NORTHEASTERN REGION

Program of Research for Forests and Associated Rangelands

Prepared by
A Joint Task Force of U.S. Department of Agriculture and National Association of State Universities and Land Grant Colleges

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Colleges of 1890

Schools of Forestry

Schools of Home Economics

U.S. Department of Agriculture

Consumer and Industry Groups

National Program of Research for Forests and Associated Rangelands

U.S. Department of Agriculture in Cooperation with the National Association of State Universities and Land Grant Colleges

August, 1978

This research plan for the Northeastern Region is intended to serve as a companion publication to the National Program of Research for Forests and Associated Rangelands. While the national program reflects both regional and national issues and priorities for forestry research, this plan provides greater detail on forestry research programs in the Northeast. For the reader's convenience, background information on the development of this regional-national planning effort is also presented.

Although this is not the first coordinated effort to plan forestry research in the Northeast, it is unprecedented in the extent to which research needs, concerns, and issues were identified by a broad cross-section of public land management agencies, industries, environmental and citizen groups, and professional organizations.

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REWORD

ns for forestry research in the Northeast must be based on the onship betwen the people and the forests. The 12 Northeastern s[1] and the District of Columbia house 27 percent of the Nation's lation on only 6 percent of the total U.S. land area (Fig. 1).[2] fifths of the people in these states live in an urban environment. e same time, the 12-State Northeastern Region has 68 percent of nd in forest cover, more than any other region in the country 2). Only 9 percent of the forest land in the Northeast is publicly ed, compared with 28 percent for the Nation as a whole. oduction of wood and other forest-derived benefits must continue ow in the Northeast to meet a wide range of projected needs. ugh research, new management alternatives and utilization ices will provide more wood while simultaneously providing er amounts of other forest products and services.

cause the large, highly concentrated Northeastern market creates demands on all types of forest resources, the potential for conflict the use of the forest land is great, and the need for information lve these problems is urgent. Differences of opinion on the use of st lands are not unique to the Northeast, but they assume a greater sity because of the combined concentration of people and forests. fferences in political development, weather, and topography have luced different problems throughout the Region. These differences, oled with heavy pressures on forest use, make the Northeast an l region for research on conflicts in forest use. Much of what is ned here can serve as a model for other regions where population sures have not reached the advanced stage found in the Northeast. his way, benefits from the research program will accomplish three ctives:

o help solve problems that are already key issues in the Northeast;
o help predict potential problems in the Northeast;
o help avoid similar problems when development reaches a similar age in other regions.

he coordinated forestry research program developed for the North- by the Forestry Schools and the U.S. Forest Service is oriented ard three broad problem areas based on the relationship between ple and the forest:

orest resources supply
nvironment protection and enhancement
orest resource policy.

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[1] necticut, Delaware, Maine, land, Massachusetts, New Hamp- , New Jersey, New York, Penn- nia, Rhode Island, Vermont, and Virginia.

[2] Figures 1-3 and Tables 1-3 are in the Appendix, pages 44-48.

CONTENTS

FOREST RESOURCES SUPPLY

The Forest and Rangeland Renewable Resources Planning Act (PL 93-378) emphasizes the need to manage forests for the production of all resources to meet local, regional, and national needs. In the Northeas where virtually all forest land i within easy reach of resource users, this charge is particularly meaningful.

We can expect requirements for all goods and services obtainable from Northeastern forests to continue to grow. In addition, industrial, residential and other uses can be expected consume an ever greater amou of the Region's forest-land acreage. There must be a concentrated effort to develop intensive management practice that will help realize the poten tial for producing more of all resources from the total acreag of forest land. Research will b directed at increasing producti of all major forest products an related benefits. Obviously, priorities will change over tim as is apparent from the new importance attached to the production of energy from the Region's forests.

Opportunities for extending wood supplies will be explored. At present, more than 50 percent of the total fiber in each tree harvested is left in the woods. Harvesting research will find ways to economically remove more of this fiber from the forest. Research into insect and disease control will help upgrade the quality and marketability of trees. Other research will consider the effects of additional removals on soil, water, and nutrients.

The Forest Products Laboratory (FPL) at Madison, Wisconsin, has a national mission in the area of wood use; its findings, together with those from university and industrial laboratories, will provide solutions to many utilization problems in the Northeastern Region.

The facilities, equipment, and personnel at these laboratories provide the resources to carry out an effective research program in engineering, wood chemistry, and solid wood and fiber processing. Current research plans emphasize greater uses for hardwoods, which are especially important in the Northeast (Fig. 3). This effort will include developing more effective pulping processes, reducing drying costs, examining the feasibility of using hardwoods in a variety of products, and improving lumber and veneer recovery for furniture and other high-value uses.

By exploring new strategies, distribution systems, and markets for presently unmerchantable timber and residues, marketing researchers can increase supplies of wood and fiber for wood industries and energy production. Through the development of new technology and processing systems, utilization research can convert low-grade timber and fiber into housing components, furnishings, paper, and paper products. Benefits will accrue in the form of new industries, more jobs for rural people, and more income from woodlands for forest owners.

Recreation use poses special research problems in the Northeastern United States because about 80 percent of the forest land is in private ownership and is close to urban areas. Research findings in the Northeast will have national application. About two-thirds of all forest and rangeland in the United States is privately owned; in many cases, the pattern of ownership is such that though private lands are close to urban centers, they are not available for public use.

Recreation research will focus on two major problems related to this ownership pattern. First, private ownership has meant limited availability for public use, leading to heavy pressure on public land and frequent conflicts between owners and users. Second, dispersed recreation use has increased on Wilderness Areas, though the needs of many of these users might be satisfied in less than a wilderness environment. In turn, the opportunity for a wilderness experience has been reduced, and the pressure for designating additional wilderness areas in the East has increased. Information on user benefits from dispersed recreation—and on the cost of providing these benefits—is needed to aid in making decisions on land use. Research must provide means to enhance recreation experiences while protecting the unique character of the recreation resource in the Northeast.

The Resources Planning Act Assessment showed that the most desirable opportunity for increasing wildlife population is through better habitat management "in places close to urban centers where large numbers of people might benefit". The Northeast is a prime area for this research because the opportunities are great, and because the Region can serve as a model for National programs in urban forestry and related programs.

ENVIRONMENT PROTECTION AND ENHANCEMENT

Protecting the environme has always been a key conc of forest managers. This co was both intensified and ex lified by passage of the Nat Environmental Policy Act (1969 (PL 91-190), and subse legislation such as the Fede Water Pollution Control A Amendments of 1972 (PL 91-604), the Endangered Sp Act of 1973 (PL 93-205), an National Forest Manageme Act of 1976 (PL 94-588).

Research is needed in the Northeast to develop comp hensive pest-management systems for rural forested a and for urban and urban-ru fringe areas. Initial researcl will determine the effects o applications of various pest so that scientists can better predict the requirements fo pest control. Long-term res will develop integrated pes management strategies whe biological controls, such as silvicultural manipulation, will play an increasingly important role.

PL 91-604 and PL 92-500 require the Environmental Protection Agency to examine, assess, and provide control techniques for nonpoint source pollutants resulting from forestry-related activities.

Research is needed to assess and provide means to control nutrient and sediment losses associated with forest-management and harvesting techniques.

The Northeast receives large quantities of air pollutants from midwestern and eastern industries. Assessment of the effects of these pollutants on forests, and of the effects of forests in ameliorating pollution, is a unique regional research need. An evaluation of the impacts of these pollutants on urban areas is particularly needed.

There is an urgent need for methods that will allow safe disposal of sewage wastes on forest lands. Research will emphasize determining the effects of sewage disposal on soil and water—and how these effects vary according to physical and climatic conditions—and establishing permissible application levels. This research is especially urgent in the Northeast because of the large, concentrated population and because of environmental questions currently being raised over present disposal methods.

The Endangered Species Act of 1973 requires the maintenance or improvement of ecosystems on which endangered and threatened species depend. In the Northeast, where man's influence is well established, research on habitat requirements for endangered plants and animals must begin immediately. There is a particular need for research on the impact of man's activities on the habitat of nongame species.

Environment protection and enhancement goes beyond natural resources. The Northeast is an area of contrasts, and rural areas are characterized by sharp differences in economic conditions. Many northeastern rural residents live at low income, often poverty, levels. Research is needed on methods to raise the employment and income levels of residents in these areas. Such research will assess manufacturing opportunities for forest products, and determine opportunities for generating income from other forest-derived goods and services.

By its very nature, harvesting trees is a dangerous occupation. While developing and examining alternative harvesting systems, researchers will pay close attention to developing safer and better conditions for woods workers.

Utilization research seeks to enhance men's microenvironment by developing systems and new wood products to conserve energy, to reduce noise levels and sound transmission, and to make structures stronger and more attractive. Marketing researchers will emphasize changing building codes and standards so that new products and systems can be used by architects and contractors.

Research on urban forestry is needed urgently in the Northeast. Studies will help maximize benefits from trees in urban areas, and will determine the impacts of urban environments on adjacent forested areas. Much progress already has been made in this area, both by individual organizations and through joint government-private endeavors. The Northeast Consortium for Environmental Forestry Studies, comprising nine Northeastern universities and the Forest Service, is an excellent, and successful, example of such cooperation.

FOREST RESOURCES POLICY

Forest resources policy may well be the most important area for research in the Northeast; the large population with its diverse pressures on forest-land use is the key element in shaping research needs. But other characteristics of the Northeast add to the complexities of policy formation. The forest types are diverse and the value of non-timber goods and services may be as high or higher than that of traditional timber products. One characteristic feature of the Northeast Region is the pattern of land ownership: a high percentage of the forest land is in small private tracts. This means that regional forest-land use is based on a large array of values and objectives which are difficult to ascertain or predict. This diversity offers an excellent opportunity for studying management goals and policy alternatives for both private and public lands.

The Northeastern forest is varied and constantly changing, so techniques for measuring changes in land use and why these changes occur are essential. A knowledge of *why* land use changes is particularly important because it will help resource managers predict changes and design programs to influence change.

A second research need is for a system to assess multiple-use values. This is a significant problem nationally, and is particularly important in the Northeast, where uses other than timber may be the dominant influence on forest-land management. Research is needed to determine the amount each forest user should contribute to encourage production of his resource preferences.

The large number of small ownerships and the myriad ownership objectives emphasize the need for either a large array of management plans or a system to combine management alternatives to enable forest owners to meet their particular needs and still provide multiple outputs from the resource available. To date, research has been designed mainly to assess production of single outputs.

Research on forest policy must provide a means of assessing owner objectives and "trade-offs"; that is, the amount of one kind of return a forest owner might be willing to forego if he receives another. An important part of this research will develop means for evaluating a program's success.

Another important need of land use policymakers is for methods to evaluate the suitability of land for specified uses. Research will provide guides for classifying forest land to minimize degradation from undesirable uses, and will examine the methods of forest taxation prevalent in the Northeast.

Research also can assist in the making of marketing policy decisions by assessing the impact of alternative courses of action such as the desirability of international trade, on the Region.

In summary, policies on forest resource use must be based on an understanding of the needs of both the urban dweller and the rural landowner. The function of research is to continually improve that understanding. This requires not only that research provide possible solutions to practitioners, but that these solutions be communicated to the general public in a comprehensible and usable form.

DEVELOPMENT OF NORTHEASTERN REGIONAL RESEARCH PLAN

ial regional planning

n October 1974, representa-
s of the Forestry Schools in
Northeast and the Forest
vice asked the Northeastern
ional Planning Committee
C) to provide leadership in
aring a regional plan for
re forestry research. This
d for a coordinated, well-
nned research program had
long recognized, and
etus was given to its develop-
t by passage of the Forest
Rangeland Renewable
ources Planning Act of 1974.
he RPC agreed to the
osal and established the
theastern Forestry Commit-
NFC) to direct the planning
rt. Overall guidance to the
was provided by the two
stry representatives on the
and by the Northeastern
esentative of the Association
tate College and University
estry Research Organizations
UFRO). The NFC, in turn,
olished 15 Subcommittees,
representing a major
arch program area (Table 1).
Subcommittee was co-
ired by one representative
a university and one from
Forest Service
is worth noting that
nbership on the Regional
committees averaged about 9
people; approximately one-half from Forestry Schools, one-third from Forest Service research, and the remainder from other public agencies and private organizations or groups. However, total participation was much broader. First, the Subcommittees solicited comments and suggestions from many people during preparation of the reports. Second, the review process reached a broad cross-section of people directly concerned with forestry research, including administrators, scientists, and users.

Subcommittee reports describing research needs in various program areas and providing guidance for assessing priorities were printed in March 1976. The Forestry Schools and the Forest Service then began drafting a proposed joint Northeastern Forestry research plan. In August 1976, the Forestry Committee, the Forestry Schools, and the Forest Service met to review the proposals and to develop a format for the final summary presentation to the Northeastern Regional Planning Committee. The 15 Subcommittee reports and the Summary report represent considerable time and expertise, and provide a most valuable reference source for research policymakers and program planners in the Northeast.

National planning program and policy conference

In July 1976, the Agricultural Research Policy Advisory Committee (ARPAC), a joint committee of the United States Department of Agriculture (USDA) and the National Association of State Universities and Land Grant Colleges (NASULGC), requested its member organizations to prepare a National Program of Research for Forests and Associated Rangelands. The Renewable Natural Resources Foundation, a group of 11 renewable natural resources professional and scientific societies, was asked to conduct a policy symposium on the organization, coordination, productivity, quality, and policy framework of public research on forests and associated rangelands. This was done in May 1977, and the Foundation's report, "A Review of Forest and Rangeland Research Policies in the United States", was issued in September 1977; it contained 19 specific recommendations on future national research policy.

Northeastern regional planning conference

To develop the content of the national program of research, the North Central, Northeastern, Southern, and Western Forestry Resources Research Planning Groups each held a working conference. At these conferences, individuals and representatives of organizations that use, or are affected by, forest- and rangeland-related research results were invited to identify and set priorities for research needs.

A total of 115 organizations were invited to attend the Northeastern Conference in Philadelphia in July 1977. About 70 delegates from government, professional, environmental, conservation, industry, and consumer organizations, together with many participants, attended the conference. A conference summary report was prepared and distributed in the Fall of 1977.

The conference was organized so that the delegates discussed questions under 15 Subject Areas, which were grouped into 7 Work Groups. The relationship among the Regional Subcommittee topics, National Subject Areas, and National Work Groups is shown in Table 1.

Northeastern regional task forces

In December 1977, seven task forces made up of roughly equal numbers of university and Forest Service scientists met to study the results of the Regional Conference. Each task force covered the same Subject Areas as a conference Work Group, and consisted of six to eight subject-matter specialists. On each task force, at least one member, and usually two or three, had taken part in the conference Work Group discussions. This earlier participation was extremely helpful in identifying the intent of the briefer problem statements.

The role of the task forces was to check the Subject Area classification of each problem, determine whether or not the stated problem was researchable, and estimate the likelihood of a solution. The task forces also were asked to recommend changes in the original planning projections of staffing needs. Task force members had an important role in the planning effort, since the content of the final regional plan largely depended on their ability to match the users' concerns with the doers' capabilities.

As a result of the users' problem identification, the task forces' recommendations, and the earlier recommendations of the 15 Subcommittees, a number of shifts were made in the existing projection of the research effort needed for each Subject Area. Overall, however, the objectives of the current research program proved to be in fairly close accord with both user and scientist estimation of the needs.

The national conference

In January 1978, the National Conference on a Program of Research for Forests and Associated Rangelands was held in Washington, D.C., to consider the results of both the symposium on research policy and the four Regional Conferences. The 100 delegates included 28 regional delegates—usually the chairman—from each of the seven Work Groups at the four Regional Conferences. The other delegates represented national organizations which had been selected to obtain a cross-section of research users and people affected by the use of research results.

The national task forces

In late February 1978, seven national task forces met in St. Paul, Minnesota, to study the results of the National Conference. Their responsibilities on the national scale were essentially those which the regional task forces had exercised in December 1977.

Northeastern regional plan

The Northeastern Forestry Planning Committee and the administrators of the Region's Forestry Schools were asked to prepare the Northeastern Plan for Forestry Research. This was done by drawing on the work of the 15 Subcommittees, and of the Regional and National Conferences and task forces.

PRESENT AND PROJECTED FORESTRY RESEARCH

Long-range planning of forestry research programs in the Northeast has been underway for a number of years. In 1974, the Forestry Schools, comprising the Northeastern segment of ASCUFRO, and the Forest Service began developing a joint plan for forestry research. The culmination to date of the various planning efforts comprises the remainder of this report.

The program is shown by Work Group and Subject Area; within each Subject Area are several broad, major problem statements. Each statement is followed by one or more numbers in parentheses. These numbers refer to the problems identified at the Regional Conference and later selected as researchable by the task force members. A listing of the problem statements to which the numbers refer is attached as an Appendix.

The number of scientist years assigned to each Subject Area for 1975, 1980, and 1985, is shown in Table 2 and also under each Work Group. They indicate the amount of effort which has been, and is expected to be, expended in each Subject Area.

Since the reader may be interested in knowing the relative importance assigned to each Subject Area by the delegates to the Northeastern Regional Conference, and by those attending the National Conference, ratings for each Subject Area are shown in Table 3. It is apparent that while there are some similarities between the ratings, there are also considerble differences. We believe that the regional program is responsive to the needs identified by the regional delegates to the extent that overriding constraints allow.

II MULTI-RESOURCE INVENTORY, APPRAISAL, AND EVALUATION

Because of the anticipated increase in population and society's deepening dependence on renewable natural resources, it is essential that we develop a greater knowledge of the multiple-use potential of forest lands. Almost all land, certainly all forest land, is capable of providing more than one product or service at the same time. The challenge is to devise and implement management procedures which optimize production of a variety of goods and services from the forest while meeting the objectives of the landowner and maintaining the quality of the resource.

In meeting this challenge, we need to develop methods which meaningfully weigh the costs and benefits of different land uses, more accurately evaluate the multiple-use potentials of land, and assess the quantity and value of the obtainable goods and services.

	Scientist Years		
Subject Area	1975	1980	1985
1. Multi-resource inventory and appraisal	11	20	21
2. Alternative uses of land	0	12	12
3. Multiple-use potential and evaluation	3	8	11
Total	14	40	44

1 Multi-Resource Inventory and Appraisal

A. Examine existing procedures ınd, where necessary, formulate ıew procedures to effectively nventory and appraise, at both ·egional and national levels, the upply of all forest resources, ncluding timber, wildlife, recrea- ion, and energy production. 11, 4, 17, 24, 25, 10, 20, 13, 267, '60, 23, 18, 6)

3. Examine existing procedures ınd, where necessary, formulate ıew methods to inventory and ,ppraise the demand, both ›ublic and private, for all of the ;oods and services obtainable rom forest lands. (113, 7)

:. Develop improved land classi- 'cation systems which show the vailability of forest resources nd the potential supply of ›rest products, and which ocument factors such as owner- ıip, transportation, soils, te, and vegetation. 19, 21, 22, 16, 1, 104)

2 Alternative Uses of Land

A. Develop methods and criteria to evaluate and compare alternative uses of forest land. Provide decisionmakers with a sound basis for comparing market and nonmarket, or multiple-use potentials of forest lands. (67, 618, 824, 874, 56, 62, 115, 52, 121)

B. Determine and measure the cause and effect of land-use changes; emphasize the economic impact and effect of public policies on land-use changes, especially on how energy supply and demand may affect forest-land use. (64, 71, 125)

C. Develop accurate, comprehensive information on the management objectives of private forest owners, with emphasis on the owners of small forest holdings, to identify what they want to obtain from their forest properties and how to stimulate their interest in improving the management of their properties. (72, 54, 59, 107, 822, 57)

D. Develop techniques to resolve problems in managing public forest lands, especially as they pertain to relationships between public and adjacent private lands, nontimber values, and methods for identifying and evaluating dominant uses. (51, 20, 21, 23, 70, 102)

E. Determine the impact of taxation on forest-land tenure and use in developing improved, uniform policies and procedures for the taxation of forest lands on the basis of both timber and nontimber values. (68, 266, 256, 610)

3 Multiple-Use Potential and Evaluation

A. Establish goals and criteria for the management of forest lands for multiple use. (823, 3, 852, 830, 58)

B. Develop techniques to measure the economic and social values and benefits of the goods and services obtainable from forest lands. (105, 122, 109, 257, 265, 814, 124)

C. Conduct economic analyses to evaluate the income derived from nonfiber products, to examine the advantages and disadvantages of managing for single versus multiple products, and to determine the trade-offs inherent in selecting a particular land use. (9, 15, 3, 119)

D. Develop systems to effectively plan and efficiently implement multiple-use management on forest lands. (63, 110, 73, 814, 830)

III TIMBER MANAGEMENT

Assuredly, trees will grow without the help of man. But to produce the variety of goods and services demanded by a growing and affluent population a contemporary forest must be managed. We need to learn more about forest ecosystems and about the culture of trees for many uses. The purpose of timber-management research is to find ways to increase wood production while allowing for the production of other goods and services, and maintaining the quality of the environment. This requires tending many species through the entire forest-management cycle—from seed production to harvest and stand reestablishment. Timber-management research also includes developing genetically superior stock, evaluating the products and related benefits expected from genetic improvement and various forest cultural practices, and determining the cost of these products and benefits.

	Scientist Years		
Subject Area	**1975**	**1980**	**1985**
4. Biology, culture, and management of forests and timber-related crops	30	42	43
5. Genetics and breeding of forest trees	13	11	16
6. Economics of timber production	4	7	8
Total	47	60	67

iology, Culture, and 4 Management of Forests and Timber-Related Crops

. Develop improved methods classifying land productivity id of predicting and measuring e growth of trees and stands ıder various management gimes and natural conditions. 56, 254, 655, 151, 165, 175, 251, 7, 706, 103)

Develop improved techniques r reproducing trees and generating forest stands. 58, 166, 167, 191, 217)

Investigate and recommend ternative methods of managing ands to produce a variety of nber and nontimber benefits. 53, 180, 188, 69, 179, 158, 170, 4, 162)

5 Genetics and Breeding of Forest Trees

A. Analyze the benefits and costs of conducting programs in tree genetics to obtain specific genetic objectives and of integrating the results of such programs into forest-management programs. (201, 209, 222)

B. Carry out breeding programs to adapt species to meet defined needs, and develop techniques to evaluate the success of such programs early in their life. (761, 216, 218, 208, 214, 220, 206, 221, 212, 215, 211, 207, 213, 808)

6 Economics of Timber Production

A. Analyze the costs and benefits associated with various forest-management activities, or groups of activities, and identify alternative courses of action to meet identified objectives. (153, 252, 273, 274, 272)

B. Develop information on the effects of different forms and levels of taxation, zoning, and price structure on the management of forest land, particularly on small ownerships. (123, 271, 174, 263)

IIII FOREST PROTECTION

The reduction of economic loss from insects, disease, or fire can effectively and dramatically increase the quantity and quality of the goods and services available from the forest. A substantial research effort must be directed toward developing highly selective biological controls, pesticides, and behavioral chemicals which are effective against specific insects, yet which can be used safely in both rural and urban environments. A parallel program of research is aimed at reducing disease and decay through improved silvicultural practices which would minimize the possibility of attack through selection of resistant tree varieties, by means of biologic controls, and, particularly in plantations and nurseries, through the judicious use of pesticides. Both insect and disease research programs will emphasize prevention as well as control.

Insect and disease control techniques are rapidly shifting to a management approach wherein ecologic and economic analyses identify the combinations of cultural, biological, and chemical measures that are most effective against a group of related pests. As forest management becomes more intensive, a greater research effort will be concentrated on controlling insects and disease in young stands, plantations, and nurseries. A substantial research program will be needed to solve pest problems associated with trees growing in the numerous urban areas in the Northeast.

Little forest fire research is conducted within the Region and these needs are met by research programs in adjacent states. Such research will emphasize identifying more efficient techniques to detect and suppress wild fires, reducing fire hazard by destroying forest fuels, and developing a better understanding of the impact of prescribed and wild fires on the environment.

	Scientist Years		
ject Area	1975	1980	1985
Control of insects affecting forests	28	27	26
Control of diseases, parasites, nematodes ffecting forests	9	10	11
revention and control of forest nd range fires	0	1	1
Total	37	38	38

7 Control of Insects Affecting Forests

Conduct impact analyses to elop usable systems for cting, monitoring, and uating insect-caused losses, for monitoring outbreaks for ning and control.
313, 320, 321)

evelop effective methods for rolling major forest pests ugh management practices h are both environmentally economically acceptable.
204, 301, 302, 315, 317, 318, 323, 324, 322, 308, 314, 330,

entify factors which pre- se specific hardwood and ood species to insect attack, develop management ices which will reduce or ent attack.
204, 301, 317, 318, 319, 324)

8 Control of Diseases, Parasites, and Nematodes Affecting Forests

A. Conduct impact analyses to develop usable systems for detecting, monitoring, and evaluating disease-caused losses, and for monitoring outbreaks for planning and control.
(355, 357, 369)

B. Develop effective methods for controlling the major forest-tree diseases through management practices which are environmentally and economically acceptable.
(371, 368, 385, 353, 380, 919, 374, 351, 375, 370, 373, 366, 372, 362, 384, 379)

C. Identify factors which predispose specific hardwood and softwood species to disease, and develop management practices which will reduce or prevent attack.
(378, 377, 704, 705, 702, 701)

9 Prevention and Control of Forest and Range Fires

A. Conduct impact analyses to develop usable systems for detecting, monitoring, and evaluating fire-caused losses, and for monitoring outbreaks for planning and control.
(421, 417, 414, 422, 423, 416, 402)

B. Develop techniques to prevent or rapidly control wildfires in the Northeast.
(401, 403, 419, 406, 412, 413)

IV HARVESTING, PROCESSING, AND MARKETING OF WOOD PRODUCTS

One way to extend the Nation's wood supply quickly, particularly its supply of hardwoods, is to learn how to use wood more efficiently. Ongoing research toward this objective ranges from developing better, more waste-free harvesting systems to finding new ways to protect wood in use. Studies on the economics of wood processing provide useful information for forest landowners, loggers, and wood-using firms. Other work ranges from basic research on wood properties to practical improvements in manufacturing techniques. Emphasis will be placed on learning how to use currently unused wood materials by converting forest and mill residues into marketable products.

	Scientist Years		
Subject Area	1975	1980	1985
10. Harvesting and forest engineering systems	4	6	7
11. Properties, processing and protection of wood	34	33	33
12. Economics and marketing of wood products	19	21	20
Total	57	60	60

10 Harvesting and Forest Engineering Systems

)evelop equipment which is
'e energy efficient and better
ed for use in a variety of
:st stands, soils, slopes, and
,ile environments than equip-
ıt now in use.
:, 458, 457, 469, 456)

)evelop alternative harvest-
and reforestation systems
able for use in various types
)rests, including small
)dlots and plantations.
·, 451, 261, 471, 466, 453, 470)

)evelop alternative forest
l and transportation systems
:h are more economical than
e now in use, while being
ronmentally acceptable.
·, 467, 717)

11 Properties, Processing, and Protection of Wood

A. Develop a better understanding of the mechanical, chemical, and structural properties of wood so that it can be processed and used more efficientlly, and its service life increased.
(329, 381, 516)

B. Apply improved fundamental knowledge in designing buildings which are more energy efficient than those now in use; employ both traditional lumber and new composite materials made from presently unusable wood residues.
(517, 551, 510, 508)

C. Develop and apply improved technology to the use of hardwoods, imported species, and whole-tree chips.
(514, 513, 507, 509)

D. Develop processing systems which maximize the quantity and quality of products obtained from logs, particularly in mills handling a mixture of species.
(186, 512, 518, 501, 515)

E. Evaluate the economic feasibility of using forest biomass as a source of energy.
(505, 511)

12 Economics and Marketing of Wood Products

A. Analyze and present alternative ways of utilizing technological advances in harvesting, engineering, and measurement systems appropriate to forest industries to improve rural development and employment.
(461, 464, 562)

B. Examine the economic effects of plant size, investment opportunity, and markets on the utilization of small and low-grade hardwoods and of forest and mill residues.
(276, 553, 566, 253, 565)

C. Develop realistic methods for forecasting timber supply by species groups, and the influence of government regulations and economic conditions on this supply.
(277, 560, 262)

V FOREST WATERSHEDS, SOILS, AND POLLUTION

In the Northeast, 27 percent of the Nation's population share 6 percent of the U.S. land area with a forest which occupies two out of every three acres. Under these conditions, there is heavy pressure on the forest manager to provide high-quality municipal water supplies, recreation opportunities, and many other forest-based goods and services. Yet this forest is continually threatened by manmade pollutants or with outright destruction through urbanization.

For example, the use of more intensive extraction processes for coal and the increasing use of forest land for disposal of municipal wastes complicate forest management. Even while generating resource management problems, the affluent society steadily becomes more insistent on enjoying a quality environment where esthetic and cultural concerns assume an increasingly important role. In the Northeast, therefore, researchers must provide resource managers with the knowledge and technology essential to maintain the quality and quantity of water, safeguard soil productivity, and minimize the effects of pollution.

	Scientist Years		
Subject Area	**1975**	**1980**	**1985**
13. Watershed protection and management	10	14	22
14. Soil, plant, water, and nutrient relationships	9	10	12
15. Alleviation of soil, water, and air pollution	7	7	10
Total	26	31	44

13 Watershed Protection and Management

A. Develop the knowledge needed to adequately manage and protect forested watersheds so that they can supply high-quality water, and to enhance the quality of water in rivers and streams.
(108, 607, 609, 615, 608, 708)

B. Develop and apply improved management techniques which will ensure that high-quality water can be obtained from forested watersheds subjected to surface mining, erosion, sedimentation, and thermal pollution associated with road building and logging, urbanization, and recreational activities.
(604, 619, 605, 616, 715, 711, 608)

14 Soil, Plant, Water, and Nutrient Relationships

A. Examine and propose methods for solving problems associated with the short- and long-term effects of intensive forest management on nutrient cycling, site productivity, soil compaction, and water pollution.
(178, 656, 657, 661, 662, 660, 653, 659, 184, 663, 21)

B. Determine the effects of spreading municipal wastes on forested land, with particular emphasis on the fate of heavy metals and other toxic materials in the applied waste, on short- and long-term nutrient cycling, and on surface and groundwater pollution.
(651, 652, 658, 611, 189, 917)

15 Alleviation of Soil, Water, and Air Pollution

A. Determine the long-term effects of air pollutants, particularly acid rain, on the forest ecosystem; develop trees which resist pollutants, and identify the extent to which trees reduce pollutants and noise levels in urban areas.
(703, 918, 182)

B. Develop improved management techniques which will minimize concentrations of pollutants resulting from logging, fertilization, and burning.
(176, 714, 710, 707, 716)

VII FOREST RANGE, WILDLIFE, AND FISHERIES HABITAT DEVELOPMENT

Though researchers have developed many management practices for improving the habitats of various species of wildlife and fish, many questions remain unanswered. A substantial effort is needed to determine how changes in vegetation affect wildlife and fish populations, and to develop ways of predicting changes in plant communities following specific events. To meet the needs of the residents of the Northeast, be they fish, fowl, human, or other animal, the research program will include work on game and nongame species habitats in both rural and urban areas.

Range or pasture research in the Northeast is generally carried on outside the forestry program. The Region also draws heavily on pertinent research results obtained elsewhere in the United States.

	Scientist Years		
Subject Area	1975	1980	1985
16. Management of range resources	0	0	0
17. Wildlife and fish habitat	28	30	44
Total	28	30	44

16 Management of Range Resources

A. Identify the costs and benefits, both in financial terms and in terms of other forest-related opportunities foregone, of grazing cattle on forest land.
(758, 764, 756, 765, 753, 760, 755, 762, 759)

B. Examine the effects of grazing on forest sites, and identify desirable management techniques.
(757, 753, 755)

17 Wildlife and Fish Habitat

A. Examine the effects of various forest-land management activities on wildlife and fish habitats so that management processes which will attain objectives for both wildlife and nonwildlife can be identified.
(185, 161, 164, 816, 821, 817, 836, 183, 815, 819, 839, 837, 838, 825, 831, 829, 826, 807, 809, 818, 803, 328)

B. Examine the effect of urban development on wildlife and fish habitats and suggest alternative ways in which these habitats can be safeguarded or enhanced.
(833, 842, 835)

C. Examine the costs and benefits of maintaining wildlife and fish habitats, and how these are viewed by the public.
(827, 806, 840, 192, 832, 834, 841)

VII FOREST RECREATION AND ENVIRONMENTAL VALUES

The presence of a great many people in the land area of the Northeast Region places great pressure on the managers of public lands to provide outdoor recreation opportunities and to maintain or improve amenity values. This pressure will continue to increase as the population becomes larger and the amount of leisure time available to individuals increases. At the same time, the public forest lands will be called on to produce more commodity products in addition to a greater diversity of non-commodity services. There is a need for research which will give managers the opportunity to choose alternative ways of increasing the availability of outdoor recreation to all segments of society in the Northeast. It is doubtful that the relatively small acreage of public land will be able to accommodate the anticipated recreation needs. Therefore, it is essential that particular attention be given to examining the role of private forest lands in providing public recreation opportunities.

Many of the people in the Northeast live, work, and spend much of their leisure time in a metropolitan environment. Much needs to be learned about how groups of trees or individual trees can be used to enhance the environment in and around urban centers.

	Scientist Years		
Subject Area	1975	1980	1985
18. Outdoor recreation	13	16	37
19. Rural and urban environmental enhancement	3	7	26
Total	16	23	63

18 Outdoor Recreation

Investigate, identify, and
asure the economic, social,
l esthetic benefits available
m a variety of outdoor rec-
tion opportunities, and the
:t of providing these benefits.
8, 881, 870, 878, 867, 859)

Determine methods for
›viding increased opportun-
s for recreation to all seg-
nts of society, including the
ıdicapped.
1)

C. Investigate and determine the factors which encourage or discourage the development of opportunities for public recreation on private land.
(820, 865)

D. Develop methods of accurately predicting recreation demands relative to changes in the age structure of the population and energy considerations.
(871, 872, 887)

E. Develop recommendations on managing the forest resource to increase the available supply of recreation opportunities, to prevent deterioration of the resource, and to ensure the compatibility of complementary resource uses.
(890, 864, 861, 884, 883, 869, 889, 860)

19 Rural and Urban Environmental Enhancement

A. Determine the economic, social, and pyschological benefits which accrue both to society and to individuals in improving the environmental quality of both urban and rural areas.
(916, 923, 712, 713)

B. Develop alternative methods for improving the quality of both rural and urban environments, and for making such improvements available to all members of society.
(927, 926, 928, 930, 929, 920, 120

IMPLEMENTING THE PLAN

Full implementation of the plan is contingent upon future funding, and on shifting emphasis within current funding and staffing constraints. Also, some current research efforts must be brought to a logical conclusion. In a given year, 15 to 20 percent of the individual research studies in progress are revised or terminated, and new ones begun. In planning new studies, ASCUFRO and Forest Service scientists and research administrators will use this plan as one guide in redirecting existing programs and in developing new ones.

A planning process must give direction, but it must also be flexible and provide for response to changing needs. This plan represents our best efforts to organize the research resources available to solve the problems which researchers and the users of research results agree are currently most pressing. There has long been interaction between researchers and practitioners, most of it on a less formal level than occurred during the preparation of this plan. Passage of the Forest and Rangeland Renewable Resources Planning Act of 1974 made such interaction mandatory for the Forest Service, and desirable for the members of ASCUFRO.

Development of a joint university-Forest Service program of research in conjunction with potential users of the research results not only maintains a continuing dialogue between the partners but provides an impetus to review the relevance of all forestry-related research on a regular schedule. Just as forestry in the Northeast is dynamic, so this plan must be constantly, but purposefully, adjusted to reflect changes in resources, available personnel, economic conditions, and political situations. For this document to be useful there can be no final report, only the current version.

APPENDIX

Among the responsibilities given to the regional Task Forces were identifying those problems emanating from the Regional Conference that were researchable and indicating the level of research effort needed on each of these.

Most of the Task Force members had worked with one or more of the Regional Subcommittees, participated in the Regional Conference, or both. Thus they were able to bring considerable technical expertise and knowledge of the process to bear on the exercise.

The researchable problems are listed by Subject Area within each Work Group. Within each Subject Area, the problems are grouped as follows:

- Problems on which the current research effort should be increased.
- Those on which the research effort should be maintained at its present level.
- Those on which the research effort should be reduced below the current level.

The problem number assigned during the Regional Conference is shown in front of each problem statement. In a few cases, the original wording of the problem has been changed slightly to clarify the meaning. Such changes have been kept to a minimum to adhere as closely as possible to the intent of the original statement.

1 Multi-Resource Inventory and Appraisal

Increase Current Level of Effort

4 *Develop more frequent, detailed, and localized forest-resource data available to political, economic, and social planners and developers at a local level.* 24

6 *Develop new and more effective inventory procedures to clarify use capabilities of forest land, based on an understanding of physical relationships among uses.* 25

11 *Develop a more comprehensive forest-land inventory which accurately reflects current land use.* 10

17 *Determine the energy production potential, integrated with other product management.* 13

18 *Develop and integrate forest-inventory processes with other land-use inventories to improve national, state, and local land-use planning capabilities.* 20

19 *Define commercial forest land so that inventory data show actual timber availability.* 21, 104, 113

Develop inventory techniques for nontimber resources of the forest.

Develop efficient sampling techniques for measuring the biomass of forest vegetation.

267 *Develop a realistic regional and national economic supply schedule.*

460 *Are present timber inventory and harvest data adequate and available to all parties?*

Continue at Current Level of Effort

Standard units of measure for various quanitifiable resources.

Determine relevance of information about production in terms of biomass to management decisions, planning, and public policy formation.

Develop a system of integrated computer storage and inventory data retrieval.

Improve forest soil and site survey, classification, and interpretation for multiple-use management.

Develop an ecological land classification system appropriate for inventory, appraisal, and evaluation.

Develop a method to determine present demand for forest resources.

Reduce Current Level of Effort

1 *Develop criteria and tecnhiques for identification of roadless areas for Northeastern forests.*

7 *Develop more efficient inventories of production possibilities and trends by aggregating the actions and plans of many operating units.*

16 *Develop data on utilization and drain from the private nonindustrial sector.*

22 *Develop a vegetation classification system to serve needs of timber wildlife, endangered species, and other forest resources.*

23 *Evaluate the efficiency of forest-resources sampling techniques for inventories.*

2 Alternative Uses of Land

Increase Current Leve of Effort

54 *Conduct a comprehensiv land-ownership inventor which recognizes current use and realistic options open to the present owne*

59 *Monitor forest-land price changes by state and smaller regions with studies of landowner aspirations.*

64 *Determine the economic impact (including social costs) of inefficient land use and land-use conversion.*

67 *Develop procedures for assessing social costs and returns from alternative, noncomplementary uses of forest land.*

71 *Analyze forest land-use regulations, policies, and institutional processes which affect land-use changes and decisions.*

72 *Study means that will help make small forest holdings viable operating units (multiple use).*

107 *Investigate means of interesting, stimulating, and encouraging small forest owners to make available or share forest resources with the wood-using industry and general public.*

125 *Evaluate the impact of current energy demands on forest land-use patterns.*

Continue at Current Level of Effort

20 *Develop a system of integrated computer storage and inventory data retrieval.*

21 *Improve forest soil and site survey, classification, and interpretation for multiple-use management.*

51 *Investigate the impact of private development and land-use patterns within and adjacent to National Forests in the Northeast.*

57 *Develop a knowledge and understanding of the small forest owner's interests, intentions, and purposes concerning his forest holdings.*

68 *Study impacts of and possible solutions to taxes (inheritance, capital gains, property) on small and large landowners.*

121 *Develop methods for defining and incorporating flexibility into plans so that it may become a major basis for choice.*

256 *Uniform policies and techniques for forest-land taxation are needed.*

266 *Recognition and incorporation of nontimber values in tax laws.*

618 *Determine how much wilderness area we can afford.*

822 *Alternative incentives for retention of forest holdings by private landowners.*

824 *Criteria for designation of unique natural forests and other vegetation communities.*

874 *Develop techniques to reconcile conflicts among competing land and water uses, particularly in areas lacking land-use planning programs and controls.*

Reduce Current Level of Effort

23 *Evaluate the efficiency of forest-resources sampling techniques for inventories.*

52 *Evaluate the protection and enhancement of natural amenity and environmental values as a recognized land-use category in National Forest planning.*

56 *Develop a method of identifying mutually exclusive uses and/or complementary uses of forest lands.*

62 *Investigate the practical and political significance of split between those who wish to preserve an undisturbed forest and those who wish to conserve it for active use.*

70 *Identification of dominant uses for forest lands, especially public lands.*

102 *Investigate better methods of providing benefits from public lands that cannot be supplied by private land.*

115 *Develop systems for applying our best knowledge to planning for the use of basic areas of land, such as operating or planning units.*

610 *Impact of land-taxation policies on maintaining forest lands in areas under pressure for development.*

3 Multiple-Use Potential and Evaluation

Increase Current Level of Effort

9 *Develop processes to enable the costs and benefits of forestry operations to be adequately represented in the economic and/or political system of decisionmaking.*

58 *Determine the economics of scale for each forest use as a basis for public assistance and regulation policy.*

63 *Develop integrated management systems for medium-size land holdings.*

823 *Establish criteria for making long-range ownership decisions on unique natural areas.*

Continue at Current Level of Effort

3 *Develop new criteria for evaluating roadless areas in the populous East.*

15 *Develop methods of including measures of the effort expended in forestry and resulting figures of merit into the economic and/or political system for making decisions on how to use scarce resources.*

105 *Develop techniques for quantification of intangible benefits, such as asthetics, to measure impacts on alternative courses of action.*

109 *Investigate the personal and social preferences for product and service mixes which are physically possible in specific instances.*

110 *Develop a planning process to permit intelligent trade-offs between alternative management programs.*

119 *Investigate the extent to which selected lands could be used for single-use purposes within a multiple-use framework.*

122 *Develop adequate social and economic measures of markets for multiple-use products of forest land.*

124 *Investigate nonfiber income generation possibilities from woodland.*

257 *Methods to effectively compare nonmonetary social benefits of land under timber management vs. land in wilderness.*

814 *Economics of managing forest land for fiber, wildlife and recreation.*

830 *Evaluate multiple-use concepts regarding wildlife and forests.*

852 *In developing criteria to determine land use, recreation and environmental values are given less priority than other uses. How can this be prevented?*

Reduce Current Level of Effort

73 *Investigate the feasibility of secondary land uses such as wildlife food and cover and recreation on utility rights-of-way.*

265 *Economics of nonwood-producing values.*

4 Biology, Culture, and Management of Forests and Timber-Related Crops

Increase Current Level of Effort

156, 254 *Develop a usable site classification system using plants, land form, and soil type.*

191 *Biology, culture, and management of Atlantic white cedar.*

217 *Stimulation of flowering in young trees.*

655 *Improve site-index curves and accompanying yield tables for important tree species.*

706 *Information on effects of acid rain on soil microflora.*

Continue at Current Level of Effort

69 *Investigate how to maintain fiber production on high-quality forest sites without destroying or depleting other values.*

103 *Develop methods of measuring and analyzing vegetative diversity.*

151 *Develop yield tables or growth simulators to facilitate management plan, and economic analysis to guide investment analysis.*

158 *Volume yields from whole-tree chipping.*

162 *Use of herbicides for integrated timber-stand improvement and wildlife-habitat management.*

163 *Impacts of logging and related management practices on the nontimber values of forests.*

165 *Ecological productivity, diversity, and stability of managed vs. unmanaged forest lands.*

166 *Oak regeneration techniques.*

167 *Natural regeneration of hardwoods by site, using selective cutting.*

168 *Selective regeneration of desirable hardwood species.*

170 *Multidiscipline studies of timber-stand improvement vs. wilderness.*

175 *Develop a site classification system and data regarding managed responses by site.*

177 *Precommercial thinning in natural stands to control species and stocking.*

179 *Develop management techniques to produce more energy.*

180 *Define forest-management systems for small forestland owners.*

188 *Determine methods to manage timber stands to produce noncommodity benefits.*

251 *Yield tables and growth simulators are needed to facilitate management planning and economic analysis, and to guide investment analysis.*

454 *Need for results of clearcutting established on a firm scientific basis.*

5 Genetics and Breeding of Forest Trees

Increase Current Level of Effort

201 *Economic analyses and evaluations of genetic programs to guide research and operational investments.*

222 *Need for hardwood tree-improvement research in context of silvicultural practices under which it will be used.*

Continue at Current Level of Effort

206 *Develop walnut strains and hybrids adapted to Northeast.*

207 *Nursery stock improvements of butternut.*

208 *Improved species and hybrids for disturbed areas and low-quality sites.*

209 *Genetic implications of single-tree management.*

211 *Genetic selection of superior Christmas trees.*

212 *Genetic selection and improvement of superior trees in fast-growing early successional species.*

214 *Develop trees for urban environments.*

215 *Selection of trees for mast and browse characteristics as well as timber.*

216 *Physiological and biochemical means of identifying superior genotypes.*

218 *Techniques for producing large volumes of softwood seed economically.*

220 *Techniques for early evaluation of hybrid pitch x loblolly hybrids.*

221 *Develop pollution-resistant trees.*

761 *Develop improved plant germ plasm adapted to forest-grassland areas.*

Reduce Current Level of Effort

213 *Develop blight resistant chestnut.*

808 *Return the American chestnut to a viable position in forest stands.*

Economics of Timber Production

Increase Current Level of Effort

op institutional ds of encouraging e nonindustrial in long run through ives and taxation.

ite zoning systems on economics of and other resource- gement objectives.

Continue at Current Level of Effort

153 *Determine quality and value effects of various timber-stand investment opportunities to guide investment programs.*

174 *Identify timber management investments needed to develop Northeast regional timber investment schedule.*

252 *Quality and value effects (in addition to volume effects) of timber-stand improvement opportunities to guide investment programs.*

263 *Develop comprehensive data on small land owners.*

272 *Economics of fiber vs. sawlog production in hardwood forests.*

273 *Long-term economics of selection vs. clearcutting in Northeastern hardwoods.*

274 *Systems for predicting costs over whole rotations.*

7 Control of Insects Affecting Forests

Increase Current Level of Effort

152 *Develop accurate predictive models of insect epidemic damage to facilitate biological and economic analysis of insect-control programs.*

159, 204, 317 *Control of white pine weevil through combined genetic, chemical, biological, and silvicultural programs.*

301 *Understanding and control of red pine scale.*

318 *Coordinate research programs on hardwood defoliators in noncommercial stands, i.e., urban trees, watersheds.*

319 *Coordinate research programs on hardwood defoliators of commercial stands.*

320 *Methods of predicting insect outbreaks and assessing impacts.*

321 *Methods of detecting, sampling, remote sensing, etc., of insect populations and damage.*

323 *Intensify research on new chemical pesticides.*

324 *Renew emphasis on silvicultural methods of managing forest pests.*

8 Control of Diseases, Parasites, and Nematodes Affecting Forests

Continue at Current Level of Effort

02 *Understand and control spruce budworm.*

07 *Renewed emphasis on pests of cones, seeds, and seedlings in seed production areas and in nurseries engaged in superior-tree programs.*

18 *Techniques to manage insects which are periodic or chronic pests in hardwood or softwood plantations.*

13 *Usable methods to carry out economic analysis of protection projects.*

14 *Reduction of hardwood yield and value by insects.*

15 *Control of gypsy moth.*

12 *Increased emphasis on biological controls of insect pests.*

10 *Evaluation of controlled burning potential for insect control.*

Increase Current Level of Effort

353 *Understand and control the beech scale-nectria complex.*

355 *Methods of detecting, sampling, remote sensing, etc., of disease.*

368 *Multidisciplinary approaches to determining causes and controls of diebacks and declines, particularly those of maple, birch, ash, and oak.*

369 *Methods of predicting disease outbreaks and assessing impacts.*

371 *Renew emphasis on silvicultural controls of tree diseases in natural stands and plantations.*

380 *Renewed emphasis on diseases of high-value trees such as cherry, black walnut, and shade trees.*

385 *Increase emphasis on biological control of tree diseases.*

919 *Develop plant species that can withstand stress from drought, heat, and pollution.*

Continue at Current Level of Effort

351 *Understand and control of scleroderris canker.*

357 *Usable methods to carry out economic analyses of protection projects.*

362 *Nursery diseases of conifer and hardwood species.*

366 *Control of Dutch elm disease.*

370 *Intensify research on new chemicals for disease control.*

372 *Renewed emphasis on wilt diseases of forest and shade trees.*

373 *Renewed emphasis on canker diseases of forest and shade trees.*

374 *Selection and breeding of trees resistant to major diseases.*

375 *Research on and development of management guidelines for reducing discoloration and decay in forest trees.*

9 Prevention and Control of Forest and Range Fires

Renewed emphasis on abiotic factors (including logging injury and pollutants) predisposing trees to disease.

Mycorrhizal relations and tree stress factors in relation to root diseases and declines.

Understanding and control of butternut canker.

Develop trees resistant to diploidea tip blight.

Information on role of air pollution in predisposing forest trees to insect and disease problems.

Possible synergistic effects of low levels of ozone and sulfur dioxide on forest trees.

Identify cultural and management procedures which protect forest and shade trees against air pollution.

Effect of air pollution damage to tree foliage on mycorrhizal relationships of forest trees.

Increase Current Level of Effort

401 *Information on rates of fire spread for all fuel types and factors affecting spread.*

403 *Implications of new harvesting systems in terms of rate of fuel breakdown in slash.*

414 *Develop improved guidelines for use of prescribed fire.*

416 *Management guidelines to weigh trade-offs between hazard reduction and fire risk considerations.*

417 *Management guidelines to minimize environmental damage from smoke.*

419 *Develop effective control methods for deep burning forest fires.*

421 *Fire protection economics-impacts, cost-benefits, budgeting, etc.*

422 *Guidelines for fuel management.*

423 *Effect of fire on ecosystem balance.*

Continue at Current Level of Effort

402 *Information on how fire damages relate to fire danger indices, weather, timber type, and land value.*

406 *Guidelines for protecting residential development in forest areas from wildfires.*

412 *National fire danger rating system should reflect hardwood fuel types in the Northeast.*

413 *Study fire hazards associated with new logging equipment and offroad vehicles.*

10 Harvesting and Forest Engineering Systems

Increase Current Level of Effort

461 *Evaluate available systems for harvesting trees on small ownerships and, where necessary, develop practical alternatives.*

451 *Breakeven analyses of alternative harvesting systems for whole-tree selective harvests of small woodlots, using small equipment.*

452 *Develop optimum road design models for small woodlots.*

455 *Develop systems for harvesting trees by individual-tree selection.*

457, 459 *Identify modifications needed and develop improved harvesting systems to log economically over fragile, esthetic, or difficult terrain.*

458 *Evaluate alternative fuels and equipment for energy conservation in harvesting of trees.*

468 *Develop remedies for soil compaction from logging.*

477 *Compare the environmental, energy, and economic costs of transporting logs by water vs. alternative systems.*

Continue at Current Level of Effort

453 *Prepare a realistic breakeven analysis of low-quality wood product harvesting, using conventional logging systems.*

456 *Develop efficient methods for harvesting whole trees by chipping in the woods.*

466 *Develop machinery and methods for mechanical reforestation.*

467 *Develop improved systems for transporting forest products to mills.*

470 *Develop systems to harvest biomass for fuel.*

471 *Develop efficient machinery for thinning plantations.*

11 Properties, Processing, and Protection of Wood

Increase Current Level of Effort

508 *Develop new wood composite products and seek alternatives to petrochemical-derived adhesives.*

510 *Develop new techniques to produce large lumber-type products from small timber stock and particulate materials.*

513 *Develop technology to increase the structural use of hardwoods.*

515 *Develop new technology for using forest and mill residues.*

517 *Develop improved designs for wood structural systems that conserve energy.*

518 *Develop log breakdown and processing systems to maximize quantity and quality.*

551 *Develop new designs for residential and commercial buildings to take advantage of the insulating properties of wood.*

12 Economics and Marketing of Wood Products

Continue at Current Level of Effort

186 *Develop methods for processing mixed species without sorting.*

329 *Develop improved methods for protecting wood in storage and use from insect damage.*

381 *Develop improved methods for controlling discoloration and decay of wood in storage and use.*

501 *Develop environmentally acceptable and economically viable ways to handle liquid, solid, and gaseous waste from forest-product plants.*

505 *Develop processes which will realize the potential of wood-derived energy.*

507 *Develop working properties for imported woods.*

509 *Improve utilization of whole-tree chips.*

511 *Develop systems to utilize biomass for fuel.*

512 *Develop techniques for reducing direct and indirect costs of lumber drying.*

514 *Develop methods to expand use of hardwoods for fiber production.*

516 *Develop environmentally acceptable methods for protecting wood in adverse conditions.*

Increase Current Level of Effort

262 *Develop methods and data for more realistic timber supply and demand forecasts by species groups.*

276 *Develop markets for low-grade hardwoods.*

277 *Study barriers to harvesting and conversion of timber as a result of state and local regulations.*

461 *Evaluate the impact of technological advances in harvesting and engineering systems on employment.*

464 *Develop methods to identify highest and best use of the total tree.*

553 *Identify new uses and markets for small or low-grade hardwood timber to permit more efficient and intensive management of hardwood forests.*

562 *Establish a more exact system of lumber grading.*

566 *Develop models to evaluate the effect of plant size on the economics of various forest products industries.*

Continue at Current Level of Effort

253 *Identify and evaluate investment opportunities for using logging residues, mill by-products, and secondary manufacturing residues.*

560 *Evaluate the impact of a reduced rate of national economic growth on the forest products industry.*

565 *Evaluate the end-use requirements for, and the economic potential of, products made from planer shavings and sawdust.*

13 Watershed Protection and Management

Increase Current Level of Effort

'8 *Investigate how each forest use physically affects the vegetation, soil, water, air, sound, and appearance of the forest.*

4 *Reforestation of strip-mine and spoil-bank areas as related to future land use.*

5 *Develop technology for erosion and sediment control.*

7 *Effectiveness of filter and buffer strips in controlling sediment and stream-water temperature.*

5 *Quantify the impact of recreation on water quality.*

' *Quantify soil loss and sediment yield as related to transportation systems in forested areas.*

Impacts of mining operations on the forest ecosystem.

Effect on water quality and quantity of changing forest land into residential development.

Continue at Current Level of Effort

608 *Quantification of nonpoint source pollution from forest lands under different management levels.*

609 *Identify techniques of land-use planning and control for water-quality management.*

615 *How to gain public acceptance for application of wastewater and sludge on forest lands.*

708 *Quantify nonpoint pollution from forest lands.*

14 Soil, Plant, Water, and Nutrient Relationships

Increase Current Level of Effort

178 *Examine soil nutrient losses with intense management on 30-40 year rotations, including energy trade-offs from fertilization.*

184 *Identify the impacts of clearcuts on nutrient loss and how these are mitigated by shelterwood cutting.*

189 *Effect of sewage waste on different soils and topography.*

611 *Use of forest lands for wastewater and sludge disposal and other biodegradable waste.*

651 *Environmental implications of using sewage sludge as a soil amendment in forested areas.*

652 *Long-term effects of applying sewage sludge on forested areas, including impact of heavy metals on the ecosystems (land and water).*

653 *Role of soil compaction in decline of trees in intensively used forest recreation areas.*

656 *Information on nutrient loss due to harvest-cutting operations as related to water pollution and future forest fertilization needs.*

657 *How much tree residue should be left in the forests to maintain site productivity?*

658 *Effect of toxic material uptake on forest vegetation.*

659 *Short- and long-term impacts of acid rain on forest lands.*

660 *Implication of soil additives on forest areas.*

661 *Develop soil tests for production of timber crops.*

662 *Develop methods to understand organic layer transformations related to tree growth.*

917 *Develop ways to control and use sewage waste and recyclable materials from urban areas in forests.*

Continue at Current Level of Effort

21 *Improve forest soil and site survey, classification, and interpretation for multiple-use management.*

663 *Develop methods to alleviate serious soil compaction.*

15 Alleviation of Soil, Water, and Air Pollution

Increase Current Level of Effort

176 *Define relationships of timber management and logging to erosion and sedimentation by land and management categories.*

703 *Information on relative ability of tree species to absorb gaseous and particulate air pollutants, and the fate of pollutants in the ecosystem.*

707 *Effects of pesticide residues as pollutants.*

716 *Pollution problems resulting from disposal of organic wood-product residues.*

918 *Study the use of trees to ameliorate noise and air pollution.*

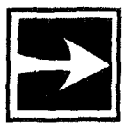
Continue at Current Level of Effort

182 *Determine the effect of air pollution, including acid rain, on forest ecosystems and how these can be ameliorated.*

710 *Quantify polluting effects of forest burning.*

714 *Water pollution resulting from forest fertilization.*

16 Management of Range Resources



Continue at Current Level of Effort

753 *Responses of forest vegetation to grazing.*

755 *Impact of grazing on endangered plants.*

756 *Comparative economics of alternative rangeland uses.*

757 *Disperse grazing pressures to minimize soil compaction and alteration of plant succession.*

758 *Impact of grazing on other multiple-use objectives.*

759 *Contribution of forest rangelands to meat production from domestic livestock.*

760 *Develop range-management systems for improved meat production compatible with multiresource uses.*

762 *Potential use of abandoned farmland reverting to brush and forest conditions.*

764 *Wildlife carrying capacity of grazed vs. ungrazed forest land.*

765 *Determine the relative efficiency of protein production from forage and browse by wildlife and domestic livestock.*

17 Wildlife and Fish Habitat

Increase Current Level of Effort

Relationships of silvicultural systems to wildlife habitat, including nongame species.

Identify techniques for integrating timber management with wildlife management.

Impacts of short rotations on wildlife species that are dependent on mature forests.

Establish the effects of silvicultural practices on game and nongame species.

Effect of slash disposal and utilization on wildlife.

Relative values of forest successional stages for wildlife.

Changes in wildlife values or use in conversion from one cover type to another.

Woodland wildlife carrying capacity: assessment, manipulation, and forest-management relationships.

Projected demands for forest-range wildlife and fisheries for nonconsumptive uses.

Ecology of urban wildlife populations.

Perceptions of wildlife by various publics.

835 *Evaluation of urban wildlife habitat-management techniques.*

836 *Forest-management techniques for maintenance of special wildlife habitats.*

841 *Develop criteria for making decisions on what wildlife species will be favored for management.*

Continue at Current Level of Effort

183 *Herbicide use and monocultures in restricting vegetative and wildlife diveristy.*

328 *Research on animal damage and control in the forest.*

803 *Effect of noise generated by logging, recreation use, and road traffic on wildlife.*

806 *Influence of illegal hunting on wildlife populations.*

807 *Impact of road construction on wildlife populations.*

809 *Impact of grazing on wildlife populations.*

815 *Impact of prescribed fire on wildlife populations in various habitats.*

818 *Effects of longer rotation of oak on mast production and habitat.*

819 *Determine the effect of human recreation use of forested areas on forest wildlife.*

826 *Impact of coal mining and processing on wildlife and fisheries.*

827 *Economic value of forest wildlife and fisheries.*

831 *Impact of use of fertilizers and pesticides on aquatic and terrestrial animals.*

837 *Impact of runoff from forest roads on streams and fisheries.*

838 *Direct and indirect impacts of rights-of-way on wildlife.*

839 *Improved plant species for wildlife food production.*

840 *Contribution of wildlife to meat production.*

842 *Urban wildlife damage and nuisance problems.*

Reduce Current Level of Effort

192 *Management and control techniques to reduce browsing and damage by deer.*

18 Outdoor Recreation

Increase Current Level of Effort

851 *Identify measures needed in outdoor recreation areas to make them more easily accessible to the physically handicapped.*

860 *Develop means to identify and designate high-quality dispersed recreation areas.*

864 *Evaluate effect of design on carrying capacity of recreational resources, with emphasis on high-density use areas.*

865 *Determine the relationship between public fee structures and supply of complementary private facilities and services.*

868 *Evaluate effectiveness of size on the use of eastern wilderness in terms of psychologically equivalent outdoor recreation experiences.*

870 *Determine the value of recreation experiences, from wilderness to intensive development.*

871 *Effect of energy demands on future recreation.*

881 *Evaluate and measure environmental, social, and esthetic intangibles.*

890 *Identify problems in use of watersheds for recreational purposes.*

Continue at Current Level of Effort

820 *Incentives to private landowners allowing public access.*

859 *Develop effective methods of quantifying recreationists' impact, esthetic values, and intrusiveness.*

861 *Develop resource-protection measures which allow use of backcountry areas while protecting them from degradation.*

867 *Determine economic and social cost for adding recreation opportunities to public land development and management activities.*

869 *Determine the effect of dispersed recreation on ecosystems, and identify new management approaches, using advanced technology.*

872 *Determine changes expected in recreation use due to anticipated change in the age of the users.*

878 *Develop more accurate and useful forecasting and monitoring techniques for recreation demand, using socioeconomic trends.*

883 *Determine effect of different silvicultural systems on recreation experiences.*

884 *Study indirect control techniques for managing recreational resources.*

887 *Create a system to evaluate past, present, and future demand studies.*

889 *Develop effective methods of quantifying and/or lessening peoples' impact on recreational resources.*

19 Rural and Urban Environmental Enhancement

Increase Current Level of Effort

20 *Develop forest-management practices to achieve planned growth objectives, i.e., provision of housing development.*

6 *Develop methods to lower facility maintenance costs in face of increased use pressures.*

7 *Study the effects of environmental education and interpretation on improving quality of rural and urban environmental experiences for disadvantaged groups, such as disabled, handicapped, rural and urban poor, minorities, aged.*

Study institutional agreements and legal options that could be better exercised to improve the quality of the landscape.

Study the possibility of providing recreation opportunities in, and adjacent to, urban areas without maintenance being prohibitive to the providing city or agency.

Continue at Current Level of Effort

120 *Develop techniques for the restoration of natural environments within forest lands.*

712 *Effectiveness of forest vegetation in reducing noise pollution.*

713 *Effectiveness of vegetation around buildings in energy conservation.*

916 *Determine what people want in the way of forest amenities.*

923 *Determine the psychological effects of various land uses.*

930 *Develop standards regarding existing and planned shoreline developments that are compatible with visual and cultural values.*

Table 1.—*Relationship between National Work Group and Subject Area, and Responsibilities of Regional Subcommittee.*

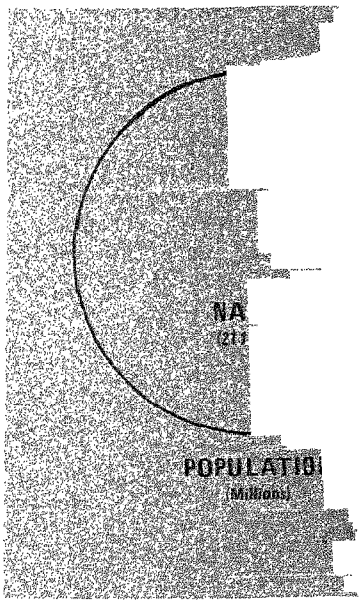
Northeastern Regional Subcommittee	National Subject Area	National Work Group
1. Forest inventory	1. Multi-resource inventory and appraisal	I. Multi-resource inventory, appraisal, and evaluation
2. Forest-land use	2. Alternative uses of land	
3. Forest economics, policies, and programs	3. Multiple-use potential and evaluation	
	4. Biology, culture, and management of forests and timber-related crops	II. Timber management
4. Timber management	5. Genetics and breeding of forest trees	
	6. Economics of timber production	
5. Forest insects	7. Control of insects affecting forests	III. Forest protection
6. Forest diseases	8. Control of diseases, parasites, and nematodes affecting forests	
7. Forest fire	9. Prevention and control of forest and range fires	
8. Timber harvesting	10. Harvesting and forest engineering systems	IV. Harvesting, processing, and marketing of forest products
9. Forest products utilization	11. Properties, processing, and protection of wood	
10. Forest products marketing	12. Economics and marketing of wood products	
11. Forest and water relationships	13. Watershed protection and management	V. Forest watersheds, soils, and pollution
12. Forest soils	14. Soil, plant, water, and nutrient relationships	
13. Forest and air relationships	15. Alleviation of soil, water, and air pollution	
14. Wildlife and fisheries habitat	16. Management of range resources	VI. Forest range, wildlife, and fisheries habitat development
	17. Wildlife and fish habitat	
15. Forest recreation	18. Outdoor recreation	VII. Forest recreation and environmental values
	19. Rural and urban environmental enhancement	

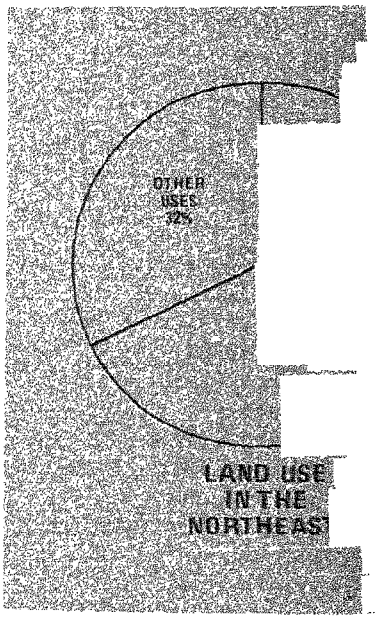
Table 2.—*Scientist years (SY's) for forestry and associated rangelands research for the state agriculture experiment stations and forestry schools (SAES + F.Sch.), and USDA Forest Service (FS) in the Northeast for 1975, 1980, and 1985.*

Research program and research problem area	1975			1980			1985		
	SAES + F.Sch.	FS	Total	SAES + F.Sch.	FS	Total	SAES + F.Sch.	FS	Total
	Scientist years								
I. Multi-resource inventory									
1. Appraisal	5	6	11	7	13	20	6	15	21
2. Alternative uses	0	0	0	0	12	12	0	12	12
3. Evaluation	2	1	3	6	2	8	9	2	11
Total	**7**	**7**	**14**	**13**	**27**	**40**	**15**	**29**	**44**
II. Timber management									
4. Biology	11	19	30	14	28	42	15	28	43
5. Genetics	5	8	13	7	4	11	11	5	16
6. Economics	3	1	4	5	2	7	6	2	8
Total	**19**	**28**	**47**	**26**	**34**	**60**	**32**	**35**	**67**
III. Forest protection									
7. Insects	12	16	28	13	14	27	13	13	26
8. Disease	4	5	9	5	5	10	6	5	11
9. Fire	0	0	0	1	0	1	1	0	1
Total	**16**	**21**	**37**	**19**	**19**	**38**	**20**	**18**	**38**
IV. Wood products									
10. Harvesting	1	3	4	2	4	6	2	5	7
11. Properties, processing, and protection	26	8	34	29	4	33	29	4	33
12. Marketing	3	16	19	2	19	21	1	19	20
Total	**30**	**27**	**57**	**33**	**27**	**60**	**32**	**28**	**60**
V. Watersheds, soils, and pollution									
13. Watersheds	2	8	10	4	10	14	9	13	22
14. Soils	6	3	9	10	0	10	11	1	12
15. Pollution	5	2	7	6	1	7	8	2	10
Total	**13**	**13**	**26**	**20**	**11**	**31**	**28**	**16**	**44**
VI. Forest range and wildlife									
16. Range	0	0	0	0	0	0	0	0	0
17. Wildlife	22	6	28	23	7	30	32	12	44
Total	**22**	**6**	**28**	**23**	**7**	**30**	**32**	**12**	**44**
VII. Recreation and environmental values									
18. Recreation	5	8	13	8	8	16	21	16	37
19. Environment	1	2	3	2	5	7	15	11	26
Total	**6**	**10**	**16**	**10**	**13**	**23**	**36**	**27**	**63**
TOTAL	**113**	**112**	**225**	**144**	**138**	**282**	**195**	**165**	**360**

Table 3.—*Subject Area ranking by delegates to the National and Northeastern Regional Conferences, from 1: highest; 19: lowest. (Subject Areas with identical rankings are shown with a letter suffix).*

Work Group and Subject Area	National conference	Northeastern conference
I. Multi-resource inventory		
1. Appraisal	1	3
2. Alternative Uses	13	4
3. Evaluation	3	5a
II. Timber management		
4. Biology	6	5b
5. Genetics	9a	17
6. Economics	4a	8
III. Forest protection		
7. Insects	12	11a
8. Diseases	14	14
9. Fires	19	18
IV. Wood products		
10. Harvesting	11	13
11. Properties, processing, and protection	9b	16
12. Marketing	4b	15
V. Watersheds, soils, and pollution		
13. Watersheds	2	5c
14. Soils	8	11b
15. Pollution	7	10
VI. Forest range and wildlife		
16. Range	16a	19
17. Wildlife	15	9
VII. Recreation and environmental values		
18. Recreation	16b	1
19. Environment	18	2





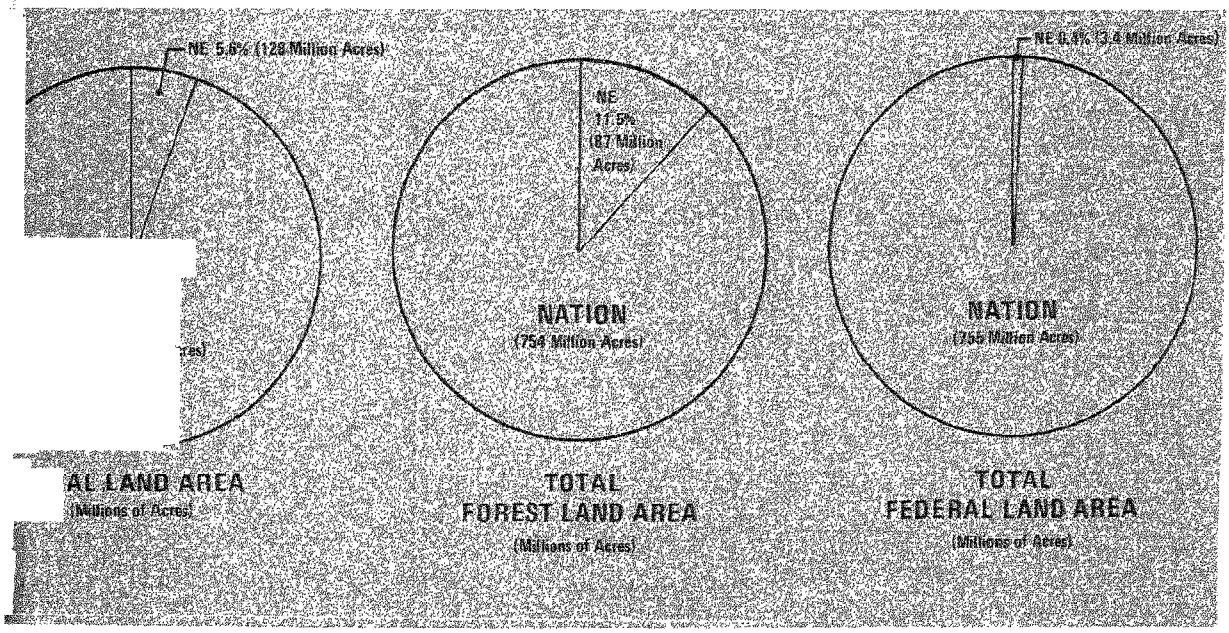


Figure 1.—Northeast Region population, total land area, forest land area, and Federal ownership as a percentage of the National total.

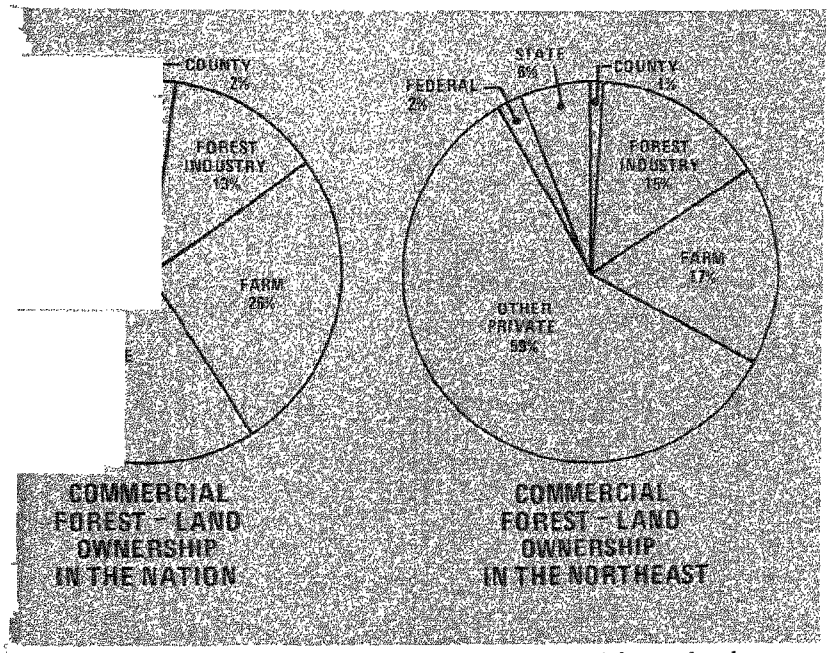


Figure 2.—Land use in the Northeast and commercial forest-land ownership in the Northeast and in the Nation.

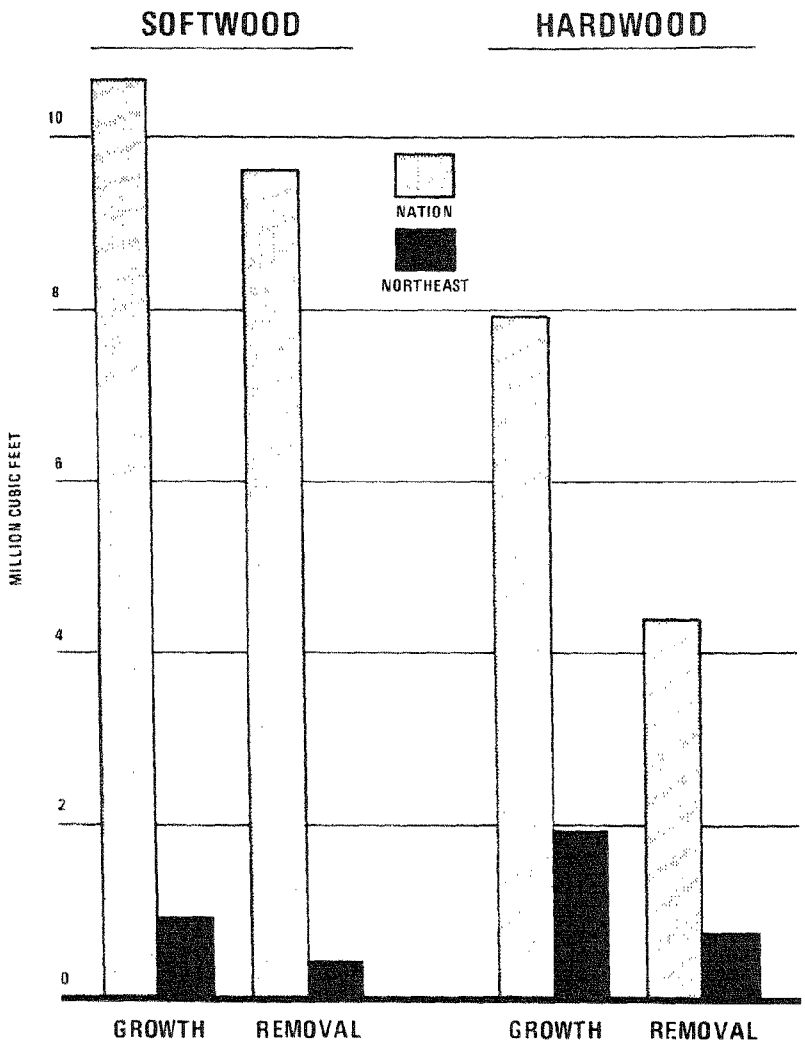


Figure 3.—Net annual growth and removal of growing stock in the Northeast and in the Nation, 1970.