	< 1	3.0	4	E. coli
Summer	220075	63	31	7.0	< 1	7.1	15	
Fall	220075	45	28	6.6	< 1	5.6	10	
Spring	220076	54	23	6.4	< 1	3.1	23	E. coli
Summer	220076	64	35	6.5	4.7	7.7	231	Moose in water upstream
Fall	220076	46	32	6.3	1.5	4.8	75	
Spring	220093	52	18	6.5	1.7	3.1	61	E. coli
Summer	220093	67	30	7.1	1.7	6.9	50	
Fall	220093	46	27	6.6	< 1	5.5	48	
Spring	220094	56	13	6.7	< 1	3.1	1	E. coli
Summer	220094	68	21	6.8	1.8	4.0	63	
Fall	220094	46	22	6.6	< 1	3.7	30	

Metals and nutrients results are shown in Table 7. Water chemistry is similar to the "typical" water chemistry of the White Mountains shown in Table 1. The dominant cation is calcium (Ca) and the dominant anion is sulfate (SO_4). The only values that raise a concern are the aluminum concentrations, which are much higher than the water quality criteria for freshwater aquatic life chronic exposure value of 0.087 mg/l.

Table 7. Metals and nutrients measured in the Upper Ammonoosuc River Watershed in 1999.

Season	Station	Al (mg/l)	Ca (mg/l)	K (mg/l)	Mg (mg/l)	Na (mg/l)	P (mg/l)	NH_4 (mg/l)	SO_4 (mg/l)	NO_3 (mg/l)	Cl (mg/l)
Spring	220075	0.26	2.17	0.38	0.51	0.89	0.01	0.00	4.00	0.49	0.56
Summer	220075	0.11	2.94	0.46	0.77	1.48	0.01	0.02	3.74	0.53	0.49
Fall	220075	0.11	2.54	0.47	0.69	1.23	0.00	0.00	4.50	0.18	0.31
Spring	220076	0.27	2.23	0.34	0.55	0.97	0.01	0.00	3.75	0.58	0.54
Summer	220076	0.27	3.14	0.50	0.83	1.50	0.02	0.04	3.72	0.31	0.53
Fall	220076	0.18	2.47	0.43	0.68	1.28	0.01	0.01	4.59	0.09	0.35
Spring	220093	0.33	2.30	0.35	0.57	0.95	0.01	0.00	3.96	0.58	0.60
Summer	220093	0.15	2.84	0.40	0.73	1.40	0.01	0.00	3.86	0.13	0.50
Fall	220093	0.14	2.48	0.40	0.67	1.23	0.00	0.01	4.56	0.04	0.35
Spring	220094	0.14	1.88	0.22	0.45	0.78	0.01	0.00	2.99	0.18	0.33
Summer	220094	0.18	2.12	0.23	0.50	1.02	0.03	0.01	3.32	0.44	0.41
Fall	220094	0.10	1.89	0.33	0.50	0.97	0.01	0.02	4.22	0.09	0.24

Wildlife

Animal and Plant Species
Federally Listed, Regionally Sensitive, and Species of Special Interest

Wildlife Biologists on the White Mountain National Forest (WMNF) found 1999 to be one of, if not "the," busiest and most demanding years they could remember. The pace actually began to accelerate in July of 1998. At that time the Canada lynx was proposed for federal listing by the U.S. Fish and Wildlife Service (FWS) as threatened under the Endangered Species Act (ESA). The Forest responded by proposing to serve as a pilot forest to test a new survey ("hair snare") protocol. The Forest was selected and received Washington Office funding for the survey. October 1999 found biologists on the WMNF laying out transects to survey lynx habitat on the Forest.

In addition, the Forest had initiated work on a programmatic biological assessment to determine possible effects of continued implementation of the existing Forest Plan on federally listed or proposed threatened or endangered species. This was necessary, not only as a result of the proposed listing of the Canada lynx but also, due to recent information that indicates the federally endangered Indiana bat may occur on the Forest.

As a result, the biologists were required to review all ongoing projects (forty-five) to ensure consistency with the ESA. By January of 1999 district biologists found themselves busy amending biological evaluations for ongoing projects to include determinations of effects to the lynx and Indiana bat. These amendments were submitted to the FWS in February for adequacy review (informal consultation) and a letter of concurrence was received in March of 1999.

On September 23, 1999, the Forest submitted the programmatic biological assessment to the FWS and requested initiation of formal consultation under the ESA. The consultation, that concerns possible effects of continued implementation of the existing Forest Plan on federally listed or proposed threatened or endangered species, has recently been completed and will lead to a Forest Plan Amendment.

Field season FY99 found WMNF biologists busy coordinating partnership efforts, contracts, and personally assisting with maintenance on 145 acres of wildlife openings and apple orchards, maintenance and monitoring of 120 duck nest boxes, as well as survey and monitoring efforts that were conducted on over 34,000 acres of National Forest lands. Survey and monitoring efforts were directed at several species groups as well as individual species and had various objectives as follows:

Surveys of suitable habitat to determine the presence of Canada lynx were conducted on approximately 32,000 acres using the survey protocol recently developed by the Rocky Mountain Research Station (RMRS). Twenty-five transects 500 meters in length with 5 detection stations ("hair snares") each, were arranged across National Forest lands in lynx habitat. Transects were inspected twice during a two week period to determine if detection of any wildlife species occurred. Thirteen detection’s occurred and have been sent to the RMRS for DNA analysis. The analysis will determine if the hair is from lynx, bear, bobcat, or some other animal. Results are expected later this spring.

Monitoring, to determine nesting success, was conduced on six peregrine falcon nesting territories (30 acres) on the WMNF in cooperation with Audubon Society of New Hampshire. Results of the monitoring indicated that five nest territories were occupied and although three pair incubated eggs, only two pair produced young. A total of seven young were fledged from National Forest nest sites. In August of 1999 the U.S. Fish and Wildlife Service issued a final rule to delist the peregrine falcon. The WMNF is committed to continue monitoring of peregrine falcon nesting success in an appropriate manner to assure continued recovery of the species.

Monitoring was conducted to determine total populations and long-term trends of two federally listed plants that occur on the WMNF (Robbins' cinquefoil and small-whorled pogonia).

Robbins' cinquefoil is a federally endangered, endemic species that occurs only on National Forest lands on Mt. Washington. The U.S. Fish and Wildlife Service and the U.S. Forest Service developed a species recovery plan in 1983. Recovery efforts through transplanting and protection as well as monitoring efforts have been underway since 1986 and will continue. Efforts in 1999 included transplanting to supplement two established populations, one of which has shown significant recovery. Monitoring of existing populations was conducted to document current numbers of plants and age ratios of young to mature. This information will be used to determine long-term trend of the (sub) populations and the species overall. The Appalachian Mountain Club, the principal investigator in the monitoring and recovery efforts, will publish results of the monitoring later this spring.

Small-whorled pogonia, a federally threatened species, is known to occur at three locations on National Forest lands. The 1992 Revised Recovery Plan developed by the FWS guides management of the species. Monitoring objectives and direction is provided in the Recovery Plan. Monitoring of sites on the WMNF has been ongoing since initial discovery in July of 1993, to determine total plant numbers and overall trend of the populations. Evaluation of monitoring data indicates no significant change in population levels since the original discovery.

Surveys of proposed project areas to determine the presence of rare plants (federal or state listed endangered or threatened, Regional sensitive) plants and exemplary plant communities. The New Hampshire Natural Heritage Inventory (NHNHI) was employed by the WMNF to conduct review and survey of proposed timber sales and recreation project areas being planned by the Forest. NHNHI uses a two step process for locating rare and exemplary communities. Landscape scale analysis is the first step and is used to identify areas with a high likelihood of supporting rare species and communities. The second step is field survey and assessment of sites, identified through landscape analysis, to be high probability habitat for rare plants and exemplary communities. In 1999, NHNHI did not locate exemplary communities or rare plants in any of the surveyed timber sale areas. They did find three exemplary communities as well as a State-threatened plant (Pickering's reed bent-grass) in a proposed recreation project area. This information will be used in the preparation of the environmental affects analysis and subsequent decision on implementation of the project.

Determine habitat condition and use of known white-tailed deer winter yards. Surveys were conducted on 40 acres of historic white-tailed deer winter yards to document current use. Deer numbers have generally been down in recent years at winter yards. This trend continues. It is generally believed that this is reflective of the relatively mild winters in recent years but may also be an indication that population numbers are down in areas surveyed.

Determine project effectiveness by monitoring the use of project areas by Management Indicator Species. Post project effectiveness monitoring is conducted to determine if the wildlife habitat objectives of a project proposal achieved the desired results. Monitoring was conducted on recently harvested timber units to determine if Management Indicator Species, indicative of certain habitat conditions, were present in the post harvest areas. Management Indicator Species are species that represent the habitat needs of a much larger group of species and may be used as a surrogate for one to many species. Presence and use of the project area by MIS are indicative of habitat conditions that will support those specific species dependent on habitat conditions associated with the respective MIS specie(s). Monitoring for the presence and use of the project area by Management Indicator Species in the project area is the typical method used to determine if objectives identified in the project analysis were accomplished.

Monitoring, to determine long term population trend of bird species, as directed by the Committee of Scientists (1992), was conducted on 1,455 acres of National Forest lands. The WMNF has procured services from the University of Vermont's Special Analysis Laboratory and the Northeast Forest Experiment Station to analyze the past eight years of monitoring data to determine any significant changes in individual species populations. Results of these analyses should be available this summer.

Surveys, to provide important information on Bicknell's thrush, an endemic bird species of the northeast's spruce-fir forests, were conduced on approximately 150 acres of high elevation habitat (spruce/fir forest) for associated bird species.

Survey and monitoring to determine presence and relative activity by woodland bats was conducted at a proposed administrative facility and a alpine ski area. Fourteen hours of monitoring at four different locations, using two Anabat detection systems was accomplished during a two night period at the proposed administrative site. A total of 523 anabat files were recorded. Four nights of monitoring at eleven different locations, using three Anabat detection systems, totaling 37 1/2 hours was conducted at the alpine ski area. A total of 152 call files were recorded.

It must be emphasized that although the Anabat system can detect bat activity there are limitations to the technology. Bat detectors do not detect all species equally well. We are not able to distinguish between multiple passes by a single bat vs. single passes by several bats. Therefore, our analysis provides an index to bat activity but not relative numbers of bats present (i.e., bat abundance). We should also note that at this time we are limited in our ability to identify specific species of bats using the Anabat detection system alone. As local call libraries are developed and as biologists gain experience with the equipment it is reasonable to believe some identification to genera will be possible.

The main objectives of these studies were twofold: 1) to gain experience and ability using a relatively new and highly sophisticated electronic survey device. 2) to document baseline information and provide an index to relative bat activity on two proposed project areas.

We must emphasize that due to the limited experience of the biologist using the equipment, as well as some inherent limitations of the equipment, findings at this time are subjective. Much of this data is still being analyzed and results, when available, will be published in a formal report.

Other survey and monitoring efforts conducted on the WMNF in FY 1999 included work by individuals, organizations, or agencies other than the WMNF. A brief review of these findings are:

Forest bat use of patch cuts on Bartlett Experimental Forest, principal investigator: Mariko Yamasaki, Northeastern Research Station, Durham, NH. Surveys were conducted to 1) document forest bat foraging activity associated with patch cuts (3 to 6 acres) relative to adjacent forest stands and other forest habitats in and around the Bartlett Experimental forest using ultrasonic detection techniques; and 2) document the relative species occurrence of those bats most likely to be caught using mist netting procedures. Results of this effort are preliminary and unavailable at this time.

Breeding Bird Benchmarks from Minimally Disturbed Forests in New Hampshire (The Wilderness Society 1999), principal investigator: Carol R. Foss, Consulting Biologist. A 24 hectare area of northern hardwoods was sampled in the Mountain Pond Proposed Research Natural Area on the WMNF. The primary objectives were to collect information on breeding status and relative abundance of birds in pristine examples of representative forest types. Information will be used to establish benchmarks for evaluation of biological integrity of forests. This was an independent study and the results are proprietary information of The Wilderness Society.

The second year, of a multi-year population and nesting inventory of the American pipit, a songbird of the alpine habitat zone on Mount Washington, was conducted by the Audubon Society of NH, Chris Martin, Senior Biologist and principal investigator. This was an independent study and the results are proprietary information of The Wilderness Society.

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