2000
MONITORING REPORT

WHITE MOUNTAIN NATIONAL FOREST

Copies of this report are available from:

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Thank you for requesting a copy of the 2000 Annual Monitoring Report for the White Mountain National Forest. This report focuses on the progress made toward achieving twelve goals in the 1986 Forest Plan. The individual resource sections summarize work accomplished during the fifteen years that the Forest Plan has been in effect.

I would like to thank the resource professionals whose work is reflected in this report – Forest Service employees and experimental stations, experimental forests, other federal and state agencies, colleges and universities. I would also like to thank many individuals and organizations for contributing their efforts on behalf of the White Mountain National Forest. I look forward to continuing these cooperative relationships.

Please feel free to communicate with us about the content of the report.

Sincerely,

Thomas G. Wagner
Forest Supervisor

EXECUTIVE SUMMARY

The purpose of the 2000 Monitoring Report is to evaluate progress the White Mountain National Forest has made toward achieving goals described in the 1986 Forest Plan (Land and Resource Management Plan, White Mountain National Forest). The report provides a general assessment of some key resource areas. It will focus on Research Natural Areas, Recreation, Wildlife, Vegetation Management, Soil Productivity and Water Quality. Information in the monitoring report will be useful in Forest Plan Revision. The monitoring report will provide information, data, and evaluation to better understand the need for change.

RESEARCH NATURAL AREAS

Research Natural Areas (RNAs) are part of a national network of ecological areas designated for research and education or to maintain biological diversity on National Forest System lands. There are three designated RNAs, nine candidate RNAs, and three areas to consider for future RNAs. Candidate RNAs are protected for future evaluation and designation and will be considered in Forest Plan revision. The Forest is achieving the goal to work with research and academic communities to identify RNAs.

DESIGNATED RESEARCH NATURAL AREAS

- ✓ Bowl RNA, 510 acres of old-growth northern hardwood forest, established in 1931
- ✓ Alpine Garden RNA, 300 acres of old-growth northern hardwood forest, established in 1989
- ✓ Nancy Brook RNA, 2,000 acres of old-growth northern hardwood forest, established in 1991

CANDIDATE RESEARCH NATURAL AREAS

- ✓ Bowl Extension, 1,000 acres of old-growth hardwood forest, establishment report is prepared.
- ✓ Mountain Pond, 300 acres of old-growth hardwood forest, establishment report is prepared.
- ✓ Monroe Flats, 45 acres of alpine area, not evaluated.
- ✓ Owl's Head, 70 acres of hardwood forest on talus slopes, not evaluated
- ✓ Cone Pond, 160 acres of geologic and hydrologic interest, research site for acid deposition.
- ✓ Peabody Mountain, 230 acres, review shows no special values related to RNA designation.
- ✓ Church Pond Bog, 300 acres, does not fit any categories for RNA designation. Should be considered for a different management area designation.
- ✓ Gibbs Brook, 1,650 acres, scenic area, should be considered for designation.

POSSIBLE FUTURE CANDIDATE RESEARCH NATURAL AREAS

- ✓ Shingle Pond , potential old-growth hemlock, spruce and northern hardwoods, evaluation data is being studied to determine the potential for RNA designation.
- ✓ Bowl extension II, needs further examination
- ✓ Rattle River, a small watershed that needs further examination, may have potential for long-term water quality monitoring.

RECREATION

The Forest Plan identifies three goals for recreation:

- ✓ Feature quality recreation opportunities not likely to be provided elsewhere.
- ✓ Recognize the demand for, and importance of day-use areas and driving for pleasure as part of the Forest's total recreation opportunity spectrum.
- ✓ Recognize the need for the Forest user to bear a share of management costs through continued use of volunteer programs, payment for services, cooperative agreements, voluntary contributions and donations.

The Forest has met the goal of featuring recreation opportunities not likely to be found elsewhere, with a particular emphasis on non-motorized dispersed recreation. There is a range of recreation opportunities from highly developed to primitive. There are many types of recreation activities that rely on the Forest's unique setting. Questions the Forest should continue to address: Are quiet times of the year becoming so busy that every season is high use? Will the range of opportunities become smaller as use increases? Can management techniques keep up with potential social and ecological impacts?

The Forest is recognizing the importance of day-use and driving for pleasure through continuing investment in day-use areas and facilities to support driving for pleasure such as parking areas and restroom facilities. The Kancamagus Highway Plan includes improved parking, picnic areas, and interpretive sites. Improvement of Route 112 through Kinsman Notch includes new parking for buses and cars, and a scenic overlook. The Forest continues to put a substantial effort into maintaining and monitoring its effects on scenic quality.

The Forest relies on volunteerism to support resource needs. Examples include services by individuals, organizations, and clubs for trail maintenance, search and rescue, and visitor information. The White Mountain Interpretative Association generated revenues for interpretive programs. Friends of Tuckerman Ravine provide citizen support to protect this area, including donating two-way radios to the Forest Service. The fee demonstration program has made it possible for the Forest Service to retain and apply fees to local projects. Some accomplishments in 2000 include 700 miles of trail maintenance and patrol, 32 campground interpretive programs, repair of cabins, shelters and tent platforms, and mowing of wildlife openings at Camp Stark.

WILDLIFE

The Forest Plan Goal for wildlife is to: Feature management for indigenous wildlife species including those that require old-growth habitat, threatened and endangered species, and sensitive/unique species. Restore and maintain the biological diversity of indigenous aquatic biota and associated habitat. Recognize the demand for non-consumptive uses of wildlife, including opportunities to observe.

The Forest tracks hundreds of species by focusing on three primary categories: 1) Federally endangered and threatened species under the Endangered Species Act; 2) Species listed by the Regional Forester as sensitive; and 3) Management Indicator Species, that represent a broad range of habitat conditions across the Forest.

Federally listed species are doing well on the Forest. The delisting of peregrine falcon and probable delisting of Robbins' cinquefoil are direct results of cooperative partner efforts, combined with access closures as prescribed by Forest Plan standards and guidelines. Education outreach has also been instrumental in gaining support for these species from hikers and rock climbers. Monitoring will continue for these species in the near future to assure populations are maintained. Three species were added to the list

since 1986 as a result of occurrences on the Forest or national listing efforts, including Indiana Bat, Small Whorled Pagonia and Canada Lynx.

The Regional Forester sensitive species list designates rare species that may require closer attention to preclude listing at the federal level. The Region created listing criteria in 1990 and updated the list again in 1994. A new process for updating the sensitive species list was adopted in 1999. The most recent updated list was completed in 2000 and resulted in 30 species designated sensitive on the Forest. Some species that are naturally rare remained on the list. Other species were removed from the list because of the new listing criteria. Following the update, the Forest Plan was amended to clarify direction regarding protection of sensitive species. Conservation assessments were initiated for nine species. The assessments and subsequent analysis of conservation approaches will lead to refinements in monitoring strategies and possibly more specific management direction.

The Forest monitors 16 Management Indicator Species to determine population and habitat trends. Evaluation shows most species to be stable or increasing in terms of populations and habitats. The one exception may be some species representing early successional habitats. It appears that these changes reflect the steady increase of stand growth as the Forest ages.

VEGETATION MANAGEMENT

The two primary goals for vegetation management in the Forest Plan are:

- ✓ Feature northern hardwood management over softwood. Move toward the culturing of high quality hardwoods that are in demand for specialty products. Assure a stable, reliable source of this raw material to support community stability.
- ✓ Use timber management as one of the tools available to achieve the desired future condition and integrated resource objectives of certain management areas.

Harvesting has taken place at a level below that which was envisioned in the Forest Plan. The average annual harvest allowed for this planning period was 35,000 MBF. The volume of timber sold in the first 12 years of the planning period averaged 24,000 MBF per year and declined from 30,000 MBF early in the period to 20,000 MBF in more recent years.

Timber management projects have been used to accomplish integrated objectives. The goal of high quality hardwood production is compatible with the integration of multiple resource objectives in the implementation of the vegetation management program.

SOIL PRODUCTIVITY

The Forest Plan goal is to: Conduct all management activities to protect soil and water resources.

Conserving long-term soil productivity includes managing soil nutrients. Improved management practices have minimized the importance of soil erosion to soil productivity. The soil calcium level is now considered a potentially more important indicator of soil productivity. Calcium is important to tree structure and the passage of nutrients within the tree. Analysis of site-specific tree data collected since the 1930s indicates forest productivity is stable over time, despite the potential impacts of acid deposition and timber harvest on soil calcium. Measurement of forest canopy nitrogen also indicates forest growth is consistent.

Forest health and species composition are also possible indicators of change in soil productivity. The symptoms of poor health might include unusual tree mortality, branch dieback or changes in crown vigor. Long-term studies at the Bartlett Experimental Forest (NH) in locations with well-known land use history do not indicate forest species changes are occurring. The Bartlett Experiment Forest has a network of forest plot locations measured since the 1930s. The White Mountain Region is part of a northeastern study of sugar maple decline extending from western Pennsylvania to Maine. In the Allegheny Plateau of Pennsylvania where soils are very old, it has been determined that soil calcium and magnesium limitations are predisposing factors along with drought and insects that lead to unusually high rates of sugar maple death.

In New England some hardwood forests have low amounts of calcium in the foliage and tree health ratings are poor, but significant evidence of large-scale dieback is not evident. Long-term studies on the status of soil calcium are continuing in the White Mountain Region. The evidence does not appear to indicate a measurable change in soil or forest productivity. The Forest is meeting its goal to maintain close cooperation with the research community on this issue.

WATER QUALITY

There are fourteen municipal watersheds on the Forest. Water quality monitoring has occurred since the 1950s. During the past year, the Forest in cooperation with the Northeast Research Station in Durham, NH, has summarized data from all sampling stations across the Forest. There are 446 monitoring stations that have been sampled for chemical content at some time. These locations represent a range of forest types, geology, and land uses such as old growth, timber harvest and ski areas. Stream chemistry measurements include calcium, sulfate, nitrate, sulfate, aluminum, and pH.

The data is important because it represents the range of stream water chemistry across the Forest in a manner that is summarized and easily available. It provides some basis of comparison for individual sites, and helps place our stream conditions in a more regional context. In 2001 the Forest summarized data for certain elements. The principal finding is that water quality on the White Mountain National Forest is good. No evidence indicates a threat to human health or stream organisms.

There is a concern that in the long-term, aluminum concentrations could reach toxic levels in this region due to the impacts of acid deposition. It may affect aquatic organisms. The average stream aluminum concentration is 0.73 mg/L collected from 165 monitoring sites across the Forest. There is variation in aluminum toxicity between species, life stages, and different pH levels; which makes it difficult to summarize expected biological responses.

TRANSPORTATION

There are two goals regarding transportation in the 1986 Forest Plan:

- ✓ Use existing roads, trail, and utility corridors to the maximum extent possible. Plan and design access to serve multiple management purposes.
- ✓ Design and build any new access, regardless of type, according to standards and criteria that focus on minimum impact.

The Forest has constructed 28.8 miles of road for vegetation management, developed recreation facilities, and administrative sites since 1986. This is less than 1/3 of the 90.8 miles of road construction estimated in the Forest Plan. The Forest has used existing roads when possible. The level of construction has been minimized to attain minimum impact.

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INTRODUCTION

The purpose of the 2000 Monitoring Report is to evaluate progress the Forest has made toward achieving goals described in the 1986 Forest Plan (*Land and Resource Management Plan, White Mountain National Forest*.) Our intent is to provide a general assessment of some key resource areas that bolster information available to revise the Forest Plan and support a better understanding of the need for change. This report is intended to provide information for the public and the employees of the Forest.

The report is organized by resource: Resource Natural Areas, Recreation, Wildlife, Vegetation Management, Soil Productivity, and Water Quality. Most resource sections are designed to consider related Forest management goals contained in the 1986 Forest Plan. The order was selected to place related resource areas near one another.

The report addresses twelve general goals described in the Forest Plan (Forest Plan III-2). These goals represent desires expressed by public comment at the time. The goals guided the development of the Forest Plan objectives, standards, guidelines, and monitoring needs.

There is not a separate section in the report on goal 12 relating to public involvement. Public participation in the decision-making process is a high priority on the White Mountain National Forest. During preparation of the 1986 Plan, more than 3,000 people participated in the process. Since that time, environmental impact statements on re-permitting the Appalachian Mountain Club Hut System, expansion at Loon Mountain Ski Area, and snowmaking water impoundments at Waterville Ski Area have incorporated comments by hundreds of individuals and many regulatory agencies.

Public comment is solicited on projects such as timber sales, maintenance of wildlife openings, and trail work. Projects that do not normally include public comments such as environmental assessments and categorical exclusions have included scoping to ensure quality public involvement. More than 2,000 individuals were contacted about the amendment to the Forest Plan. Local planning groups are actively involved in revision of the Forest Plan. Forest Planning staff contacts about 600 people each month with information on meetings and other planning news. There is ongoing, significant activity to solicit public participation and cooperation in decision-making on the White Mountain National Forest.

1986 FOREST PLAN MANAGEMENT GOALS:

1. Conduct all management activities to protect soil and water resources. (see Soil Productivity p 43 and Water Quality sections p 53)
2. Conduct all management activities with full recognition of the appearance of the Forest, recognizing the importance to society of a natural landscape distinct from the man-made environments otherwise dominant in the East. (see Recreation section p 11)
3. Feature quality recreation opportunities not likely to be provided elsewhere on other lands. (see Recreation section p 11)
4. Recognize the demand for and importance of day-use areas and driving for pleasure as part of the Forest's total recreation opportunity spectrum. (see Recreation section p 11)
5. Recognize the need for the Forest user to bear a share of management costs through continued use of volunteer programs, payment for services, cooperative agreements, and voluntary contributions and donations. (see Recreation section p 11)
6. Use existing roads, trail, and utility corridors to the maximum extent possible. Plan and design access to serve multiple management purposes. (see Transportation section p 61)
7. Design and build any new access, regardless of type, according to standards and criteria that focus on minimum impact. (see Transportation section p 61)
8. Feature management for indigenous wildlife species including those that require old-growth habitat, threatened and endangered species, and sensitive/unique species. Recognize the demand for non-consumptive uses of wildlife, including opportunities to observe. (see Wildlife p 23)
9. Work with research and academic communities to preserve unique portions of the Forest through the Research Natural Area program. (see Research Natural Areas p 11)
10. Use timber management as one of the tools available to achieve the desired future condition and integrated resource objectives of certain management areas. (see Vegetation Management p 35)
11. Feature northern hardwood management over softwood. Move toward the culturing of high quality hardwoods that are in demand for specialty products. Assure a stable, reliable source of this raw material to support community stability. (see Vegetation Management p 35)
12. Involve the public in National forest management decisions

The first section in the report is a discussion of Research Natural Areas (goal 9). It is followed by Recreation (goals 2-5). The next sections are Wildlife (goal 8), Vegetation Management (goals 10 and 11), Soil Productivity Monitoring (goal 1), and Water Resources (goal 1). Each section will discuss activities relating to the resource and the goals described in the Forest Plan.

RESEARCH NATURAL AREAS

INTRODUCTION

Research Natural Areas (RNAs) are part of a national network of ecological areas designated by the Regional Forester in perpetuity for research and education or to maintain biological diversity on National Forest System lands. RNAs are meant for non-manipulative research, observation and study. RNAs are to serve as reference areas or baselines for long-term ecological change. Another objective is to preserve a wide spectrum of pristine areas that typify important forest, alpine, geologic, and aquatic systems that have special or unique characteristics of scientific interest. The White Mountain National Forest contains the first Research Natural Area (RNA) that was established on National Forest System lands. The Bowl RNA near Wonalancet, New Hampshire was established in 1931. In addition to the Bowl RNA, the White Mountain National Forest has the Alpine Garden and Nancy Brook RNAs. These were designated in 1989 and 1991.

At the time of the 1986 Forest Plan, the emphasis for RNA designation was on forested sites with distinctive features. Six forested locations were proposed as candidate RNAs as well as Monroe Flats alpine area, Cone Pond and Church Pond Bog. The forest sites are the Bowl Extension, Gibbs Brook, Mountain Pond, Nancy Brook, Owls Head and Peabody Mountain. Most of these candidate locations have been examined for designation since 1986. The candidate RNAs are protected by a special management area (MA) designation, MA 9.3. These areas represent about 6,000 acres that have been under evaluation to become permanently designated RNAs.

Figure 1 Status of Research Natural Areas and approximate size

Designated RNAs	Candidate RNAs	Possible Future RNAs
Bowl RNA, 510 ac. Alpine Garden RNA, 300 ac. Nancy Brook RNA, 2,000 ac.	Monroe Flats alpine area, 45 ac. Cone Pond, 160 ac. Church Pond Bog, 300 ac. Bowl extension, 1,000 ac Gibbs Brook, 1,650 ac Mountain Pond, 300 ac Owls Head, 70 ac. Peabody Mountain, 230 ac.	Shingle Pond Bowl extension II Rattle River

In 1986 RNAs throughout the Forest Service were selected based on forest cover types established by the Society of American Forests. RNAs are now seelected based on a combination of U.S. Forest Service Hierarchy of Ecological Units and the Nature Conservancy's National Vegetation Classification. The goal is to devise a system of RNAs that represent the range of natural communities at the alliance level. Alliances are determined by the dominant species of the uppermost layer of vegetation, for example, Red Spruce-Balsam Fir Alliance or Bigelow's Sedge-Three Forked Rush Herbaceous Alliance. The focus has shifted to consider a range of ecosystems from rare to common. The common communities are believed to be the best reference areas for monitoring and research objectives. The goal is for RNAs to contribute to biodiversity. RNA communities range from forest to alpine zone.

The factors that are taken into account for RNA candidacy include size, condition and landscape context; which determine the quality or viability of an area. Size is meant to account for the persistence of biological and non-biological factors, structure, and processes within an alliance. Condition has more to do with

qualities such as evidence of exotic species or human impacts. Context has to do with events happening in areas near the alliance.

Additional local factors are also taken into account. For example, it seems important to represent landscapes from mountaintops to major valley bottoms, especially valley bottoms that may not be well represented where natural processes are meant to dominate. Recent forest-wide analysis indicates 22% of major valley bottoms across the White Mountain National Forest are in some form of "protective" status.

Entire watersheds are included because water quality is also an important consideration. Water quality is one of the issues that led to the formation of the White Mountain National Forest. Monitoring changes in old forest stands is also important to understanding long-term trends in species composition. Equally important is understanding changes that occur as areas transition from earlier disturbances such as fire, timber harvest, and agriculture.

RESEARCH NATURAL AREA ACCOMPLISHMENTS

DESIGNATED RESEARCH NATURAL AREAS

BOWL RESEARCH NATURAL AREA

The Bowl RNA is an excellent representative of an old-growth northern hardwood-spruce forest that also contains important streams. Significant research on the dynamics of old-growth forests has been completed at this location:

- Water quality has been sampled for many years
- It was included in groundbreaking studies of bryophytes, or non-vascular plants
- It is a reference site for long-term studies of forest productivity
- It is the first place where nitrogen "leakage" into streams from old-growth forests was documented
- It has been a salamander study site.
- Permanent, unmarked herbaceous plant plots are now established to monitor long-term species changes, possibly from impacts of global climate change.

Several perennial and intermittent streams drain the Bowl RNA, including Wonalancet Brook. Meander surveys for flora were performed in 1991-1992. Temporary plots were established in each of the four ecological land types found in this vicinity. Surveys included concentrated searches in obvious microhabitats such as seeps, stream channels, large boulders, and ledges. Sugar maple up to 33 inches dbh (diameter at breast height), beech up to 30 inches dbh, and yellow birch up to 12 inches dbh were found in the hardwood forest. In the softwood forest, balsam fir up to 15 inches dbh and red spruce to 26 inches dbh were found. Rare species included Squirrel Corn (*Dicentra Canadensis*), which is listed as State threatened, and Lady slipper (*Cypripedium* sp.) There were 13 shrub species and 70 herbs. No federally listed plant species were found. The detailed report is found in *USDA General Technical Report NE-189*, *Botanical Reconnaissance of the Bowl Research Natural Area*.

Fieldwork for a PhD dissertation completed recently at UNH included detailed plot work in the Bowl RNA. This survey was conducted routinely throughout the growing season to obtain a thorough inventory.

More than 70 plant species were found in the Bowl. One occurrence of a U.S. Forest Service sensitive species, Squirrel Corn (*Dicentra Canadensis*), was discovered. This research focused on herbaceous plants.

NANCY BROOK

Nancy Brook is about 2,000 acres near the height of land at Crawford Notch State Park. It was surveyed in 1992 and transects and plots were established. This location is believed to be the largest virgin mountain spruce-fir forest in New Hampshire and one of the few remaining large examples in the Northeast. A total of 167 species of vascular plants in 43 families were found as well as 29 species of mosses and liverworts. Two State threatened species were inventoried at previously documented sites, Wiegands Sedge (*Carex wiegandii*) and mountain avens (*Geum peckii*). Searches also revealed populations of State threatened Pickering's reed grass (*Calamagrostis pickeringii*) in streamside acidic fen communities. A report of the findings is found in *U.S.D.A. Forest Service General Technical Report NE-216*.

ALPINE GARDEN

Alpine Garden lies in an arctic-alpine tundra community between Huntington and Tuckerman Ravines on the eastern shoulder of Mount Washington at elevations between 4,750 and 5,500 feet. It is a unique assemblage of rare species in an exemplary natural community. It contains sedges, grasses, lichens, mosses and rare arctic-alpine species. There are also scattered pockets of krummholz and matted black spruce. It was evaluated in 1988 and had one candidate for listing under the Federal Endangered Species Act (Boott's Rattlesnake Root), nine state endangered plants, eight state threatened plants, sixteen state rare plants, and four state rare animals. The Establishment Report for Alpine Garden is available upon request.

CANDIDATE RESEARCH NATURAL AREAS

BOWL EXTENSION

An Establishment Report was written in 1985 for the Bowl Extension. It has never been formally designated. It is about 925 acres in size. This site was identified because it enlarges and helps protect the integrity of "The Bowl", and provides an additional area of old-growth northern hardwoods. The distinguishing features include its cirque-like shape and old beech, yellow birch, and spruce. Species represented include balsam fir, sugar maple, beech, eastern hemlock, beech, red spruce, spring beauty, painted trillium and dogtooth violet. The Establishment Report is available from the White Mountain National Forest.

MOUNTAIN POND

Mountain Pond RNA is near the East Branch of the Saco River and on the west side of the White Mountain National Forest. Faculty and students from the University of New Hampshire at Durham inventoried this location. The site is about 70 acres. It lies near, but not adjoining, Mountain Pond, and is a northern hardwood old-growth with sugar maple and white ash up to 35 inches dbh. These species are usually 18-26 inches dbh.

This location was visited weekly during the growing season, so a very complete examination of the flora was made. There was an effort to locate species of special concern, such as federally threatened or endangered species, or State species of concern. No federally listed species were found. The only State species of concern was Pink lady-slipper (*Cypripedium acaule Alton*). It is a State species of concern because although it is a very common plant of acid woods throughout the State, it is vulnerable to commercial exploitation.

Other noteworthy plants included: Lance-leaved grape-fern (*Botrychium lanceolatum* sp. Angustisegmentum), spring beauty (*Claytonia carolinianna*) and Round-leaved orchid (*Plantanthera orbiculata*). The complete report may be found in *USDA Forest Service General Technical Report NE-187*.

CONE POND

Cone Pond is a small watershed about 160 acres in size that lies on a mountainside slope near the Town of Waterville Valley. It is a spruce-fir forest generally surrounded by till soils shallow to ledge. Its selection is based on its geologic and watershed features. Cone Pond and its watershed have been studied for nutrient cycling for about three decades. Cone Pond soils and water have very high acidity. The site has had disturbances such as glaciation, wind, and fire. There is an absence of human disturbance such as agriculture or forest harvesting. The disturbance history is partly responsible for the acid conditions of the watershed and pond, and has provided conditions for studying acidification processes and effects in a natural setting.

Studies at Cone Pond can help reduce the uncertainties that have accompanied the large body of research conducted in human impacted environments. Major findings have included weathering rates for calcium, an improved understanding of the movement of aluminum through terrestrial and aquatic ecosystems, and development of baseline data on stream water and soil chemistry for an acidified system. A bibliography of over fifty publications is available. Cone Pond will be considered for RNA designation during Forest Plan revision based on its important watershed value.

GIBBS BROOK

Gibbs Brook is a scenic area. It lies near the height of land in Crawford Notch, and is about 1,650 acres. Temporary plots were established in Gibbs Brook representing each of the different ecological land types that occur there. One hundred two species of vascular plants were identified between 3,700 and 4,050 foot elevation. No federal or state listed plants were found; no non-native plants were found; there was an abundance of downed logs, and there was no evidence of timber harvest. Some firewood collection may have occurred near the highway. Tree cores indicate red spruce originating between 1755 and 1904. This candidate RNA will be considered for designation in the current Forest Plan Revision. A report on the plant species and tree ages is available from the White Mountain National Forest.

PEABODY MOUNTAIN, MONROE FLATS, OWLS HEAD, CHURCH POND BOG

Peabody Mountain was examined for possible detailed study in 2000. The site was previously identified as spruce-fir and hardwood. On-site examination revealed steep, spruce forest shallow to ledge similar to many sites across the White Mountain National Forest.

Monroe Flats has not been studied in detail, and should probably be retained as a potential candidate RNA pending further study.

Owls Head was the subject of an Establishment Report. There are six species of bryophytes found only in the red pine stand at this location. This site warrants further consideration.

Church Pond Bog does not fit any of the categories established for RNAs and needs to be considered for an alternative classification that provides this special resource with adequate protection.

Old-growth Hemlock Forest

FUTURE POSSIBLE CANDIDATE RESEARCH NATURAL AREAS

The Forest has investigated areas that might be future candidate RNAs. The Eastern Region of the Forest Service, in cooperation with The Nature Conservancy, analyzed alliances for possible inclusion on individual National Forests. The entire analysis is available for public examination, but for the purposes of this report we will focus on the additional work done to date. In general, the goal is to pay attention first to large, or matrix, alliances such as northern hardwood. These locations will be considered during Plan revision.

SHINGLE POND

Forest workers in the 1980s discovered what appeared to be an old-growth eastern hemlock stand in the vicinity of Shingle Pond, which is near the Kearsarge North fire tower in North Conway, New Hampshire. Various botanists, ecologists and foresters made further visits until the summer of 2000 when Forest Service botanists spent significant time to examine this location in detail. A preliminary map of the site is completed; which includes information gathered by New Hampshire Natural Heritage Inventory. Volunteer botanists provided help, as did the Northeast Research Station in Durham, NH.

Twelve temporary plots were established in an area of old-growth to the north and southeast of Shingle Pond between 1800 and 2600 foot elevation. The forest types were red spruce-balsam fir, sugar maple-yellow birch-hemlock, sugar maple-beech, and hemlock. The largest tree diameters measured were: red spruce 27 inches, sugar maple 38.4 inches, hemlock 37.5 inches, white ash 31.8 inches, and yellow birch 29.2 inches. Eighty-six different vascular plants were found. No plants were federally endangered or threatened or state listed rare plants, and there were no non-native species. Trees were cored for ages for all species represented. Some representative ages and dates of origin are as follows: American Beech dating from 1773, Sugar Maple dating from 1775, Hemlock 260 years old, and Red Spruce 200 years old.

The New Hampshire Natural Heritage Inventory identified exemplary communities on the Forest that are down slope of Shingle Pond. The communities represented include: semi-rich mesic hardwoods, hemlock-spruce-northern hardwood and maple-beech-yellow birch. The University of New Hampshire conducted detailed flora surveys along the Weeks Brook Trail.

Information collected on the Shingle Pond area will be summarized, and compared to the needs identified in the Eastern Region RNA Assessment, to determine its value for consideration during Forest Plan revision.

BOWL EXTENSION II

Public comment during the 1986 Forest Plan, and since that time, indicates a desire to add lands to RNA or some similar classification that represents forests of major valleys. As noted earlier, GIS analysis shows that about 22% of the major valleys are already in some form of "protective" status. The Forest has examined existing core RNAs for logical opportunities for expansion into major valleys. For the most part, there are not nearby valley positions, with the possible exception of the Bowl RNA. At the Bowl there are mountainside and valley lands that might make a logical addition. These areas contain ecological land types that provide a variety of future forest types, including hemlock, spruce-fir, and northern hardwood-spruce. There is a line of reasoning that setting aside some disturbed sites has merit because it permits the study of recovery processes. In this instance, the disturbed sites and undisturbed forest have geographic similarity plus geologic and soil factors in common. This is a location that deserves further examination as a candidate RNA.

RATTLE RIVER

Another location of possible interest is Rattle River. Data from this site has been examined although extensive on-site examination has not been conducted. It appears that this small, self-contained watershed of a few thousand acres has some older forest of eastern hemlock, a species of interest based on the Regional assessment, plus some old stands of northern hardwood and spruce-fir. There do not appear to be any roads, though on-site examination may prove otherwise. While more review needs to be done; an especially attractive feature of this location is that it is a small watershed that may have some usefulness for long-term water quality monitoring.

DISCUSSION – RESEARCH NATURAL AREAS

The 1986 Forest Plan identifies the need to cooperate with Forest Service Research Stations and Universities to develop a system of RNAs across the White Mountain National Forest. While there is more work yet to be done, including cooperating with State Ecological Reserve efforts, all evidence indicates that this Forest has responded to this goal in the Forest Plan. Future plans include examining some of the alliances that are missing based on the Eastern Region RNA Assessment.

Hardwood Old-growth Forest

RECREATION MONITORING REPORT

INTRODUCTION

The Forest Plan identifies the ROS (Recreation Opportunity Spectrum) as the general measure by which recreation opportunities will be managed (Forest Plan III-5). The ROS provides a "formalized system of identifying and managing the different recreation environments so that they will continue to provide a range (spectrum) of opportunities from which the user can choose." (Forest Plan VII-H-1)

Based on combinations of settings, activities, and experience opportunities, ROS is broken down into five classes: Primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, and rural. The specific attributes of each ROS class can vary based on local application but the categories and goals provide a framework by which to measure and manage recreation opportunities.

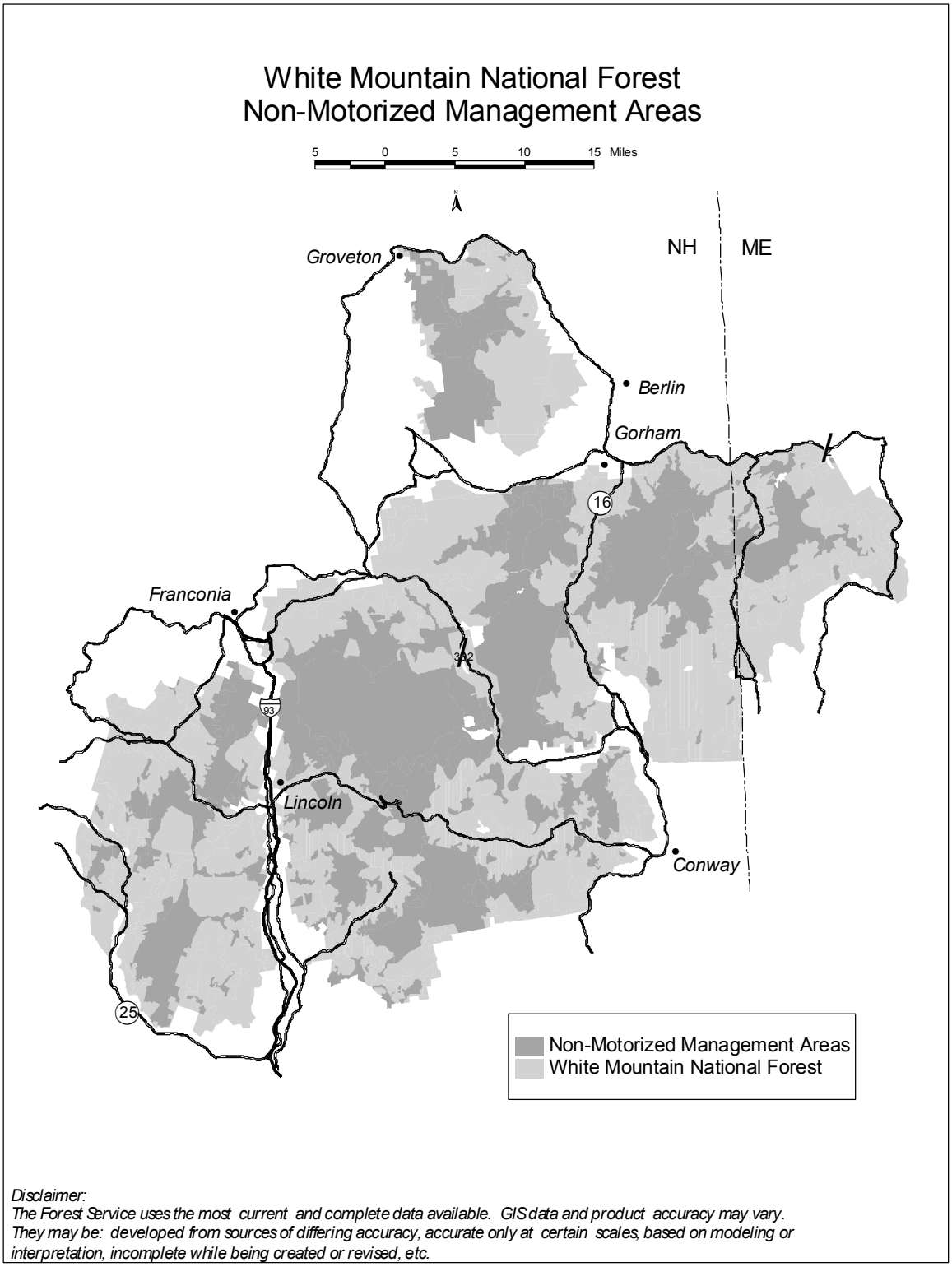
This report focuses on primitive, semi-primitive, and roaded natural ROS classes, although the Forest strives to provide a range of opportunities across the full ROS. The following are definitions of the recreation opportunity spectrum:

Primitive – Setting is essentially an unmodified naturally appearing environment. Evidence of humans would be unnoticed by an observer wandering through the area. Evidence of trails is limited. Structures such as roads, power lines, pipelines, microwave towers, developed recreation areas, tent platforms, shelters, etc. are extremely rare. Controls such as signing, barriers, and required use permits are low with controls primarily off-site.

Semi-Primitive Non-Motorized (SPNM) – Naturally appearing setting, may have subtle modification that would be noticed but would not draw the attention of an observer wandering through the area. There is little or no evidence of primitive roads or the motorized use of trails or primitive roads. Structures are rare and isolated. On-site controls are present but subtle.

Semi-Primitive Motorized (SPM) - Naturally appearing setting, may have moderately dominant alterations but would not draw the attention of motorized observers on trials and primitive roads within the area. There is strong evidence of primitive roads and the motorized use of trails or primitive roads. Structures are rare and isolated. On-site controls are present but subtle.

Roaded Natural (RN) – Naturally appearing setting, may have modifications which range from being easily noticed to strongly dominant to observers within the area. However, these alternations would remain unnoticed or visually subordinate along sensitive travel routes and use a**r**eas. There is strong evidence of designed roads. Structures are generally scattered, remaining visually subordinate or unnoticed along sensitive travel routes. Structures many include power lines, microwave towers and so on. On-site controls such as signing, barriers, and required use permits are noticeable, but harmonize with the natural environment (Forest Plan VII-H-1).



Disclaimer:
The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. They may be: developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation, incomplete while being created or revised, etc.

HAVE FOREST PLAN GOALS BEEN MET?

The 1986 Forest Plan identified three goals specific to recreation:

- ✓ Goal 3 - Feature quality recreation opportunities not likely to be provided elsewhere
- ✓ Goal 4 - Recognize the demand for, and importance of day-use areas and driving for pleasure as part of the Forest's total recreation opportunity spectrum
- ✓ Goal 5 - Recognize the need for the Forest user to bear a share of management costs through continued use of volunteer programs, payment for services, cooperative agreements, voluntary contributions and donations.

These goals are reflected in forest-wide direction, management area allocations and prescriptions (Forest Plan Record of Decision, 1986, p. 13), and adherence to the recreation opportunity spectrum. This report will assess how well we have done in meeting these general goals.

The 1986 Forest Plan states "The Forest will continue to emphasize non-motorized dispersed recreation in its general management philosophy." (Forest Plan II-5). Approximately 378,000 acres are assigned to management areas where non-roaded, dispersed recreation is emphasized. There are three important considerations:

- ✓ Dispersed recreation is a major use of the WMNF (White Mountain National Forest)
- ✓ The WMNF provides a significant portion of the dispersed recreation opportunities in the northeast (Forest Plan Final Environmental Impact Statement (FEIS) III-4)
- ✓ Public comment during Forest planning strongly supported non-motorized dispersed recreation (FEIS IX-K-54).

FOREST PLAN GOAL 3

Have we featured quality recreation opportunities not likely to be provided elsewhere?

To help answer this question it may be useful to identify the factors that determine whether an opportunity is unique or not. Based on the ROS and other factors, we can break recreation experiences into these components:

1. Setting or environment
2. Opportunities
3. Managerial controls
4. Activity
5. Quantity
6. Quality

Some examples in categories that may be unique to the WMNF, or at least hard to find elsewhere include:

Setting or environment:

The largest alpine zone in the eastern United States; the Presidential Range with some of the most challenging weather anywhere on earth; unique formations such as the glacial cirque of Tuckerman Ravine; a largely undisturbed and undeveloped landscape; outstanding scenery.

Opportunities:

Many opportunities exist to find solitude as well as recreation within structured social frameworks such as the AMC hut system; viewing nature both on foot and by car; relatively unconfined recreation with challenge and risk.

The ability to recreate in any of these settings, or to have these opportunities (and many more as defined by each individual) is unique. Given the high levels of development surrounding the Forest, it is becoming harder to find quiet and solitude. While not unique, the WMNF still has places where it is possible to be alone and relatively far from other people.

Challenge and self-reliance appear to be increasingly scarce as our society becomes more and more reliant on technology and outside controls. Because of weather, terrain, and minimal managerial controls, the WMNF plays a particular role in providing this opportunity.

Although there are other beautiful places in the Northeast, many of which are contiguous to the Forest, the WMNF is surrounded by human development. The Forest provides a unique place to view nature with little human intervention. The WMNF, with its combination of topographical relief and undisturbed landscape, plays a particular role in providing the opportunity to view beautiful, undeveloped scenery.

Managerial Controls:

The WMNF has relatively few controls compared to other popular public lands in the Northeast. With few exceptions, areas are not closed because of the time of year or potential danger. People are encouraged to make their own informed and responsible decisions based on their individual capabilities. Camping is only limited to protect the land from overuse or other damage, and in some cases to protect very specific social conditions (such as not seeing tents everywhere along a trail or at a trailhead.)

Activities:

The WMNF allows for a wide range of activities. This includes, hiking and backpacking, mountaineering, backcountry skiing, developed alpine and cross country skiing, mountain biking, guided trips, snowmobiling, rock and ice climbing, to name only a few of the activities that happen on the Forest. While many of these activities are not unique to the WMNF, they are unique in terms of the quantity, range, quality, and accessibility of the experience.

Quantity:

The WMNF provides nearly 800,000 acres of recreation land, about 1,200 miles of hiking trails, 22 campgrounds, 13 picnic areas, 20 scenic outlooks, 3 boat ramps, 2 swimming areas, and more than 60 backcountry cabins, shelters, tent sites, or huts. Since the 1986 Forest Plan, an additional 12,000 acres in the Caribou-Speckled Wilderness was designated in part for non-motorized dispersed recreation.

There are no other public lands in the Northeast with such an extensive trail system that offers the variety of terrain, elevation and difficulty. The WMNF also provides the largest expanse of public land in New England. The Forest is within a day's drive of the most highly developed corridor in the country and 1/3 of the nation's population.

Quality:

Quality of recreation experiences can be very relative and subjective. Monitoring techniques are used to gauge whether or not certain standards are met. These standards can include: condition of the environment in which people recreate, condition of facilities, numbers of people recreating, whether or not designated standards within the ROS are met, and visitor satisfaction.

MONITORING AND EVALUATION

The Forest Plan identified consistency with the assigned ROS class, the condition of the resource, and type of user experience to indicate how closely management standards and guidelines are being applied and followed. Each of these items can be measured, either by comparing given areas against standard ROS class descriptions or through on-site inspections of the ROS class achieved (Forest Plan IV-5).

The Forest has addressed various concerns with the backcountry experience and ROS consistency. For example, the Forest worked with AMC to minimize inconsistencies between ROS and AMC hut operations by limiting helicopter and radio use and additional development that would affect visitors who were not staying in the huts.

Other examples include adhering to appropriate trail standards, providing signs, and education efforts. The Forest also conducted a study to determine whether visitors to the backcountry are satisfied with the conditions they find and experiences they have. This is described in more detail below.

Monitoring recreation use has occurred through a variety of techniques. While these figures cannot be looked at in isolation to determine the quality of experiences, it does give a general sense of trends and an indication of increased management challenges.

MEASURING HIKER SATISFACTION

In 2000 the WMNF commissioned a study with the State University of New York (SUNY) at Syracuse to find out how hikers and backpackers feel about their experience on the Forest.

Initially we wanted to answer four questions:

1. What type of experience do visitors to the WMNF backcountry think they're having?
2. What type of experience does the Forest Service think it's providing?
3. Are people happy with the experience they're having?
4. If people are not happy, what trade-offs would they be willing to accept to get the type of experience they want?

Recognizing that expectations and experiences can vary greatly by the time of year, we intended to complete the study over four seasons. Due to budget constraints we were only able to look at summer use and only able to address questions one though three.

The study design relied on brief, on-site interviews of hikers and backpackers during their trips to seven Wilderness and non-motorized backcountry areas of the Forest in New Hampshire and Maine. This data collection technique ensured that visitor responses to survey questions reflected their actual on-site recreation experience. Most of the data was gathered during 15-minute interviews in the field by a trained interviewer.

A total of 51 interview sites were selected in the seven areas with the number of sites in each area ranging from six to 12 depending on the size of the area, number of public access points, and estimated visitor use. The on-site interview survey determined:

1. Size and type of visitor group
2. Day or overnight user
3. Recreation activities participated in by visitors while in the area
4. Visitor perception of the importance of and satisfaction with 12 wilderness and backcountry recreation experience and setting attributes

5. Visitor preference for 16 potential management actions that could be used by the Forest Service to reduce recreation user impacts or conflicts
6. Previous recreation experience in the WMNF.

Preliminary results indicate that people using the WMNF backcountry are very happy. Two areas of potential concern, although they don't yet rate as problems are: the pre-trip information people receive and increasing levels of use at certain trailheads and trails.

OTHER MONITORING

Some specific monitoring shows that there are localized impacts to soil and vegetation from recreation activities (WMNF Campsite Inventory 2000). These impacts do not indicate diminished recreation experiences as evidenced by the survey cited above. In some cases impacted areas have actually decreased over time. This is true, for example, for the area around some of the AMC huts (Cogbill C.V. 1996) and the areas around Hermit Lake (personal communication Brad Ray.)

Discussion:

There is no simple formula to determine the quality or uniqueness of recreation opportunities. There are many factors to consider, some of which are objective and others that are largely subjective. Nevertheless, based on the evidence outlined here, it seems that the WMNF has met the goal of featuring recreation opportunities not likely to be found elsewhere, with a particular emphasis on non-motorized dispersed recreation.

There is a range of recreation opportunities from highly developed to primitive. There are many types of recreation activities that rely on the unique setting, land base and infrastructure of the Forest. This does not mean that everyone agrees on the range of recreation offered or on specific management actions needed to achieve the overall goal. Nor does it mean that we can be complacent that the goal will always be reached and that high quality experiences will always be available without active management to ensure it.

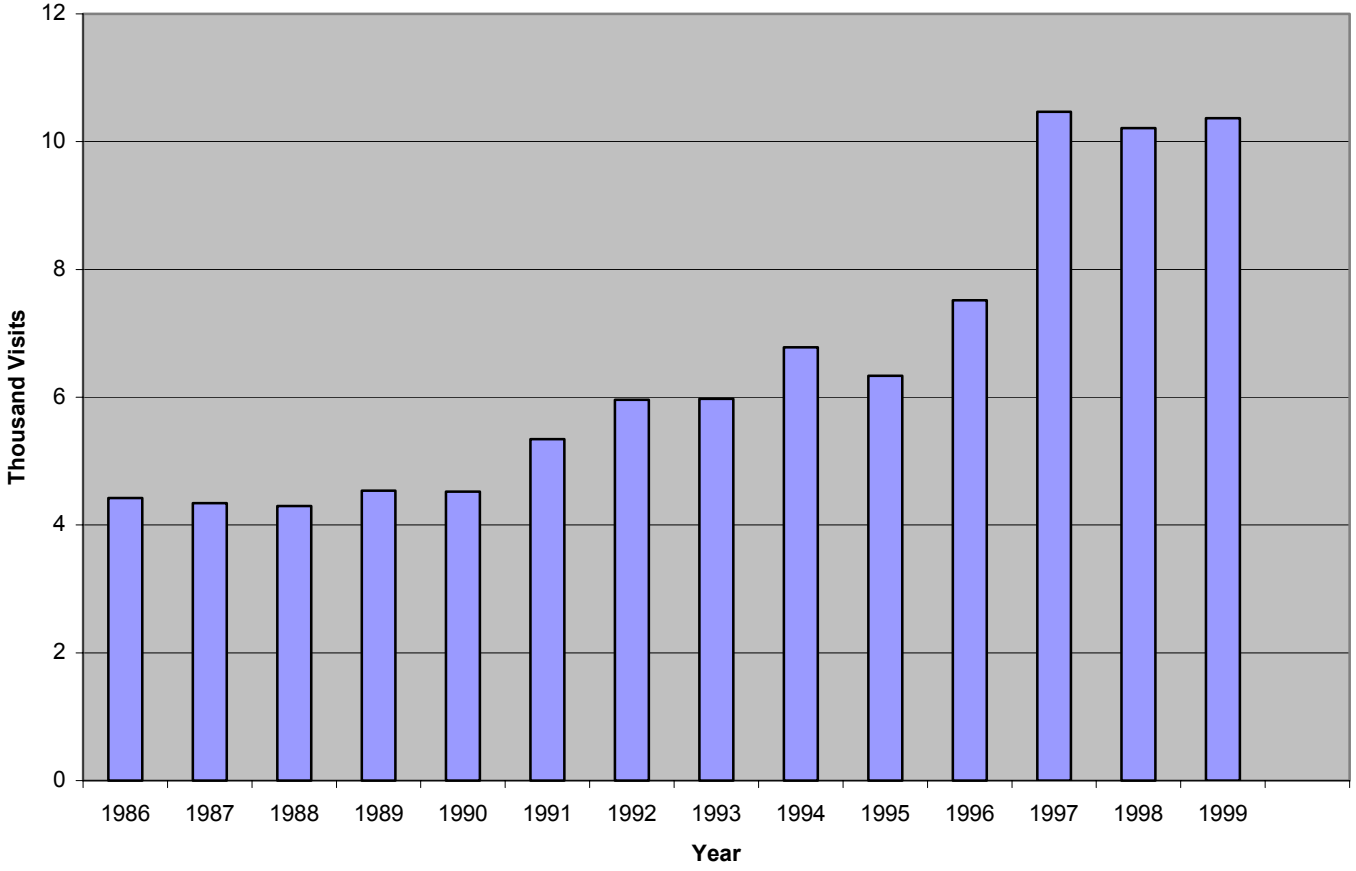
Some questions the Forest should continue to address:

1. Are formally quiet times of year becoming so busy that every season has high use?
2. Will the range of opportunities become smaller as use increases?
3. Can management techniques keep up with potential social and ecological impacts?

RECREATION USE TABLES:

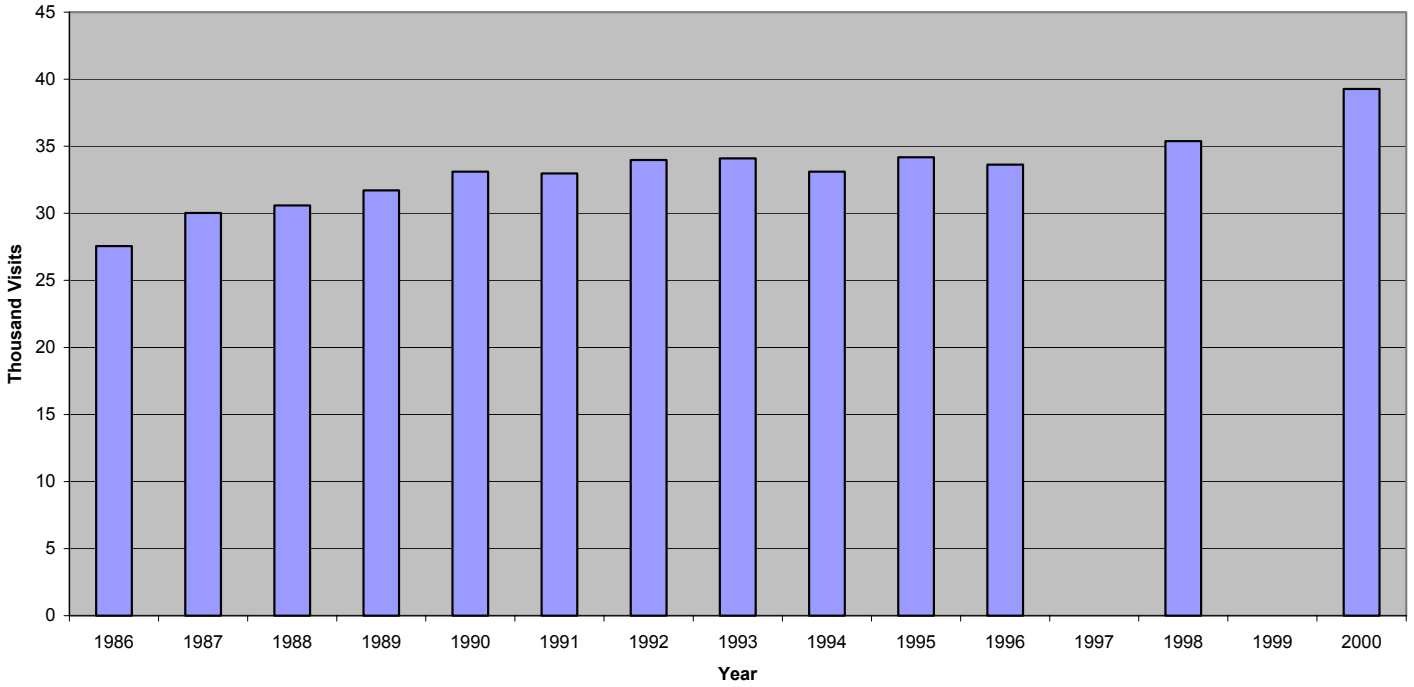
The following tables show use figures from shelter and hut sites along the Appalachian Trail where data is gathered. These 13 backcountry sites are managed as semi-primitive non-motorized areas and represent about 40 percent of the total capacity of backcountry facilities on the Forest. Use of the shelter sites grew by seven percent annually from 1986 to 1999. Hut use grew by about 2.5 percent annually from 1986 to 2000.

Total Use - Selected Backcountry Shelter Sites on AT
Includes Liberty Springs Campsite, Garfield Ridge Campsite, Guyot Campsites
Speck Pond Shelter, Nauman Tentsites, and Camp 13



Huts Total Use 1986-2000

Includes Carter, Galehead, Greenleaf, Lakes of the Clouds, Madison, Mizpah, and Zealand



FOREST PLAN GOAL 4

Has the WMNF recognized the demand for and importance of day-use areas and driving for pleasure as part of the Forest's total recreation opportunity spectrum?

The Forest goal of featuring recreation opportunities not likely to be found elsewhere, includes more than the emphasis on non-motorized dispersed recreation. The Forest's unique setting, land base and infrastructure are also important for the large number of people whose recreation experience is driving for pleasure and using roadside areas.

Activities such as driving for pleasure or sightseeing and visits to day-use areas such as picnic sites continue to grow. The publication *Emerging Markets for Outdoor Recreation in the United States* is based on the National Survey on Recreation and the Environment and developed with collaborative research between Sporting Goods Manufacturers Association (SGMA) and the USDA Forest Service. The study of outdoor recreation in the lives of American adults showed a 16 percent increase in picnicking from 1983 to 1995 and a 40 percent increase in sightseeing for the same period. The report further states:

> *Sightseeing covers a wide range of sites and attractions. The majestic natural attractions that justify an extended vacation are largely concentrated on public land. Transportation, tour services, photography equipment, and lodging and food, however, are provided by private means. Tourism and travel services and facilities that make sightseeing more enjoyable are on the rise.*

The Forest emphasis on visual quality and the road related facilities are important to driving for pleasure. The Forest continues to evaluate scenery management to meet resource goals and objectives, and to monitor scenic resources to ensure high-quality scenery for future generations. An example of forest emphasis on visual quality is a study titled *Clearcutting in the White Mountains: Perceptions of Citizens, Opinion Leaders, and U.S. Forest Service Employees* (James F. Palmer, January 1998). The study previewed in a *Journal of Forestry* article in 1995 titled "Esthetics of Clearcutting Alternatives in the White Mountain National Forest" and clarified the effect some management activities had on visual quality. This study is described in the 1998 WMNF Monitoring Report. Because of that study, the Forest Landscape Architect recommended maintaining the current practice of designing cutting units between 10 and 14 acres but reducing the number new openings per decade.

The Kancamagus Highway was designated as a National Scenic Byway in 1989. It was later incorporated with sections of Routes 3, 302, and Bear Notch Road to create the "White Mountain Trail," a 100-mile National Scenic Byway loop. National Scenic Byway designation makes it easier to provide visitor projects such as scenic vistas, waysides and interpretive exhibits. The Forest is implementing the Kancamagus Highway Plan, including upgrading parking lots, picnic sites and overlooks, as well as creating new day-use sites and providing forestry and wildlife interpretive opportunities.

The Forest continues to work closely with the State Department of Transportation to make sure state highway improvements on Kinsman Notch, Route 3 and Route 16 within the Forest consider scenic quality and day-use along the roads. The Forest has also upgraded some of its roadside parking areas including upgraded toilet facilities, screening them from the road, and adding bus parking.

Discussion:

The Forest continues to recognize the demand and importance of day-use areas and driving for pleasure as a vital part of the range of recreation activities. The Forest continues to put a substantial effort into maintaining and monitoring scenic quality. The management goal "To conduct all management activities with

full recognition of the appearance of the Forest, realizing the importance to society of a natural landscape distinct from the man-made environments otherwise dominant in the East." is being carried through into Forest Plan Revision. The continued investment in day-use areas and driving for pleasure seems to show that the Forest Service has met this goal.

FOREST PLAN GOAL 5

Has the WMNF recognized the need for the forest user to bear a share of management costs?

There a several examples of how this goal has traditionally been met: Campground fees as well as some cabins, shelters and tent sites, and fees under special use permits such as the AMC huts and downhill and cross country ski areas. In addition, private concessionaires now operate Forest Service campgrounds; which was an effort to improve efficiency. Part of the fees is re-invested in campground facilities.

Another long-standing example of users helping pay costs is the history of volunteerism on the forest. Individual volunteers, organizations, and trail clubs have provided help with trail maintenance, search and rescue, and visitor information. In 2000 volunteer help amounted to just under ten years worth of labor.

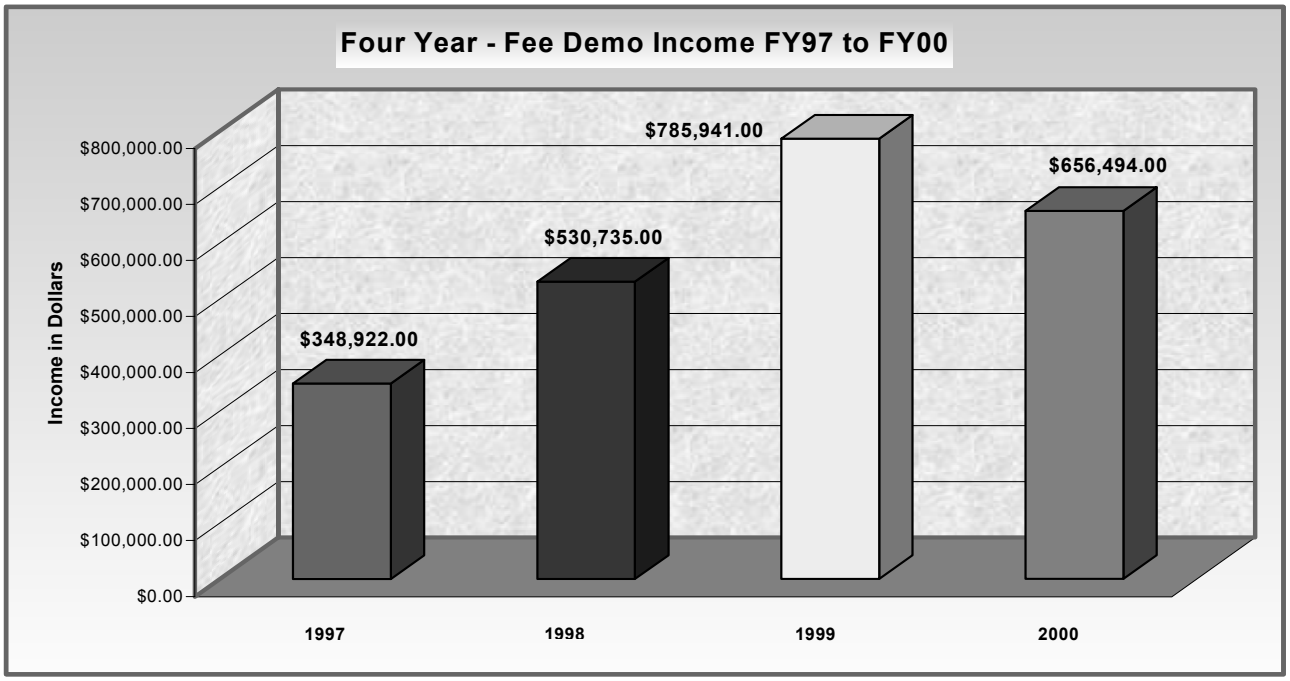
The White Mountain Interpretive Association (WMIA), a private non-profit organization consisting largely of volunteers, helps generate revenue with retail sales at Forest Service offices. This money helps pay for interpretive programs, materials and supplies. The recently formed Friends of Tuckerman Ravine "…was founded to provide citizen support to the USFS in order to preserve and protect Tuckerman Ravine and the Cutler River Drainage area." Friends of Tuckerman Ravine donated two-way radios to the Forest Service and are exploring other ways to assist with much-needed projects and public service.

A more broad-scale and controversial example of forest users bearing a share of management costs is the WMNF participation in the national recreation fee demonstration program since 1996. The forest retains most of the income generated by fees. The WMNF chose to institute the fee demonstration program in the form of a Forest parking fee. Costs in 2000 were $20 for an annual parking pass, $5 for a weekly pass, and $3 for a daily site-specific pass. Volunteers receive passes in exchange for 16 hours of work.

Funds generated through the fee demonstration program provide many services that directly benefit the people who use the Forest. Some accomplishments in 2000 include:

- ✓ Maintenance and patrol of more than 700 miles of trail
- ✓ Management of 46 day-use areas and 105 trailheads in Maine and New Hampshire
- ✓ Maintenance and patrol of parking areas, dispersed campsites, roadside pullouts, and picnic areas
- ✓ Maintenance of three Wilderness winter access sites including snowplowing and grooming cross-country ski trails
- ✓ Staffing and information materials to serve visitors at Evans Notch Visitor Center, Pinkham Notch Visitor Center, Androscoggin Ranger District, New Hampton, Waterville Valley Chamber of Commerce, White Mountain Attractions, and Lincoln Woods
- ✓ Interpretive programs at 32 campgrounds.
- ✓ Backcountry information and education, trailhead maintenance, patrol, repair of shelter and platform sites, maintenance of toilet systems, roof repairs on cabins, and other facilities maintenance.
- ✓ Cooperated with the Town of Stark to mow the wildlife opening at Camp Stark
- ✓ Construction of two visitor information kiosks

Figure 5 Revenue generated by the Fee Demonstration program



Some research indicates that user fees may negatively affect low-income people. (More, T., & Stevens, T. 2000) The WMNF has offered free passes for volunteers and the option to purchase one-day passes in order to reduce costs to the public. Other studies show a general willingness to pay fees as long as funds go back into the Forest where they were generated.

Discussion:

The WMNF has increased the use of traditional methods for users to share in management costs, such as fees for cabin rentals. The Forest Service also recognizes the importance and potential of volunteerism as a way to share costs. The fee demonstration program has made it possible for the Forest Service to retain fees collected on-site. The program has proven beneficial in helping maintain recreation facilities on the forest. Based on the examples shown, the Forest has met the goal of having users pay a share of management costs.

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WILDLIFE MONITORING REPORT

INTRODUCTION

The 1986 Forest Plan set the following goal for wildlife species:

> *"Feature management for indigenous wildlife species including those that require old-growth habitat, threatened and endangered species, and sensitive/unique species. Restore and maintain the biological diversity of indigenous aquatic biota and associated habitat. Recognize the demand for non-consumptive uses of wildlife, including opportunities to observe." (Forest Plan p. III-3)*

The intent of the Forest Plan is to protect species as mandated by the Endangered Species Act and regulations in the National Forest Management Act. In addition to species listed by the U.S. Fish and Wildlife Service under the Endangered Species Act, a list of Management Indicator Species was defined to represent the full range of habitats and conditions present on the Forest. Species monitoring can indicate population trends and measure the effectiveness of management activities. Declining trends may be cause for further investigation to determine if Forest management needs to be changed in order to maintain species viability.

THREATENED AND ENDANGERED SPECIES

Federally endangered and threatened species listed in 1986 Forest Plan include the following:

- American peregrine falcon – endangered
- Bald eagle – endangered
- Eastern cougar - endangered
- Eastern timber wolf - endangered
- Robbins' Cinquefoil – endangered

Additional species either found on the Forest after 1986 or known to exist on the Forest and subsequently listed under the Endangered Species Act include:

- Indiana bat - endangered
- Small whorled pogonia – endangered, then reclassified to threatened
- Canada lynx - threatened

SPECIES ACCOUNTS

AMERICAN PEREGRINE FALCON

The peregrine falcon was a widespread predator across North America until use of the pesticide DDT in the mid-20th century led to eggshell thinning. Weak eggshells resulted in breakage and subsequent catastrophic population declines. The species was listed as Endangered in 1969. In 1976, the WMNF (White Mountain National Forest) began releasing captive-bred falcons in cooperation with the Peregrine Fund, Inc. at Cornell University and the U.S. Fish and Wildlife Service. In 1981, a pair of peregrines at Franconia Notch successfully fledged young at a natural cliff site for the first time anywhere in the eastern U.S. Ten years later, cooperative monitoring efforts with the Audubon Society of New Hampshire, New Hampshire Department of Fish and Game, and the U.S. Fish and Wildlife Service found that a total of 59 peregrines had been hatched from six cliff nests in New Hampshire, one nest was on the WMNF.

In 1999, peregrine falcon had recovered to the point where the U.S. Fish and Wildlife Service removed them from the endangered species list. By 2000, the local population had steadily increased to 18 active nests in New Hampshire and Maine. Thirteen territories located on or immediately adjacent to the Forest have been active for at least one year, with five active for at least ten years (Martin 2000, Todd 2000).

Cliff habitats are unique and not a condition that can be created, so protection of existing and potential nest sites is important. The greatest potential threat to cliff nesting on the WMNF is rock climbing, which has increased in popularity in recent years. Closure orders and voluntary restrictions adopted by local rock climbing clubs have proven effective, with successful nesting occurring near established climbing trails. It is expected that peregrines will continue to expand the local population until the habitat is saturated.

BALD EAGLE

Bald eagles were also widespread until the use of DDT resulted in population declines and subsequent listing under the Endangered Species Act. Bald eagles have also made a remarkable comeback and were reclassified from Endangered to Threatened status in 1995. The Audubon Society of New Hampshire reported a minimum of 34 bald eagles in the state in 2000. Although bald eagles are occasionally spotted, nesting has not occurred on the Forest. This is not surprising because although the Forest has a great abundance of tall, mature trees for nesting, there are few large bodies of water that support an adequate forage base for an eagle pair. We will continue to inventory larger ponds and potential habitat surrounding Lake Tarleton (a recent acquisition), but there is little else that can be done to promote recovery on the Forest.

EASTERN COUGAR

The eastern cougar is considered extirpated from the eastern U.S. from historic over-hunting, with the last confirmed report in New Hampshire occurring in 1885. Tracking surveys in 1993-1996 showed no evidence of cougars on the Forest, nor were any found on the Forest's Canada lynx scratch pad surveys in 1999 and 2000 which would likely have attracted other big cats. Although occasional sightings of cougars are reported, it is presumed that these sightings are either captive-reared animals or translocated individuals of the western mountain lion, a more abundant subspecies.

EASTERN TIMBER WOLF

Similar to the eastern cougar, the eastern timber wolf is considered extirpated from New England from historic over-hunting. Winter track surveys in 1993-1996 did not identify any wolves and none were found on the 1999 or 2000 Canada lynx surveys. While the lynx survey protocol is not designed specifically to

attract wolves, they have been found on lynx surveys on other National Forests. Despite occasional sightings, wolves haven't been confirmed on or near the Forest in over 100 years.

ROBBINS' CINQUEFOIL

Robbins' cinquefoil is common to the alpine zone of the White Mountains. It was listed as Endangered in 1980 following over collecting by botanists and trampling by hikers, although its harsh growing conditions may also contribute to population losses. Critical habitat was designated over an area approximately 4,000 feet by 400 feet on Monroe Flats. To protect the critical habitat, part of the Appalachian Trail was relocated, scree buffer walls were constructed, and educational outreach efforts were initiated.

By 1991, the U.S. Fish and Wildlife Service recognized another remnant population in the Franconia Range. The species occurs at two general locations, although the U.S. Fish and Wildlife Service documents transplant efforts that have taken place at some nineteen different locations around Mt. Washington. A total of four individual colonies currently support Robbins' cinquefoil.

Monitoring and transplant efforts have been achieved through cooperation with the U.S. Fish and Wildlife Service, Appalachian Mountain Club (AMC) Research Department, and the New England Wild Flower Society. In 2000, AMC reported the Franconia natural population continued to persist with population increases at two of the remaining three Mt. Washington sites. Both transplant populations now meet the modeled minimum population size and the U.S. Fish and Wildlife Service has proposed to delist the species from Endangered Species status (Susi von Oettingen, pers. com.).

INDIANA BAT

The Indiana bat was listed as an Endangered species in 1967. Critical habitat designated in 1976 included eleven caves and two mines in six states, the closest being West Virginia. In 1992, one male Indiana bat was netted during Forest summer bat surveys implemented by the University of New Hampshire and the Northeast Forest Experiment Station. The species had previously been unknown in either New Hampshire or Maine. No Indiana bat hibernacula (winter roost sites), maternity roosts, or individual roosts have been located in either state to date, nor have other Indiana bats been located.

A Programmatic Biological Assessment was developed and submitted to the U.S. Fish and Wildlife Service in 1999. In 2000, the U.S. Fish and Wildlife Service concluded formal consultation by issuing a Biological Opinion concurring that the Forest's current management standards and guidelines (Forest Plan) were not adequate to avoid adverse effects to Indiana bats possibly occurring on the Forest. As part of the Biological Opinion, mandatory Terms and Conditions were issued to specify mitigation actions to avoid harm to Indiana bats. Terms and Conditions include such actions as protecting known roost trees (if discovered), retaining additional snags near upland and wetland openings, reserving live trees around potential roost trees in timber sales, and monitoring.

Terms and Conditions also require the Forest to report the number of acres harvested during the non-hibernation season (May 15 through August 30) when Indiana bats may be present on the Forest. In 2000, a total of 85 acres were harvested during this period in potentially suitable Indiana Bat habitat from all activities (e.g. timber sales, hazard tree removal from trails, etc.), well below the 1,500 acres allowed under the "incidental take" permit accompanying the Biological Opinion.

Additional efforts are underway to add the new standards and guidelines to the Forest Plan, refine habitat parameters to more specifically define where Indiana bats might be found, define specific monitoring protocols, and continue additional surveys.

SMALL WHORLED POGONIA

The small whorled pogonia was listed as Endangered in 1982, and then reclassified to Threatened in 1994 after a number of additional site occurrences were located. The species was first discovered on the Forest in 1993, when 13 plants were found at two separate sites (Sperduto 1993). Later that same year, a monitoring protocol was developed (von Oettingen 1993) and implementation began on the Forest. In 1994, 34 potential sites were evaluated, but no further occurrences were found. By 1997, 36 plants were known from the same sites. The population has fluctuated somewhat since then, but has remained more or less stable. In 2000, there were 32 known plants. The U.S. Fish and Wildlife Service has indicated implementation of the Forest plan would not likely result in adverse effects (U.S. Fish and Wildlife Service 2000).

CANADA LYNX

Declining Canada lynx populations were identified as a concern in the 1986 Forest Plan. Historically, the species was known from at least 20 sites on or adjacent to the Forest, but slowly disappeared during the 20th century and is now believed extirpated from the Forest and New Hampshire, although a breeding population exists in northern Maine. Directed searches for lynx on the Forest covered 610 km in the winters of 1986 and 1991, but found no evidence of lynx (Litvaitis et al. 1991, Brocke et al. 1993). No lynx were found on winter track surveys located across the Forest during the winters of 1993-1996. Most recently, the Forest participated in a national survey for lynx using scratch pads to capture fur samples, which were then analyzed for mitochondrial DNA to determine species. Survey blocks covered 32,000 acres over all districts, but no lynx were found in 1999 or 2000.

Lynx populations throughout the U.S. followed a similar trend to that of New England. In 2000, the contiguous U.S. population of Canada lynx was listed as Threatened. Even prior to the listing the Forest Service proactively initiated a cooperative effort with other federal agencies to develop conservation measures. Lynx habitat was mapped following the standards in the Canada Lynx Conservation Assessment and Strategy (Ruediger et al. 2000). The parameters for lynx habitat on the White Mountain National Forest were developed in cooperation with lynx experts from the U.S. Fish and Wildlife Service, New Hampshire Department of Fish and Game, University of New Hampshire, and Northeastern Research Station.

Lynx habitat is based on denning and foraging conditions and consists primarily of softwood, mixed hardwood and softwood, and brushy wetlands habitats. Within these forest types, virtually all age classes of trees older than five years may be considered habitat of some type. In addition, ecological land types were used to define areas that may not currently be suitable, but have the potential to support suitable stand types. Snow depth was also considered in designing habitat parameters, but while we feel snow conditions above 2,500 feet elevation may provide lynx with a competitive advantage, lower elevations are also counted as suitable because they provide linkages between patches of suitable habitat.

The result of this mapping exercise is a series of 13 Lynx Analysis Units, ranging from approximately 26,000 to 83,000 acres. The majority of the Forest is included in Lynx Analysis Units, although not all acreage is considered lynx habitat. Only the extreme northeast and southwest portions of the Forest are not included because the existing suitable habitat is too sparse and fragmented to be considered adequate.

According to the national Canada Lynx Conservation Agreement with the U.S. Fish and Wildlife Service, all projects must be evaluated against the standards in the Canada Lynx Conservation Assessment and Strategy. Although lynx are not currently believed present on the Forest, the goal of the Agreement and Strategy is that no additional habitat be lost until more specific recovery goals can be determined. With a breeding population in Maine, it is not unrealistic to think lynx may be able to naturally re-colonize the Forest in the future if suitable habitat is present. Standards and guidelines in the National Lynx Strategy will be incorporated into the revised Forest Plan.

THREATENED AND ENDANGERED SPECIES DISCUSSION

Overall, federally listed species have done well since the Forest Plan was approved, not that Forest Plan implementation was solely responsible for that success. Clearly the delisting of peregrine falcon and probable delisting of Robbins' cinquefoil are direct results of cooperative partner efforts, combined with access closures as prescribed by Forest Plan standards and guidelines. Education outreach has also been instrumental in gaining support for these species from hikers and rock climbers. Continued monitoring for these species will be implemented at least in the near future to assure populations are maintained.

Habitat is naturally limited for bald eagle and protection standards are currently in place.

Small whorled pogonia populations are currently stable, although future habitat modifications to maintain adequate light conditions may be necessary if the existing colonies are to persist.

Eastern cougar, eastern timber wolf, and Canada lynx require large home ranges and were greatly reduced in numbers over the last two centuries. Populations cannot persist on the Forest without adequate linkages to other suitable habitat and source populations. Further study is needed on existing Canada lynx populations to fully understand whether the current habitat conditions (especially in terms of prey base and human disturbance levels) on the Forest are adequate to support lynx. It is also believed that in the interim, measures prescribed in the Canada Lynx Assessment and Strategy are sufficient to protect existing cougar and wolf habitat as well.

It is unclear whether the White Mountains are truly part of the Indiana bat's range or if the one bat captured was an anomaly. Some habitat parameters such as trees with sloughing bark for summer roosts and cool, stable air temperatures during winter hibernation are well understood. There is no evidence of Indiana bats being present on the Forest before 1992. Future studies to determine movement from the Vermont and New York hibernacula (where it is assumed Indiana bats in New Hampshire would spend the winter), as well as Anabat (echo locator) and mist netting surveys, will be important in determining the status of Indiana bats on the Forest.

REGIONAL FORESTER SENSITIVE SPECIES

The Regional Forester sensitive species list designates rare species that may require closer attention to preclude listing at the federal level. Forest Service Manual 2670 requires periodic updates to the list as species' status changes. In 1986, only one species, White Mountain silverling, *Paronychia argyrocoma*, was considered sensitive following its delisting from federal status. The Forest Service Northeast Region created listing criteria in 1990 and updated the list again in 1994.

In 1999, a new process for updating the sensitive species list was adopted. Previously, species had to be considered "at risk" region-wide to be designated sensitive. The criteria for the latest update included separate consideration by each Forest. In addition, rather than using only screening criteria (i.e. species must be ranked globally rare by The Nature Conservancy or a candidate for listing (C2) by the U.S. Fish and Wildlife Service), Forests had the latitude to include any species if sound rationale for listing could be provided. This allowed for more specific local conditions to be considered. The final list using this new process was approved in 2000. The change in sensitive species over time is shown in Figure 6.

Figure 6 The change in sensitive species listed 1990, 1994, 2000

Common name	Scientific name	1990 list	1994 list	2000 list
Northern goshawk	*Accipiter gentilis*		X	
Bicknell's thrush	*Catharus bicknellii*			X
American peregrine falcon	*Falco peregrinus*			X
Common loon	*Gavia immer*			X
Eastern small-footed bat	*Myotis leibii*	X	X	X
New England cottontail	*Sylvilagus transitionalis*	X	X	
Northern bog lemming	*Synaptomys borealis sphagnicola*	X	X	X
Canada lynx	*Lynx canadensis*	X	X	
Wood turtle	*Clemmys insculpta*			X
White Mountain fritillary	*Boloria chariclea montina*			X
White Mountain butterfly	*Oenesis melissa semidea*			X
White Mountain silverling	*Paronychia argyrocoma var. albimontana*		X	
Arnica	*Arnica lanceolata*		X	X
Pond reedgrass	*Calamagrostis lacustris*		X	X
Wiegand's sedge	*Carex wiegandii*		X	X
Ram's-head lady's slipper	*Cypripedium arietinum*		X	
Mountain avens	*Geum peckii*		X	X
Butternut	*Juglans cinerea*		X	X
Auricled twayblade	*Listera auriculata*		X	X
Wavy bluegrass	*Poa fernaldiana*		X	X
Alga pondweed	*Potamogeton confervoides*		X	
Boott's rattlesnake-root	*Prenanthes boottii*		X	X
Boreal blueberry	*Vaccinium boreale*		X	X
Dwarf white birch	*Betula minor*			X
Alpine bitter-cress	*Cardamine bellidifolia*			X
Bailey's sedge	*Carex baileyi*			X
Clustered sedge	*Carex cumulata*			X
Squirrel-corn	*Dicentra canadensis*			X
Goldie's woodfern	*Dryopteris goldiana*			X
Oakes' eyebright	*Euphrasia oakesii*			X

Common name	Scientific name	1990 list	1994 list	2000 list
Proliferous red fescue	*Festuca rubra var. prolifera*			X
Northern comandra	*Geocaulon lividum*			X
Broad-leaved twayblade	*Listera convallarioides*			X
Heart-leaved twayblade	*Listera cordata*			X
Alpine cudweed	*Omalotheca supinum*			X
Canada mountain-ricegrass	*Oryzopsis candensis*			X
Mountain sweet cicely	*Osmorhiza berteroi*			X
American ginseng	*Panax quinquefolius*			X
Sweet coltsfoot	*Petasites frigidus var. palmatus*			X
Pink wintergreen	*Pyrola asarifolia*			X
Livelong saxifrage	*Saxifraga paniculata*			X
Moss campion	*Silene acaulis var. exscapa*			X
Nodding pogonia	*Triphora trianthophora*			X

Specific details regarding status changes on the 2000 list are documented in species risk evaluations (U.S. Forest Service 1999). The increase in species listed in 2000 is a reflection of the changed criteria allowing more local designations. Many are alpine or subalpine species not present on other Forests, so they wouldn't have been listed by earlier regional-based criteria.

In 2000, a regional supplement to Forest Service Manual 2670 also provided new guidance for development of conservation assessments and conservation strategies for sensitive species. A conservation assessment is essentially a compilation of all known information regarding a species or community, while a conservation strategy uses the information gathered in the conservation assessment to recommend appropriate management actions to protect or recover the species.

Through partnership with the New England Wild Flower Society and the Vermont Institute of Natural Science, conservation assessments for two plant species (White Mountain silverling and nodding pogonia) and for Bicknell's thrush were initiated in 2000, with another six conservation assessments planned for 2001.

Finally, a Forest Plan amendment was proposed in 2000 to clarify direction in the current Forest plan regarding protection of sensitive species.

The Regional Forester sensitive species list has undergone quite a few changes since its initial inception. The most recent list gives the Forest flexibility to focus time and resources on those species most in need of attention locally. More frequent review and update of the list will also result in more timely changes. Conservation strategies will provide more specific management guidelines to protect and enhance habitat for these species. Implementation of these guidelines will result in more species being removed from sensitive species status in the future.

MANAGEMENT INDICATOR SPECIES

Management Indicator Species (MIS) are defined in Forest Service Manual 2620.5 as "plant and animal species, communities, or special habitats selected for emphasis in planning, and which are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent." The 1986 Forest Plan identified 17 MIS to represent a range of habitat conditions. They include the following:

Figure 7. Management Indicator Species – White Mountain National Forest

Species	Habitat type
Northern goshawk	Mature and overmature northern hardwoods, including northern hardwood/spruce and swamp hardwoods
Chestnut-sided warbler	Regenerating northern hardwoods, including northern hardwood/spruce and swamp hardwoods
Broad-winged hawk	Mature and overmature paper birch/aspen
Ruffed grouse	Aspen of all ages and regenerating or young birch
Gray squirrel	Mature and overmature oak, including oak/pine
Rufous-sided (now Eastern) towhee	Regenerating and young oak, including oak/pine
Pine warbler	Mature and overmature pine
Northern Junco	Regenerating and young pine
White-tailed deer	All ages of hemlock
Cape May warbler	Mature and overmature spruce, spruce/fir, and fir
Snowshoe hare	Regenerating and young spruce, spruce/fir, and fir
Eastern kingbird *and* Eastern bluebird	Grass, forb or apple upland opening
Mourning warbler	Shrub upland opening
Black duck	Wetlands
Brook trout	Permanent lakes, ponds, and streams
Peregrine falcon	Cliffs and talus

Pine marten, osprey, common loon, and Sunapee trout are included as management indicator species because in 1986 they were listed as "endangered or threatened on a state list or have special habitat needs" (Forest Plan p. VII-B-9). These species were not selected to serve as an indicator of some vegetative type or condition like the MIS in the above table.

Robbins' cinquefoil, Canada lynx, gray-cheeked (now Bicknell's) thrush, blackpoll warbler, gray squirrel, eastern kingbird, northern goshawk, broad-winged hawk, and Cape May warbler were selected to represent changes caused by human disturbance such as trails and ski areas.

The Forest plan identifies monitoring for each species to determine population and habitat trends. Among the National Forests, the White Mountain is unique in using a Committee of Scientists to help develop monitoring protocols for wildlife species. Three separate subcommittees were convened in 1987 to recommend monitoring strategies for birds, large mammals, and small mammals that would relate to management practices. The subcommittees were to identify needed changes to management activities that might cause negative impacts to populations or habitats.

Monitoring projects resulting from the subcommittee recommendations include:

- Breeding bird surveys on 360 permanent plots
- Wetland bird surveys on 59 wetlands
- High elevation bird surveys over 40 individual transects
- Winter track surveys over 45 miles of transects
- Small mammal trapping over the permanent plot transects used for breeding birds

Monitoring that uses these protocols is expected to cover the majority of the MIS species. Other directed searches or species-specific protocols were developed for the remaining species. In 2000, the Forest initiated an assessment evaluating population and habitat trends for Management Indicator Species based primarily on monitoring using the above protocols, but also incorporating other known information (U.S. Forest Service 2000). The final MIS report will be available 12/31/01. A brief summary of preliminary findings is presented here.

SUMMARY OF MANAGEMENT INDICATOR SPECIES TRENDS

MIS THAT REPRESENT MATURE STANDS

northern goshawk, broad-winged hawk, gray squirrel, pine warbler, Cape May warbler, gray squirrel

Populations of these species are stable, although most fluctuate on the Forest from year to year. This is a natural phenomenon also evident in other parts of these species' ranges. Mature and over mature stands have made up more than 80% of the vegetation on the Forest since 1974, so habitat is considered available.

MIS THAT REPRESENT YOUNG OR REGENERATING STANDS

chestnut-sided warbler, eastern towhee, northern junco, snowshoe hare

Population trends for these species are generally declining at the regional level (Partners in Flight Physiographic Area 28). Trends at the Forest level are less clear. Habitats for some species are naturally scarce and populations are not picked up frequently in monitoring efforts. Some MIS represent early successional habitats but will also use a variety of other habitat. Stable or increasing population trends for those species do not only reflect early successional habitat conditions.

Data on habitat conditions has been categorized by different techniques over the years, but some patterns can be drawn. Information from 1974 shows approximately 28% of the land base available for timber harvest was in regenerating or young stands. By 1991, after the Forest plan was approved, the percent of Management Area 2.1 or 3.1 lands available for timber harvest in regenerating or young condition had dropped to 21%. A decade later, the percentage dropped to 18%. Looking at the entire Forest, the decline is less noticeable, a 2% reduction since 1991. This makes sense, since approximately half of the Forest is not

available for timber harvest and would be expected to mature unless severe weather such wind or ice storms resulted in whole stands being regenerated.

MIS THAT REPRESENT OPEN HABITATS

eastern kingbird, eastern bluebird, mourning warbler, black duck

This category includes a number of species with very different requirements. Both the kingbird and bluebird represent large openings that are naturally limited on the Forest. Both species show declining trends at the Physiographic Area level, but are stable on or near the Forest. The mourning warbler also uses openings, but prefers them in shrubby condition. This species is considered stable in the Physiographic Area, but has shown declines on the Forest in the last decade. Habitat for all three of these species is considered more or less stable although limited on the Forest.

Black duck has rapidly declined globally, although local populations in Physiographic Area 28 are more stable. Forest populations appear stable, although wetland habitats in the White Mountains may be smaller and fluctuate more because of beaver activity than in other coastal areas.

MIS THAT REPRESENT AQUATIC HABITATS

brook trout

Brook trout densities have been monitored at 2 to 14 index sites from 1992 to 2000. Over 90% of fish collected were determined to be wild fish. Population levels appear to experience large natural fluctuations due to flood and drought events. Numbers of fish per mile ranged from a low of 822 in 1996 to a high of 2550 in 1995. A large flood in late 1995 is believed to have substantially reduced numbers in subsequent years. Populations rebounded by 1999 when densities averaged 1850 per mile. Total stream miles providing fish habitat are considered to be stable at this time.

RARE SPECIES

pine marten, osprey, common loon, Sunapee trout

Pine marten populations have grown since relocation in the Wild River area. Habitat is readily available across the Forest. Osprey and common loon recovery is limited by available habitat, since large ponds with available forage are naturally uncommon on the Forest (similar to the bald eagle situation). Sunapee trout, which was never indigenous to the Forest, is believed to have been extirpated from New Hampshire for at least 50 years. There is little hope of recovery because of genetic cross-breeding.

SPECIES AFFECTED BY HUMAN DISTURBANCE

Robbins' cinquefoil, Canada lynx, Bicknell's thrush, blackpoll warbler, gray squirrel, eastern kingbird, northern goshawk, broad-winged hawk, Cape May warbler

Robbins' cinquefoil, Canada lynx, gray squirrel, eastern kingbird, northern goshawk, broad-winged hawk, and Cape May warbler are addressed above under MIS That Represent Mature Stands. High elevation monitoring shows Bicknell's thrush and blackpoll warbler populations fluctuated from year to year, but essentially remained stable over the period 1993-1999. Habitat is considered stable.

OTHER MIS

ruffed grouse, white-tailed deer

Ruffed grouse and white-tailed deer are both hunted species. Ruffed grouse tend to fluctuate on the Forest from year to year, although they appear to be widely distributed across the Forest (MacFaden and Capen 2000). The Forest has not yet reached habitat goals identified in the Forest Plan, so additional habitat may be desirable. White-tailed deer and habitat are similarly well distributed across the Forest, although local populations are more limited by winter severity.

MANAGEMENT INDICATOR SPECIES DISCUSSION

Evaluation of Management Indicator Species shows that most species are stable or increasing in population and habitat. There could be exceptions in some species representing early successional habitats. None of the species representing early successional habitats are currently considered rare and there is no immediate concern regarding loss of species persistence. It appears that these changes reflect the steady increase of stand growth as the Forest ages. Current Forest plan objectives for stand age class distribution have not been met in recent years, with shortfalls in regenerating and young age classes for virtually all forest types. This may explain the shortfall of habitat and subsequent population declines. This does not necessarily reflect a need to amend the current Forest plan. Rather, until the current Forest plan is fully implemented, changes in some Management Indicator Species populations can be expected.

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Old-Growth Hardwood Snag

VEGETATION MANAGEMENT

INTRODUCTION

The purpose of this report is to describe progress toward meeting the vegetation management goals in the Forest Plan. There are two primary goals involving timber management stated in Chapter III of the Forest Plan.

1. Feature northern hardwood management over softwood. Move toward the culturing of high quality hardwoods that are in demand for specialty products. Assure a stable, reliable source of this raw material to support community stability.
2. Use timber management as one of the tools available to achieve the desired future condition and integrated resource objectives of certain management areas.

The reasoning behind these goals is explained in detail in the FEIS (Final Environmental Impact Statement) for the Forest Plan. Among the points emphasized in the FEIS are the following:

- Properly planned, designed and executed timber harvesting can enhance scenic viewing, especially along road corridors, opening up vistas and providing tree and foliage variety.
- Timber management activities increase wildlife diversity by improving tree species composition and age class distribution.
- There is indication that quality sawlogs will become scarce. Federal lands may be an important component of quality sawlog supplies in the future.

Before discussing these goals in detail, here is a brief summary of the 2000 White Mountain National Forest vegetation management program including sale preparation, reforestation, silvicultural examination, and timber stand improvement activities.

VEGETATION MANAGEMENT ACTIVITIES FOR FY 2000

During FY 2000 the White Mountain National Forest vegetation management program included sale preparation on several upcoming projects as well as reforestation, silvicultural examination, and stand improvement activities. In addition, approximately 17,000 MBF (thousand board feet) of timber was harvested on 2,698 acres.

Figure 8. Acres of silvicultural activity in FY 2000

Silvicultural Activity	Acres
Stocking Surveys	3,016 acres
Site Preparation	366 acres
Release	104 acres
Silvicultural Examination	36,938 acres

Stocking surveys are completed in the first and third years following harvest to insure that regeneration is established on harvested sites. Site preparation consists primarily of removing poor quality saplings on

harvested sites to promote the development of high quality stands in the future. The purpose of most of the release treatments is to improve diversity within specific stands by enhancing growing conditions for desirable species that occur in relatively small proportions on the WMNF.

In 2000 there were several cases where release treatments were done to promote oak or pine in young northern hardwood stands. Silvicultural examination involved field inventory to assess vegetative conditions on approximately five percent of WMNF land.

Although no timber sales were offered during FY 2000, due to the need to complete the TES amendment to the Forest Plan, sales that were under contract continued to be harvested. The acres harvested by various methods are shown in Figure 9.

Figure 9. Acres of Timber Harvest Activity in FY 2000

Harvest Method	Even-aged Management	Uneven-aged Management
Clearcutting (includes patch clearcuts and stand clearcuts)	242 acres	
Seed Tree	9 acres	
Shelterwood (includes shelterwood preparation, seed, and removal)	154 acres	
Thinning	204 acres	
Selection (includes single tree, group selection and improvement cuts)		2,089 acres
Totals	609 acres 23% of total harvest	2,089 acres 77% of total harvest

PRODUCTION OF HIGH QUALITY HARDWOOD

While high quality hardwood management is emphasized, it is clearly not meant to be at the exclusion of management for softwoods. There are many reasons why softwood management is practiced on the WMNF such as habitat diversity, maintenance of winter cover, and site suitability. However, the majority of the ecological land types within the management areas where harvesting takes place are more suited to hardwoods than softwoods. By following management practices that rely primarily on natural regeneration the Forest places emphasis on the production of high quality hardwood.

There are large quantities of low quality sawtimber or pulpwood available on the Forest. There is a limited supply of high quality material. A recent study of supply and demand in the market area shows that the value of high quality sugar maple, red oak and yellow birch has a log value approximately three times greater than low quality material of the same species. The difference in value between pulpwood and high quality logs is even greater. Timber sale receipts often show the stumpage value of even moderately good quality sawlogs to be 20 to 30 times greater than for pulpwood.

The long-term goal of producing high quality sawtimber does not mean that the program should focus exclusively on harvesting the best material on the forest. The long-term production of high quality products requires using silvicultural practices such as thinning and selection harvests that create conditions for vigorous growth of trees that have the potential to produce high quality logs in the future. Even in a forest with a high percentage of good quality trees, pulpwood and low quality logs will always be part of the harvest. Recent research completed in the Bartlett Experimental Forest found that the percentage of high quality sawtimber (grades 1 and 2) could be increased through properly applied harvests. In this study, the high quality component of a stand rose from 29% to 45% after two harvests.

Thinning and selection harvests on the WMNF have been implemented using the same principles applied in the Bartlett Experimental Forest study. Similar results are expected to occur in treated stands across the Forest. The value of sawtimber harvested on the forest increased dramatically from the inception of the 1986 Forest Plan through 1998. Because sawlogs are not graded on WMNF timber sales, it is not possible to know exactly how much of this increase relates to overall improvement in the price of sawlogs in general and how much relates to the relative improvement in the quality of material harvested.

A large percentage of thinning and selection harvests were implemented for the first time under the 1986 Forest Plan silvicultural guides. Treatments under these silvicultural guidelines will show a similar trend to that described in the Bartlett study. The treatments will produce a significant increase in the proportion of high value timber left to grow in treated stands. Consequently, the outlook for the future is for an even greater increase in the stumpage value of timber sold.

There are 345,000 acres suitable and available for timber harvest on the Forest. The ratio of pulpwood to sawlogs remained fairly constant with sawlogs accounting for approximately one-third of the volume sold. The ratios are not expected to change radically in the near future. Even with the goal of high quality sawlog production, application of sound silvicultural practices will result in the harvest of significant quantities of low value material to promote the growth of high quality trees into the future.

There is a noticeable difference in the trend between sawtimber prices and pulpwood. Pulpwood values fluctuated very little between 1986 and 1998. Pulpwood prices in 1998 were almost identical to those in 1988. Sawtimber has shown a steady increase in value with the average value in the final six years being 70% higher than the value for the initial six years. This trend is highly compatible with the projection in the Final Environmental Impact Statement for the Forest Plan that there would be a scarcity of high quality sawlogs.

Figures 10 and 11 are from the WMNF Cut and Sold Reports and depict the trends in volume and value of stumpage sold on the WMNF from 1987 through 1998. The volume ranged from a high of just over 30,000 MBF early in the period to a low of just under 18,000 MBF in 1998. The average volume sold was 24,000 MBF per year. This average harvest affects approximately 4,800 acres annually, including thinning, improvement, selection and group cuts. By comparison, a similar mix of harvest methods at the anticipated harvest intensity of the Forest Plan, 35,000 MBF, would affect about 7,000 acres each year.

Fugure 10. Volume of Forest Products Sold on the WMNF 1987 through 1998

Fiscal Year	Sawtimber MBF	Pulpwood MBF	Total Sold MBF
1987	9,614	18,553	28,167
1988	10,664	19,587	30,251
1989	9.903	20,283	30,186
1990	8.538	18,652	27,190
1991	8,118	15,658	23,776
1992	5,818	12,696	18,514
1993	9,496	17,390	26,886
1994	8,022	15,304	23,326
1995	7,467	16,714	24,181
1996	5,560	11,764	17,324
1997	5,944	13,551	19,495
1998	5,899	11,760	17,659
Totals	**95,043**	**191,912**	**286,955**
Average	7,920	15,993	23,913

Figure 11. Value of Forest Products Sold on the WMNF 1987 through 1998

Fiscal Year	Sawtimber $ per MBF	Pulpwood $ per MBF
1987	76.57	13.24
1988	94.11	18.97
1989	96.21	19.99
1990	98.25	19.76
1991	94.96	20.62
1992	88.73	18.76
1993	121.25	19.59
1994	144.13	22.34
1995	135.54	21.09
1996	157.52	21.58
1997	192.68	22.08
1998	180.80	18.61
Average	123.40	19.72

INTEGRATED RESOURCE OBJECTIVES

Timber Management activities have been guided by the concepts of sustainability and integrated resource management in the 1986 Forest Plan. Numerous projects have been completed that demonstrate these principles. Shortly after the completion of the 1986 Forest Plan, the WMNF completed an interim step between forest planning and project implementation on many areas on the Forest. This undertaking, known as Opportunity Area Analysis, provided a means of reviewing specific areas of the Forest to insure that the Forest Plan would be implemented in an integrated manner. The size of the analysis units varied but was often in the range of 10,000 to 20,000 acres.

The Opportunity Area Analysis process provided a means for looking at all resource needs across the landscape, obtaining public input, and developing a coordinated project list aimed at achieving the goals established in the Forest Plan. Several examples demonstrating the application of these integrated principles to the management of the land are pictured below.

Vista and Wildlife Opening along the Bretton Woods Cross-country Ski Trails

Harvesting along the Bretton Woods cross-country ski trails was completed in the early 1990s with the integrated objectives of providing views of the Presidential Range, creating a permanent wildlife opening, and improving age class diversity. As part of a timber sale that harvested approximately 2,500 MBF of timber, units were laid out along the cross-country ski trails in a manner that opened up views such as the one seen above. Approximately one acre of this particular harvest site was then smoothed and seeded so it could be maintained as a wildlife opening. The wildlife opening is now vegetated with a mix of forbs, berry bushes and small saplings. It provides habitat diversity in an otherwise densely forested area and has been used by snowshoe hare, moose, deer, bear, woodcock, and numerous songbirds.

To insure that impacts to skiers were minimized, harvesting was scheduled outside the active ski season to the extent possible. When soil conditions required winter harvesting, the timber purchaser worked closely with the ski area permitee and the Forest Service to insure that operations were conducted in a safe manner compatible with skiers on the trail system. Crossing trails with logging equipment was minimized and when trail closures were necessary they were implemented for short periods of time and on a minimum number of trails at any given time.

Regenerated Clearcut Approximately 14 Years after Harvest

A mature red maple/paper birch stand was clearcut in the late 1980s to improve age class and species diversity. The regeneration pictured above has developed since the clearcut was completed. It includes aspen, paper birch, yellow birch, black cherry, sugar maple, and red maple as well as the serviceberry that is flowering in the center of the photo. This type of regeneration is typical of regenerating stands in this ecological land type. Paper birch developing on this site will grow into good quality stems that are much in demand by the millwood industry in northern New England. At the same time a stand such as this provides wildlife habitat diversity and is particularly important for neo-tropical migrant bird species.

Vista/wildlife Opening along the Beaver Brook Cross-Country Ski Trails.

This view of the Garfield Range was created along the Beaver Brook cross-country ski trails. In the foreground is a maintained wildlife opening while the middle ground displays a regenerating aspen/paper

birch stand. Summer harvesting was used to minimize impacts to skiers and to obtain some scarification to aid in the regeneration of paper birch on the site. This particular opening has developed a heavy component of raspberries and blackberries that can be maintained on the site through periodic mowing or burning.

Apple Orchard Released Through Commercial Timber Harvest

The Moody Ledge Timber Sale was completed in 1999. It included several units designed primarily for removing large trees that were overtopping apple orchards. The orchards had been established in the 19th century as part of the South Landaff Settlement. Apple trees that were being choked out by competing vegetation are now responding to the increased sunlight available for growth. The apple crop produced in the orchard provides food for species such as ruffed grouse, deer and bear. Harvesting in a sensitive site like this requires careful planning and supervision to insure that cultural resources such as cellar holes and stonewalls are protected. The boundaries of harvest units were meticulously marked and the skid system was carefully laid out to insure protection of resources. The forest archaeologist was closely involved with this project to insure that Forest Plan Standards and Guides were followed.

Closed Logging Road

Once harvesting was completed in 1999, this access road was water-barred and seeded. It will remain closed to vehicles until harvesting once again takes place in the future, perhaps 10 to 15 years from now. This road is typical of many that have been constructed for intermittent use to haul timber. When not in use they are blocked to vehicular traffic and re-vegetated. They are frequently used for recreational activities such as cross-country skiing, hunting and bird watching. If they are mowed, they can be maintained in a mixture of forbs, berries and young saplings. It is not unusual to see moose and deer browsing on the saplings, bear and deer feeding on the berries, and snowshoe hare feeding on the forbs in a setting such as this.

VEGETATION MANAGEMENT DISCUSSION

Harvesting has taken place at a level below that envisioned in the Forest Plan. The average annual harvest allowed for this planning period was 35,000 MBF. The volume of timber sold in the first 12 years of the planning period averaged 24,000 MBF per year and showed a decline from around 30,000 MBF early in the period to less than 20,000 MBF in more recent years. The reduced size of the harvesting program means that the two goals are being met to a lesser extent than was anticipated in the 1986 Forest Plan. Less volume harvested means smaller quantities of high quality hardwood production and less progress toward integrated objectives such as improving age class diversity.

The two primary vegetation management goals stated in the Forest Plan that deal with the use of timber management as a tool to achieve integrated resource objectives and with the production of high quality hardwood appear as valid now as when the Forest Plan was developed. While there is still diverse public opinion about the extent to which harvesting should take place on the forest, in actual practice, management on the forest is attaining these goals. Timber management projects have been used to accomplish integrated objectives. The goal of high quality hardwood production is compatible with the integration of multiple resource objectives in the implementation of the vegetation management program.

SOIL PRODUCTIVITY MONITORING

INTRODUCTION

The focus of this report is on the management of soil nutrients, an issue that only briefly surfaced in the 1986 Forest Plan. Past theories are that productivity of forest ecosystems is limited by the availability of resources such as light, water and nitrogen. Recent evidence is that the availability of calcium (Ca) and magnesium (Mg) may limit soil productivity on sensitive sites. The results of limited productivity may include acidification of soils and surface waters and declines in forest growth rates, health, or biodiversity (1).

Decreases in soil calcium are attributed to tree uptake, acid deposition, forest harvest, and a decline in calcium available from the atmosphere. Some studies indicate acid deposition and agriculture each account for three to four times more soil calcium loss compared to intensive forest harvesting of hardwoods. Calcium is of interest because it is important to forest growth and because it buffers the impacts of acid rain. It has been of scientific and public interest since the 1970s. There is renewed interest because some people believe forest practices may intensify and because changes are occurring in rates of atmospheric deposition (4).

Historically, soil erosion was the central issue to soil productivity. Best management practices (BMPs) to prevent soil erosion are well known and have been applied for more than thirty years. There is general agreement that BMPs are effective. Soil erosion is a concern immediately following new road construction because the fine particles are most susceptible to erosion (2). The White Mountain National Forest has built very few miles of new road during the last fifteen years. Existing roads have been re-opened and then closed again at the completion of projects. Reviews of timber sales and ski area construction since the 1986 Forest Plan was initiated indicate few instances of serious concern.

The Forest made a commitment to monitor research findings about soil nutrients in 1986 (3)**.** The Forest is the benefactor of nearby Forest Service Experiment Stations and universities that make significant contributions on this subject. Major contributors include the Bartlett and Hubbard Brook Experimental Forests, Complex Systems Research Center at the University of New Hampshire, the U. S. Geological Survey, and Brown and Syracuse Universities.

The main soil productivity concern is depletion of calcium. If there is calcium depletion, then is the long-term productivity of the forest at risk from activities such as timber harvest? Watershed specific research at the Hubbard Brook Experimental Forest and Cone Pond shows that calcium is leached from the soil faster than it is replaced. These are locations where weathering of minerals to re-supply calcium is relatively slow. In other areas weathering of minerals may occur at faster rates.

DETERMINING SOIL PRODUCTIVITY

Two general approaches may be used to determine soil productivity:

1. Measurement of three forest ecosystem functions: forest productivity, species composition, and forest health

2. Analysis of soil and water chemistry processes

Measuring forest ecosystem functions indicates potential changes in sustainability by measuring forest productivity, species composition, and forest health. Site-specific information for all three measurements is

available on the White Mountain National Forest. Analyses of soil and water chemistry processes indicate whether or not the processes themselves are being impacted. Soil and water chemistry relates to processes such as nitrogen saturation, sulfur saturation, and soil acidification. Both approaches to determining soil productivity are difficult to monitor because changes are not distributed evenly across a forest landscape. There may be places where there is a concern about soil productivity, and nearby, places where there is no concern. The White Mountain National Forest is a mosaic of soils, mineralogy, forest, and land use; which are factors that affect sustainability

MEASUREMENT OF FOREST ECOSYSTEM FUNCTIONS

Forest ecosystem functions are indicated by measuring forest productivity, species composition, and forest health. Ecosystem functions are used to evaluate changes in soil productivity and indicate potential changes in sustainability.

FOREST PRODUCTIVITY

There is some disagreement about the usefulness of measuring forest productivity because in the short-term it may be insensitive to possible long-term changes in nutrient processes. However, this simply underscores the wisdom of relying on multiple indicators. Historically, forest productivity measurement has focused on timber management descriptions such as merchantability, stand density, and basal area. Attention has shifted to considering biomass—the aboveground weight of the forest. The advantage of measuring biomass is that it avoids factors such as forest stand density that can be misleading. Another advantage is that over time measuring biomass incorporates the impacts of human activity, natural succession and natural disturbances. It is a useful way of estimating production, and understanding the impacts of factors such as acid deposition. A shortcoming is that available data does not always incorporate root or leaf biomass. Root biomass is an important consideration when calculating forest carbon content.

The White Mountain National Forest has benefited from two significant types of study about biomass accumulation: site-specific data analysis and remote sensing.

Site-specific data analysis

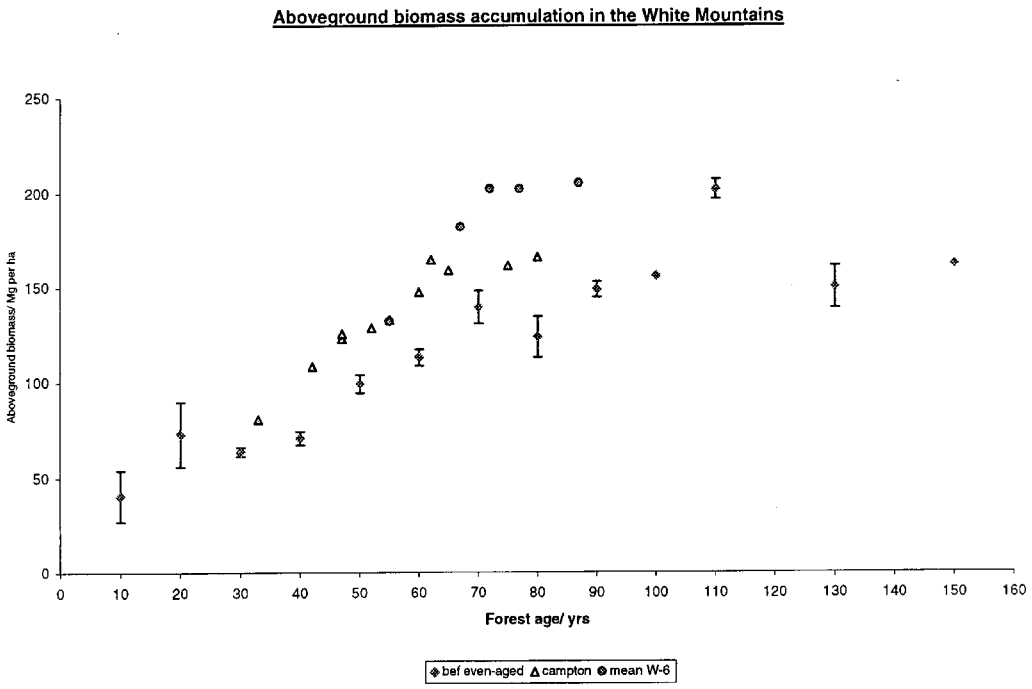
An analysis of site-specific hardwood forest tree data collected since the early 1930s provides information about how hardwood forests grow (5). Analysis of the data provides useful insight into productivity before and after the occurrence of acid rain.

An examination of site-specific tree data was done in 1998. It relied on information from 444 long-term plots established at the Bartlett Experimental Forest in 1931 and information from the late 1970s at old field sites in Campton, NH. Reference sites included Hubbard Brook Experimental Forest and the Bowl Research Natural Area. These are mainly northern hardwood or northern hardwood-spruce forest. The biomass values were plotted on a graph against age to illustrate biomass accumulation over time; and statistics were applied to estimate annual productivity.

A summary of findings is illustrated in the following diagram titled “Aboveground biomass accumulation in the White Mountains.” The central point of this diagram is that the amount of biomass, and the rate at which it accrues, is very similar among the sites analyzed. This indicates that stands that were old before the onset of acid deposition, and those that are old now look pretty similar. This suggests that overall northern hardwood forest productivity has not suffered from human impacts such as atmospheric deposition, and that forest and soil productivity is on track. The biomass accumulation study indicates that forest growth, before and since acid rain, is annually about ½ cord per acre—about what we find in hardwood stands today.

Figure 12 Aboveground Biomass Accumulation on the WMNF

Fig. 5. Overlay of 150 years of forest growth in Campton Agricultural plots , BEF even-aged stands and HBEF WS-6.



Two other important findings have come from this research. First, the natural variability in measurement of biomass is 6%, indicating that changes less than this cannot be attributed to human factors such as timber harvest or acid deposition. This is an important number to know as we try to assess changes in productivity over time. The second important finding is that biomass accumulation peaks at about 80-90 years in northern hardwoods. This is valuable to know because it confirms other field measurements, and helps to resolve differing viewpoints on the age of trees when biomass accumulation peaks. Sometimes there are reports that northern hardwood forests have stopped growing prematurely at 80-90 years. This research indicates that 80-90 years is normal and not premature.

Remote sensing

Remote sensing was used in 1977 to generate data to estimate forest productivity on the White Mountain National Forest (6). The Forest was photographed from an altitude of about 60,000 feet using an airborne visible infrared spectrophotometer (AVIRIS). The results are translated into the nitrogen concentration of the forest canopy. Canopy nitrogen concentration is closely affiliated with soil nitrogen and forest productivity. This approach can estimate forest productivity over large landscapes at a very fine scale, a very important advance and application. This study included ground confirmation of remotely sensed data, and field measurements of productivity. The results depend on the species selected, but the range is ½ to ¾ cords per acre for hardwoods, a little higher then the site-specific data analyses. This helps confirm that forest productivity seems to be staying pretty consistent over time. It is important to note that the results from

imagery and on-the-ground plot measurements are similar and make this imagery application a significant tool in natural resources monitoring.

FOREST SPECIES COMPOSITION

Changes in forest productivity might be reflected by changes in species composition. Some theories indicate that soil productivity changes might lead to long-term changes in species composition. For example, diagnostic species such as sugar maple that appear in both the forest over-story and under-story on certain soils or habitats might start disappearing from the under-story over time. It is already known that the proportion of sugar maple on similar soils changes as the mineralogy becomes richer in calcium. There is also evidence that the richness of herbaceous species follows the same trend.

There is not a large body of long-term information on species changes. There is evidence from Bartlett Experimental Forest and the Bowl Research Natural Area. At Bartlett, long-term trends in forest composition have been measured over a 60-year period since the 1930s (7). Measurement factors that might affect species composition included timber harvest; disease (beech bark disease), natural disturbances (1938 hurricane) and succession patterns related to different soil (site) characteristics. Stands measured included those subject to timber harvest, and those not. In general, timber harvest was modest in intensity. Only the lowest elevations were subject to heavy harvest in the late 1800s. The harvesting included individual tree selection, group selection and clearcuts. In addition, attention was paid to the fact that red spruce decline might be attributed to acid deposition, especially at the higher elevations; or that migration of species to higher elevations might be attributed to climate change.

It was anticipated that shade tolerant species such as sugar maple, beech, hemlock and red spruce might tend to increase in representation, and that declines would denote significant external factors, such as harvest or disease. The results show that shade tolerant species demonstrated little change, beech increasing slightly in unmanaged stands, and decreasing slightly in managed stands; and sugar maple increasing slightly in managed stands. Red spruce also showed little change. The only shade tolerant species that demonstrated a significant increase was eastern hemlock, and this may have been recovery on suitable sites from the earlier days of harvesting for bark tannins. In general, it can be concluded that species succession patterns were the most important factor in species changes over the 60-year time frame of the study. Bartlett Experimental Forest has generally coarse textured soils that are low in terms of initial calcium concentrations. This supports findings that there are not species changes from changes in soil nutrition.

The same pattern emerges in the Bowl Research Natural Area. There has been no history of harvest, or disease, but there has been wind throw. The site conditions in the northern hardwood portion of the Bowl demonstrate that species trends are unfolding as might be expected on fine till soils. Sugar maple and beech, typical succession species on this kind of site, show a range of age classes that indicate replacement of older stems is taking place with younger trees of the same species. Sugar maple is a good example because this is thought to be a species sensitive to soil and site changes. At Haystack Mountain near Bartlett, for example, fine till sites continue to show replacement of sugar maple, but on sites shallow to bedrock, replacement exists in the over-story and is not present in the under-story.

FOREST HEALTH

Forest health decline is another potential measure of change in forest and soil productivity. The symptoms might include unusually high tree mortality, branch dieback, or changes in crown vigor. Hypotheses about decline often rely on soil factors, including nutrient deficiencies related to acid deposition, intense harvest, nutrient imbalances, and low availability of bases such as calcium inherited from soil parent materials. In northern New England, the concern has been with high elevation spruce-fir forests where there

are high rates of acid deposition on thin, acid soils. There is not widespread evidence of decline in the lower elevation hardwood forests often available for commercial forest harvest operations (8).

Red spruce at high elevations has been the focus of research on forest health (9). There is general agreement that red spruce decline has occurred. The source of concern has been acid rain. While it is well known at certain sites that acid deposition contributes to loss of calcium in the soil, it also turns out that acid rain impacts foliage directly, and this impact occurs even when soil calcium is abundant. This does not mean soil calcium is not a factor on some sites. There is an expectation that soil poor in calcium may make these forests more susceptible to low foliar calcium, which in turn leads to diminished cold tolerance, and susceptibility to frost injury and decline. The connection with soil calcium depletion is uncertain, but if it becomes documented, then the implications are potentially significant

The White Mountain Region is part of a northeastern study of sugar maple decline extending from western Pennsylvania to Maine (10). Sugar maple decline has been studied rigorously. It was not until recently, however, that the roles of nutrition, stress, and stand factors were investigated together. It is important to realize that forest decline, or gradual deterioration of health often leading to death, is due to multiple factors that weaken trees and ultimately may trigger mortality.

In the Alleghany plateau, where the effects of tree mortality are very obvious, sugar maple is the most impacted species, effects being evident on more than 30,000 acres. It was determined that low calcium and magnesium were a predisposing factor, and that serious defoliation then triggered the maple decline. In this case, tree mortality is substantial. In northern New England, while there has not been as much defoliation and stress, there is evidence that in some stands foliage has low calcium and magnesium that can predispose these stands to decline. At these locations, tree health ratings are poorer. Some theories suggest this indicates that sugar maple may be sensitive to chemical levels such as calcium.

The argument that whole-tree harvest is acceptable includes detailed evidence the hardwood forest does not demonstrate bio-mass accumulation decline over an extended time, even including the impacts of acid deposition and intense harvest in the late 1800s. Evidence for sugar maple decline potentially related to nutrients exists, but does not include high rates of mortality as in the Allegheny plateau. Stream chemistry values do not indicate high values for aluminum, which would be anticipated from intense calcium depletion. There are no changes in forest composition and most of the harvest sites are deep, well drained soil where the mineral soil plays a more important role than surface organic layers.

There is an argument that whole-tree harvest is unacceptable because the harvest sites include locations where mineral weathering rates are low and total calcium supply limited. Bartlett Experimental Forest, where long-term biomass accumulation studies were done, has fairly coarse-textured soil where current approximations indicate total soil calcium may be low. Scandinavian forests declined without any significant indication of growth change. The decline was sudden, suggesting measurement of process, not functions, may be more important. However, acid deposition rates are much higher in Scandinavia. It is important to remember that there are other factors, such as fertilization from increasing atmosphere CO_2 concentrations, and the impacts of ozone on photosynthesis, that are part of this equation.

Ultimately, a choice about application of whole-tree harvest will rely on trade-offs between visual quality, wildlife habitat management, economics, and soil productivity. From the clinical perspective of soil nutrition, the common ground would be to allow whole-tree harvest on deep, fine to medium texture soils where till source model or foliar chemistry indicators show calcium to be more abundant, and to disallow it otherwise. This would take advantage of the best science available, and allow for changing circumstances. Another factor to consider is developing evidence that at some sites more abundant soil calcium, or calcium draining from ledges, promotes a more rich ground flora including uncommon species.

ANALYSIS OF SOIL AND WATER CHEMISTRY

Interest in forest soil productivity processes in New England has focused on calcium. This is because it is an important nutrient for forests and it is the principal base element in surface waters. Interest has also focused on aluminum mobilization into surface waters, and possible impacts on aquatic habitat. There has also been concern about nitrogen deposition and the possibility it would lead to saturation in the soil and affect productivity. The most recent analyses indicate that impacts to forest productivity are unlikely, except in the very distant future (11).

Calcium cycling has been the focus of local and regional studies. There are continuing studies concerning calcium cycling at Hubbard Brook Experimental Forest and Cone Pond as well as forest-wide on a more extensive basis. This report will summarize some of the main points.

Calcium available for plant growth originates principally from two sources—soil organic matter and mineral soil. There is also a small contribution from atmospheric deposition. In mineral soil, calcium can originate from weathering of primary minerals or from calcium bound to the soil particles. Leaf litter provides a continuing source of calcium that is cycled between the forest and the soil. Calcium in leaves is not conserved in the tree before litter fall, but instead is re-deposited to the soil surface, making the cycling process important for calcium.

Significant progress has been made in understanding calcium cycling such as where it is stored, how rapidly it changes from one storage site to another, the multiple factors that affect its availability, and the possible impacts of forestry activities. No one is able to conclude that changes in calcium are affecting forest productivity, but there is concern. The fundamental concern is that the amount (pool) of available (exchangeable) calcium is limited and its depletion by factors such as acid rain and intense forest harvest, such as repeated clearcut harvest at a single site at short intervals (40-years) may prove ecologically significant (12). The low availability of calcium results from relatively few sites in the soil where calcium can be bound (cation exchange capacity), a relatively small amount of calcium (low base saturation), and low mineral weathering rates. The quantity of calcium available at any one time is approximately 3% of the total amount that may be found in the soil (13). The rate that calcium is released by weathering appears to be slow.

The concern about calcium rests on studies that indicate the available amount is small, and so the impacts of intense forest harvest and acid deposition are large. There are theories that a much larger amount of calcium is actually available, and therefore the magnitude of the problem may be significantly smaller. It is known that it takes about three years for leaves to cycle calcium back to an available form. It is also known that the tree bole, bark and roots hold about 50% of the calcium in a tree, and that branches are about 40% and leaves 3% (13).

Mineral soil is very important because it represents a much larger portion of the available and total soil calcium. There can be significant differences in the mineralogy of seemingly similar soils that represent important differences in the amount and rate of calcium made available for tree growth. The White Mountain National Forest is the benefactor of the Till Source Model being developed for this region. This model uses the bedrock geology of the Forest, and surrounding lands, to derive a computer-generated representation of the original calcium (and magnesium) content of the soil. For example, the model looks up “glacier” to discover what bedrock contributed to the soil; it then estimates the proportion of each bedrock type. The model looks in a table for the chemistry of that kind of bedrock, and displays the results in a map of the Forest.

Work is also being done to display the kinds of minerals that contribute to the soil, so that the actual rates of calcium availability can be displayed. This is important because it will help discriminate those parts of the Forest that are more, or less, sensitive to the impacts of acid deposition, and those places that may be more, or

less, suitable for different levels of forest harvesting. The Forest is also working with the Northeast Research Station and Complex Systems to link the Till Source Model with a more site-specific model (Profile) so that we can actually estimate the impacts of forest harvest and other factors such as acid deposition, and fine-tune harvesting practices.

SOIL PRODUCTIVITY DISCUSSION

The Forest Plan goal to conduct management activities to protect soil and water resources has been reasonably met. The central concern with respect to soils is nutrients, especially calcium. Refinements will result from the till source model, and its extension, the critical loads model. The till source model will show the calcium levels and differences in mineral weathering rates on the Forest. The critical loads model will apply this to specific sites show where soil water and stream water threshold values may be applied for monitoring purposes.

The Forest has avoided short rotation (40-year intervals), and clearcut or whole-tree harvest on soils shallow to ledge (less than 40 inches deep) or on sand soils. No biomass harvest has ever occurred on the Forest. There is no timber harvest of any kind on soils shallow to ledge because for the most part these sites are not considered suitable timberland. There is no harvest on sand soils because these sites are identified and avoided. Soil chemistry and mineralogy studies being done cooperatively between the Forest and the Northeast Research Station may reveal that sand soils are more resilient that currently thought.

Research at Hubbard Brook Experimental Forest indicates foliage, tree bole, soil, and stream calcium is generally lower at elevations above 2,500 feet. On the White Mountain National Forest there are few locations where harvesting of any kind occurs at these higher elevations. The Forest has been applying whole-tree harvest in northern hardwoods on soils beneath 2,500-foot elevation where it is not shallow to ledge or on sand. In those forest stands where clearcut is the final harvest method, the interval between final harvests is approximately 120 years. The amount of clearcut harvest is small compared to group or single tree selection. Estimates of calcium loss are greater for other methods because calcium loss has more to do with the quantity of wood removed over time than the harvest method used. While there is reason to believe that differences in soil texture, chemistry, mineralogy and earlier land use may make some sites more sensitive to calcium loss than others, the Forest Plan goal to conserve soil resources is being met.

Frequent harvest leads to the greatest impacts on soil productivity because the total calcium removed in harvest is maximized and the recovery period is short. It remains to be seen if the Forest has locations where soil is sufficiently rich to warrant this practice. We expect that further till source development and soil sampling will significantly enhance the Forest's ability to make this kind of determination.

Research guidance released after the 1986 Plan indicates soils shallow to ledge and indicates that soils should not be subject to intense harvest, meaning short rotation clearcut harvest. The reasoning with respect to thin soils over ledge is that the available and total calcium supply is small, even if soil texture and mineralogy is favorable. The Forest incorporated this standard in all timber sale activity, whether it was whole-tree harvest or bole-only harvest.

Research guidance also suggests the need to avoid intense, short interval harvest on sand soils. The reasoning is that both low amounts of calcium on few exchange sites and possible low mineral weathering rates, make surface soil organic matter layers more important. For example, affecting litter fall rates is more important here where mineral soil properties are less beneficial. This guidance was followed in all cases where whole-tree harvest was applied; even though harvest was far less frequent than the frequencies used in the research. Avoiding short rotation clearcut harvest and avoiding short interval harvest on sand soils will be considered in Forest Plan revision.

Ongoing studies can be combined with GIS technology to create spatially explicit forest management tools. These studies focus on quantifying biologically available calcium, determining thresholds and indicators for calcium deficient forest stands, and studying calcium cycling across landscapes. These tools may do no more than indicate the areas on the White Mountain National Forest that are potentially low in calcium, and consequently should be treated with more caution.

As research progresses, we may be able to refine forest management strategies to favor species that are more or less sensitive to low nutrient status soils. Research using remote sensing technology has the potential to provide multiple years of remote sensing data that can be used to detect changes in forest nutrient status, health, and productivity. The net effect will be to increase forest health and productivity across all managed lands based on explicit knowledge of soil nutrient status. Proactive use of these tools may help prevent incidences of forest decline on the Forest in the face of a changing environment.

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WATER RESOURCES

INTRODUCTION:

The focus of this report is water quality, especially its chemistry. The principal finding is that based on key chemical parameters, the water quality on the White Mountain National Forest remains good. No evidence indicates a threat to human health or stream organisms. This includes results from watersheds that represent a range of activities including recreation, timber, roads and Wilderness. From a technical point of view, one issue that bears watching may be aluminum in streams. There is some concern regionally that it may at some future time reach toxic levels to stream organisms. Its source is mainly atmospheric deposition. The concern is somewhat heightened because the narrow range of stream calcium values indicate they may be more susceptible to such deposition.

The Forest has monitored water quality and stream water chemistry since the 1950s. In 2000 the White Mountain National Forest in cooperation with the Northeastern Research Station (Durham, NH) summarized the sampling results at all stations across the Forest since the 1950s. There are 446 monitoring stations that have been sampled for chemical content at some time. The locations represent a range of land uses, forest types, and geologies, including old-growth northern hardwood forest and alpine ski areas. Some recent sampling has focused on the Swift River because it represents a variety of uses along a major recreational watershed. Hubbard Brook Experimental Forest (HBEF) has done intensive monitoring since the mid 1950s. Hubbard Brook information is kept separately.

Data collection has been variable. Some sites have been sampled for many years at the same location, and for the same attributes, and some locations were sampled only once, perhaps because of a nearby activity. Analytical methods have also changed and improved over time. This does not diminish the importance of this spatially referenced data set across the White Mountain National Forest.

The importance of this data set is that it represents the range of stream water chemistry conditions found across the White Mountain National Forest. It provides a basis for comparing individual site data collected. It also aids our understanding of the conditions in a more regional context. For example, how does our stream chemistry compare to the more base rich soils and streams in Vermont? Detailed trend analysis over time cannot be done with this data set at this time. The data provides some trend information for stream water chemistry and a baseline for trends into the future.

This data set is also important in the interpretation of other monitoring efforts. The soil productivity monitoring effort is implementing a model about soil chemistry and possible soil changes that may lead to impacts on forest productivity. The model is known as the Profile Model and is also able to estimate changes in stream chemistry related mainly to acid deposition. The water quality sampling across the Forest represents observations that may help refine the model to local conditions.

WATER QUALITY MEASUREMENTS

This report will describe and summarize the stream chemistry data that has been gathered across the forest. The main chemicals evaluated are aluminum (Al^{2+}), calcium (Ca^{2+}), sulfate (SO_4^{2-}), nitrate (NO_3^{1-}), and pH.

Aluminum was selected because it may be mobilized in soils by acid deposition, and when it reappears in streams it may be toxic to aquatic life. There is a similar concern that it may also be toxic to forest growth when it occurs in high concentrations in soils and soil solution.

Calcium was selected because its presence may mitigate the impacts of high aluminum concentrations in stream water. Regionally, stream water calcium concentrations vary by an order of magnitude, and similar differences may occur across the Forest.

Water acidity, or pH, was selected because it controls the solubility of aluminum and is an important factor in governing the possibility of aluminum toxicity. As pH becomes more acid, or lower, aluminum solubility increases.

Nitrate was selected because there are standards for drinking water quality and it may be an indicator of nitrogen saturation in the soil, a concern in the Northeast. The long-term possibility of nitrogen saturation from acid deposition is that it acidifies the soil and may lead to changes in forest and stream productivity.

Sulfate was selected because it is an indicator of changes in air quality or acid deposition, and it may diminish as air quality improves.

REPRESENTATIVE WATERSHEDS

Four representative watersheds are used here to illustrate conditions on the WMNF. The watersheds care the Swift River, South Branch Gale River, Upper Ammonoosuc River, and Dry River. The Swift River represents timber management and recreation activity. The South Branch Gale River and Upper Ammonoosuc River represent municipal watersheds that have timber management and recreation use. The Dry River watershed was chosen because it is in the Presidential Range – Dry River Wilderness Area and does not receive impacts from timber harvesting. It does receive backcountry recreation use. These watersheds are identified in the following figures and are compared with forest-wide water quality.

Figure 13 shows average or "typical" concentrations of the White Mountain streams as determined from an analysis of the entire database of WMNF stream water chemistry data. These are useful for comparison purposes across the Forest. Figure 15 shows the averages for the representative watersheds. Ions are electrically charged atoms or groups of atoms. Cations are positively charged ions (loss of an electron or electrons.) Anions are negatively charged ions (gain of an electron or electrons.)

Figure 13. "Typical" water chemistry in the White Mountain streams.

	Cations (mg/L) (positively charged ions)	Anions (mg/L) (negatively charged ions)
Calcium (Ca^{2+})	1.54	
Aluminum (Al^{2+})	0.03	
Hydrogen (H^{+}) *	0.01	
Sulfate (SO_4^{2-})		5.07
Nitrate (NO_3^{1-})		0.72

* Hydrogen Ion of 0.01 mg/L equates to a pH of 5.0.

STREAM pH (ACIDITY)

The range of pH found on the White Mountain National Forest is 4.05 to 8.12. In the four representative watersheds, the pH ranged from 5.99 to 6.65 or close to neutral, which is 7.0. Figure 14 shows that 50% of the 367 stations have an average pH of 5.97 or less. The pH level is important to aquatic organisms because it is a controlling factor in aluminum solubility.

Figure 14. Streamwater pH data from 367 sampling stations

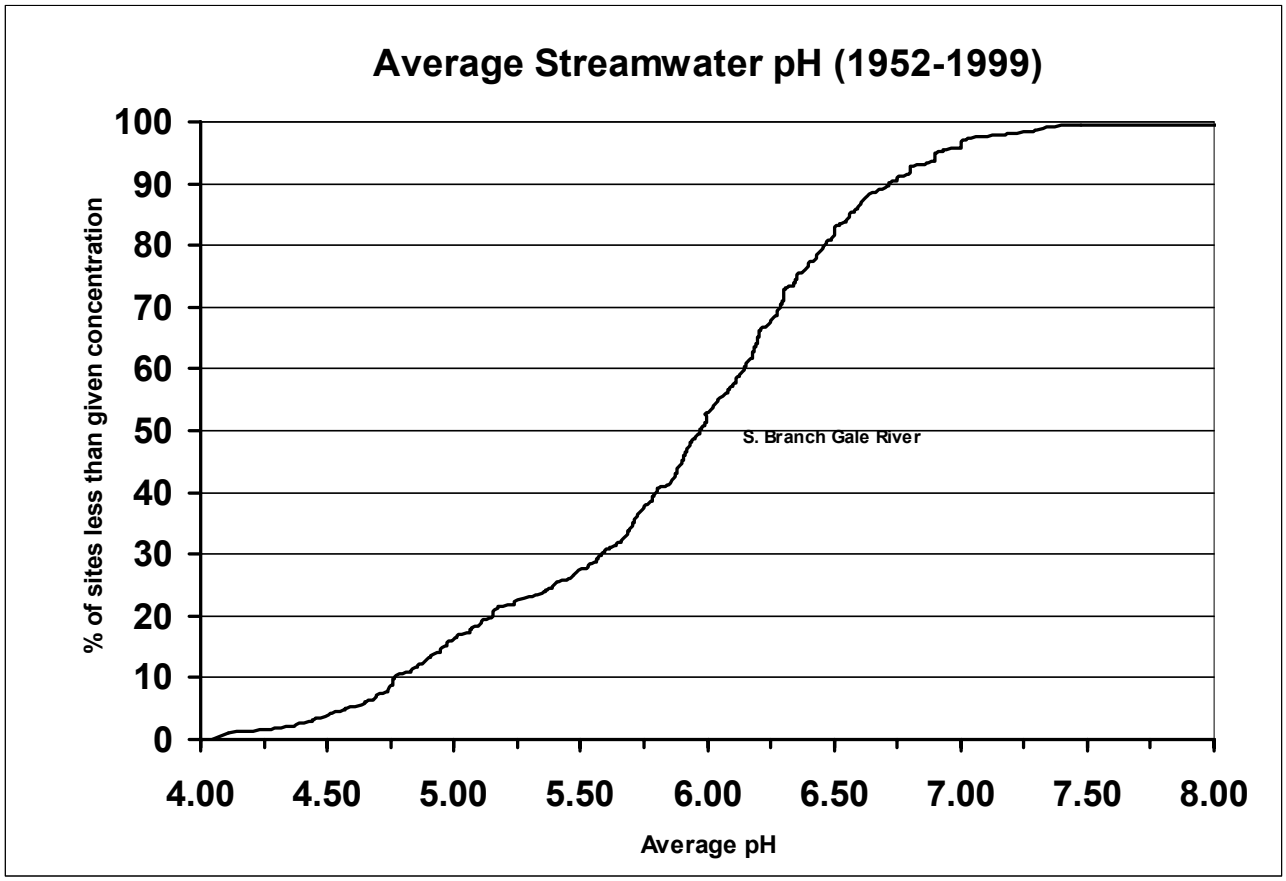


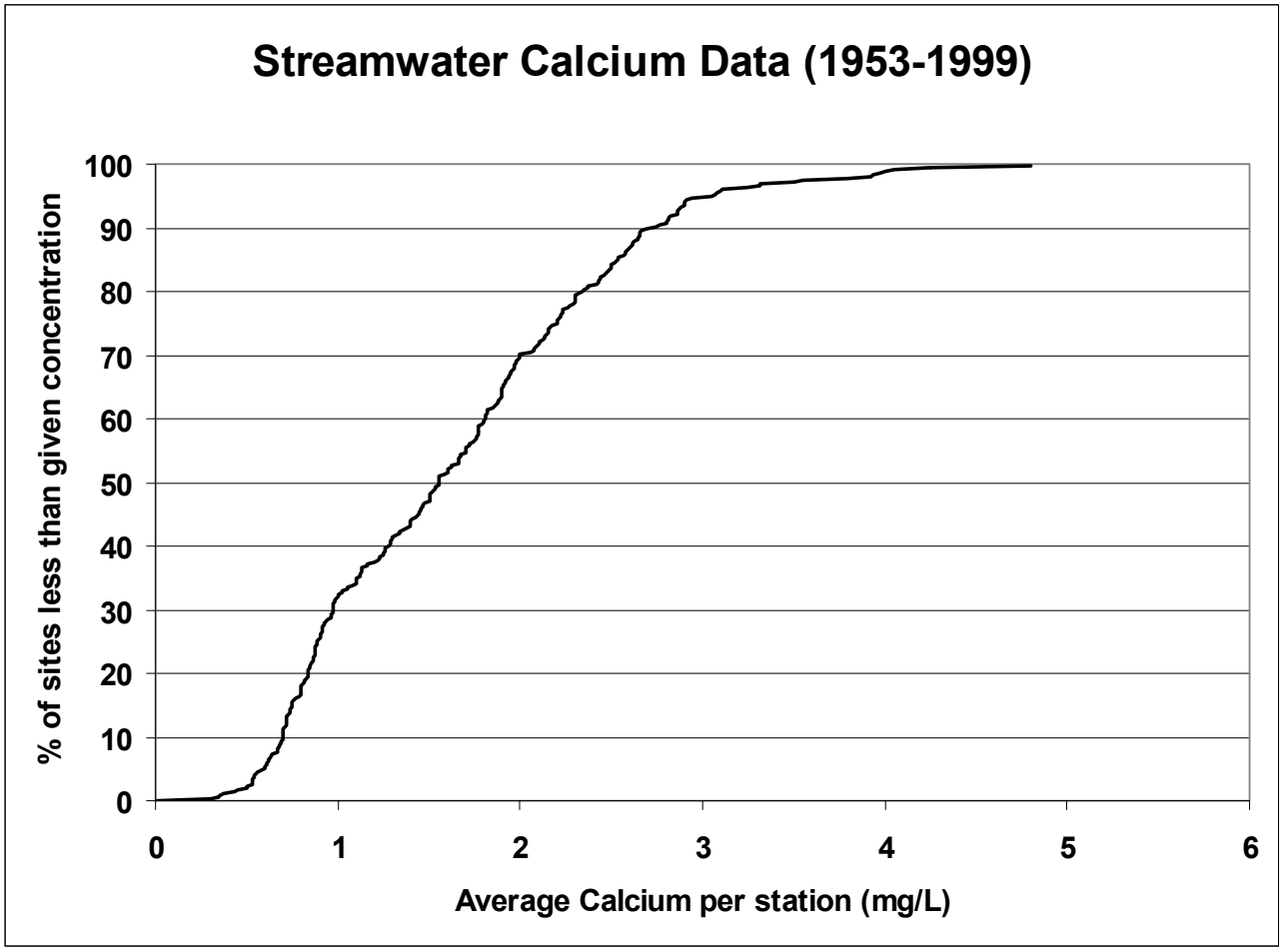
Table 15. Average chemical levels in the four representative watersheds

Watershed Name	Acidity pH	Calcium (mg/L)	Sulfate (mg/L)	Aluminum (mg/L)	Nitrite/Nitrate (mg/L)
Swift River	6.12	2.0	3.5	0.38	0.96
S. Branch Gale River	5.99	4.5	5.3	0.16	2.06
Upper Ammonoosuc River	6.65	2.4	3.9	0.19	0.27
Dry River	6.13	0.6	3.3	0.08	0.05

STREAM CALCIUM (Ca^{2+})

Stream calcium (Ca^{2+}) from 355 stations ranged from 0.1 mg/L to 58.69 mg/L. The 58.69 mg/L is an unnatural concentration measured in Ore Hill Brook after the Ore Hill Mine was rehabilitated and limed. In general, the range on the WMNF is from 0.1 mg/L to 9.47 mg/L. Figure 16 shows that 50% of the stations have Ca^{2+} concentrations of 1.55 mg/L or less. In the four representative watersheds, the range is from 0.6 mg/L to 2.0 mg/L.

Figure 16. Streamwater calcium data from 355 sampling stations

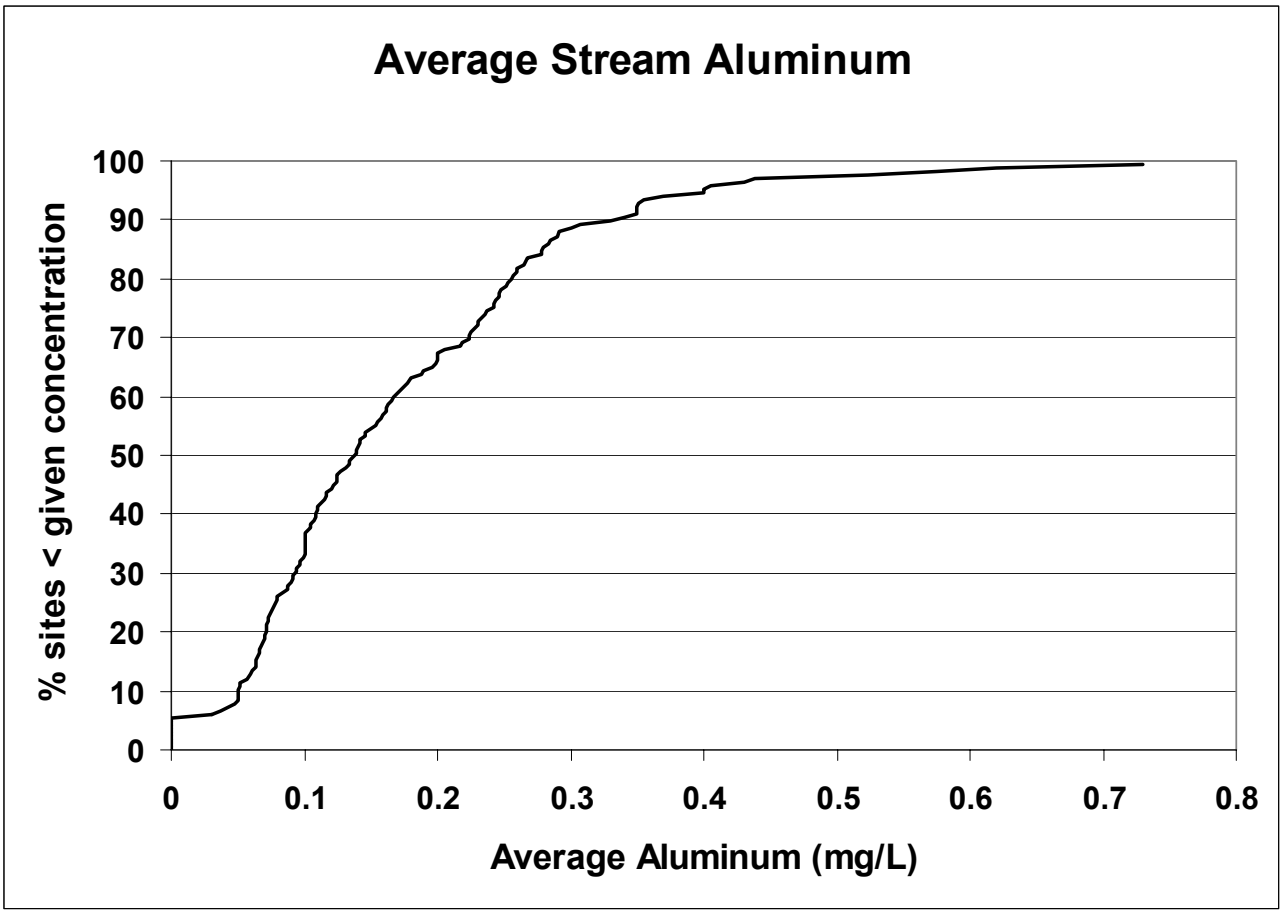


A good way to think about these calcium values is to compare them to regional values that represent the range from base rich to base poor soils. At Sleepers River, Vermont, where the soil is very basic related to base rich bedrock, the calcium concentration is about 20 mg/L. At Hubbard Brook Experimental Forest; which leans toward much less basic bedrock and soils, the value is about 0.80 mg/L. At Cone Pond, NH, thought to be an extreme in terms of acidic conditions, the value is 0.58 mg/L. These differences are representative of differences not only in geologic material but also in soil mineralogy. The range of Ca^{2+} illustrated in Figure 16 is relatively narrow suggesting that ability to buffer acidity and counter aluminum mobilization is also relatively low. This suggests WMNF streams are relatively sensitive to the factors that acidify soils and surface waters, the main factor being acid deposition.

STREAM ALUMINUM (Al^{2+})

The average stream aluminum (AL^{2+}) from 165 stations ranged from near zero to 0.73 mg/L. For the four representative watersheds, the range is from 0.08 mg/L to 0.38 mg/L. Figure 17 shows that 50 % of the stations have AL^{2+} concentrations of 0.14 mg/L or less.

Figure 17. Streamwater aluminum data from 165 sampling stations

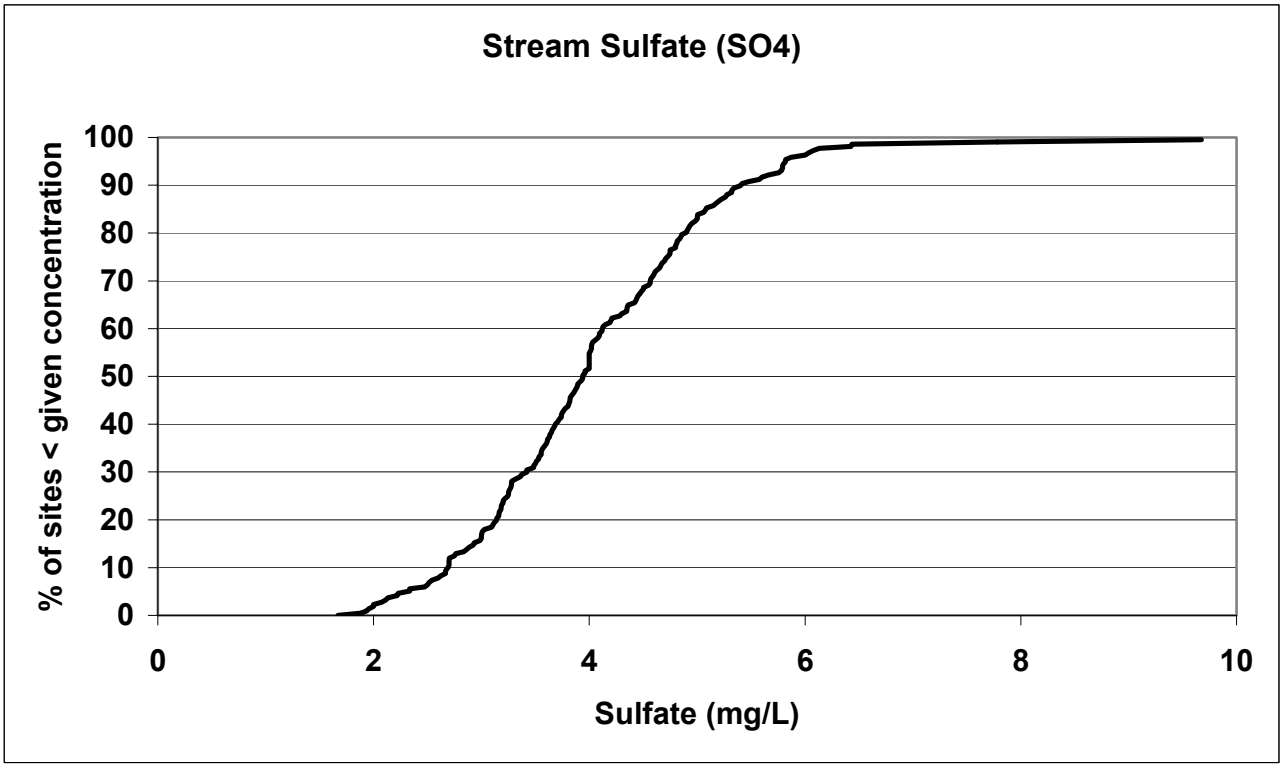


Aluminum toxicity is a very difficult issue, and variations in toxicity occur between species, life stages, and at different pH levels, making it difficult to summarize expected biological responses to aluminum levels. There are summaries of adverse effects on selected fish, insects, zooplankton, and toads that over time may prove useful to improving assessment of impacts. It is well known that the biologically important chemical properties are pH, calcium, and inorganic aluminum.

STREAM SULFATE (SO_4^{2-})

Stream Sulfate (SO_4^{2-}) ranges from 1.67 mg/L to 9.68 mg/L from 217 stations sampled on the WMNF. In the four representative watersheds, the range is from 3.3 mg/L to 5.3 mg/L. Figure 18 shows that 50% of the stations have SO_4^{2-} concentrations of 3.94 mg/L or less.

Figure 18. Streamwater sulfate data from 217 sampling stations



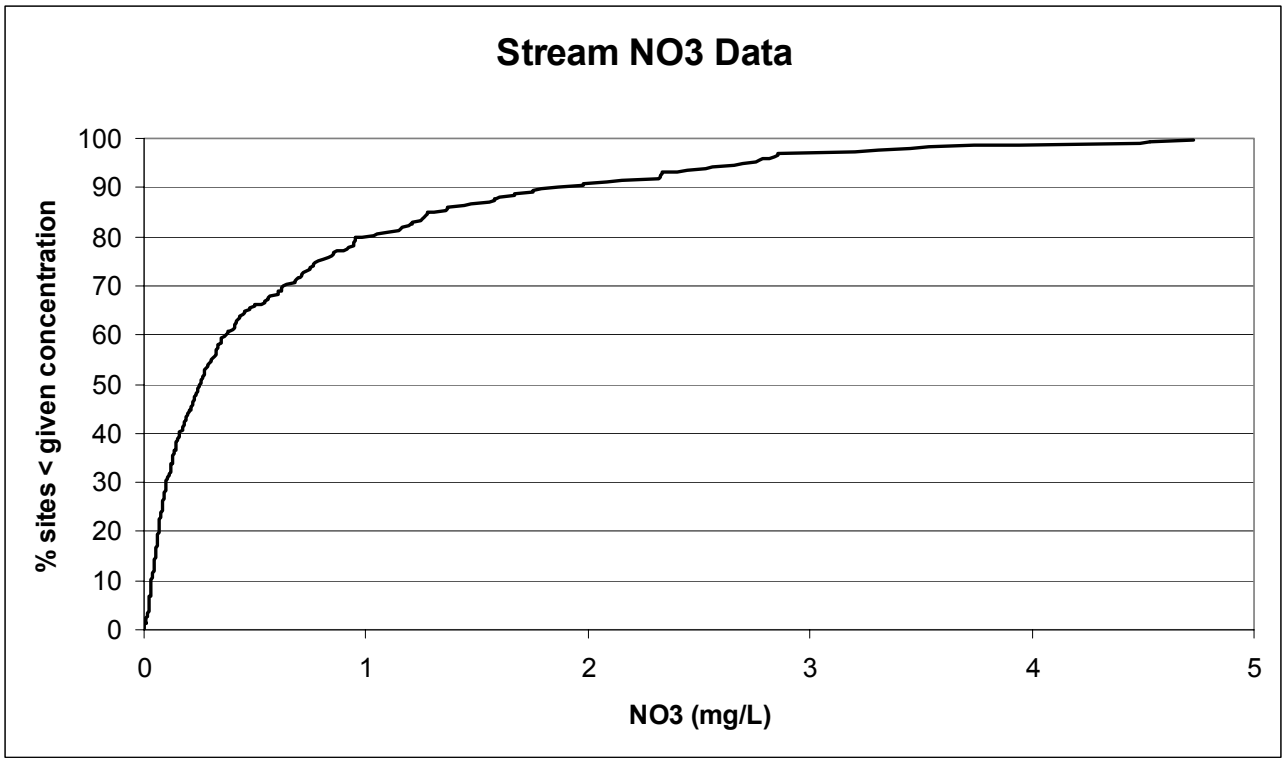
Since the implementation of the Clean Air Act and its amendments, the concentration of sulfate has decreased in atmospheric deposition. This decrease has lead to long-term decreases of sulfate in surface waters throughout the Northeast. However, recent studies of mass balances (what comes in vs. what leaves a watershed) in watersheds in the Northeast have shown watershed loss of sulfate exceeds the atmospheric deposition of sulfur. This pattern suggests that decades of atmospheric sulfur deposition may have led to accumulation of sulfur in the forest soils of the Northeast. SO_4^{2-} concentrations in streams may continue to be elevated for the foreseeable future. Timber harvesting research at Hubbard Brook Experimental Forest showed that sulfate concentrations in stream water declined immediately following harvesting partly because the sulfate (SO_4^{2-}) adsorption capacity of the soil is increased due to the release of Hydrogen Ions (H+) which acidifies the forest soil and soil water; and partly because of dilution from increased water yields that accompany harvesting.

STREAM NITRATE (NO_3^{1-})

Stream nitrate ranges from 0 mg/L to 4.73 mg/L at 330 stations on the WMNF. For the four representative watersheds, the range is from 0.053 mg/L to 2.06 mg/L. Figure 19 shows that 50 % of the

stations have NO_3^{1-} concentrations of 0.25 mg/L or less. The water quality standard for nitrates is 45 mg/L for the protection of human health.

Figure 19. Streamwater nitrate data from sampling stations



Work at Hubbard Brook and other experimental forests shows that the initial removal of trees can result in increased nitrification and production of nitric acid in both the forest floor and mineral soil. The production of nitric acid results in mobilization of base cations (Ca2+, Mg2+, Na2+, and K+) and Al3+. These base cations bind with NO_3^{1-} and leach from the soils into stream water. However, through the natural rapid regeneration of the northern hardwood forests nitrification returns to pre-harvest levels within two to four years and NO_3^{1-} concentration is reduced in stream water. It should be noted that in Hubbard Brook research reported in Martin et. al. (2000), the volume-weighted mean monthly concentrations of NO_3^{1-} were the greatest the year after the harvesting began. For a shelter-wood, strip-cutting harvest method, the mean monthly concentration peaked at 9 mg/L. For whole tree harvest the mean monthly concentration peaked at 30 mg/L. The NO_3^{1-} concentrations dropped to pre-harvest levels within three to five years after harvest.

WATER QUALITY DISCUSSION

The most important recent monitoring activity for water quality is the assembly of long-term water sampling data results into a single database that can be shared. This will not only serve the purposes of the White Mountain National Forest, but also that of experiment stations, universities, and others who may use it. It is a benchmark.

Long-term changes in stream chemistry result from land use, atmospheric deposition, forest type, soils, and mineralogy. Unraveling the importance of individual factors is an ongoing analysis. No evidence on the

White Mountain National Forest indicates an threat to human health or stream organisms. The water chemistry data represents a full range of activities that may occur on the WMNF, from timber harvest, road building, and intense recreation along major rivers. In the future, aluminum mobilization and possible impacts to aquatic organisms may be a concern. This is because the rates of atmospheric deposition of sulfur and nitrogen, the low base saturation of soils, and relatively acid stream water, make the streams relatively sensitive.

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TRANSPORTATION

The Forest Plan describes two management goals for transportation:

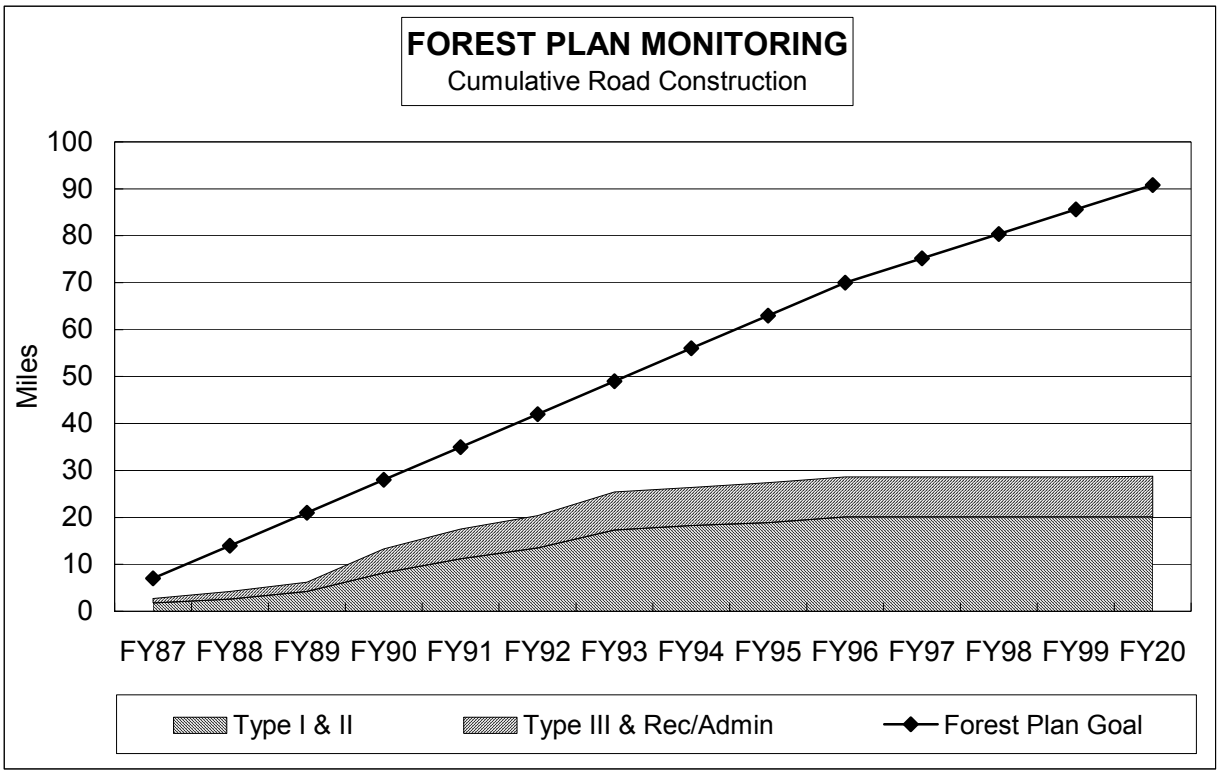
- ✓ Use existing roads, trails and utility corridors to the maximum extent possible. Plan and design access to serve multiple management purposes.
- ✓ Design and build any new roads, regardless of type, according to standards and criteria that focus on minimum impact.

The Forest has relied on using the existing road system. The Forest emphasized the re-use of existing roads and the minimal construction necessary that still provided environmental protection.

The Forest Plan states that all roads will be located, designed, and constructed to the minimum standard necessary to meet management objectives for the area served. Table IV-1 of the Forest Plan requires annual monitoring of the miles of Forest Service Road constructed by Road Type (I, II, III). Type I or II roads are used for a selected season such as dry season or winter. They have spot surfacing and culverts are generally only in place when the roadway is being used. The road is closed to vehicle use for periods of 15-20 years between times of active vegetation management. A Type III Road is a gravel surface road with permanent culverts and stream crossings. They are often open for motorized public use except during the spring season. Type III roads are also used to service recreation and administrative facilities such as campgrounds and ranger stations.

The anticipated annual road construction miles between 1986 and 2000, and the actual mileage constructed, are illustrated in the following graphic. Type I and II roads are combined because it is the distinction between these and Type III that is of most interest.

Figure 20 Projected and actual road construction since 1986



The graph illustrates that between 1986 and 2000 the Forest built approximately 28.8 miles of road compared to a Forest Plan estimated need of 90.8 miles. The Forest anticipated building 5.2 miles of Type III road by the year 2000 and actually built 8.7 miles. The increase is due to the construction of roads at campgrounds and other facilities. The extent of construction reflects the intensity of vegetation management, developed recreation, and administrative programs during the planning period. It is evident that the miles of construction are well within those anticipated.

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