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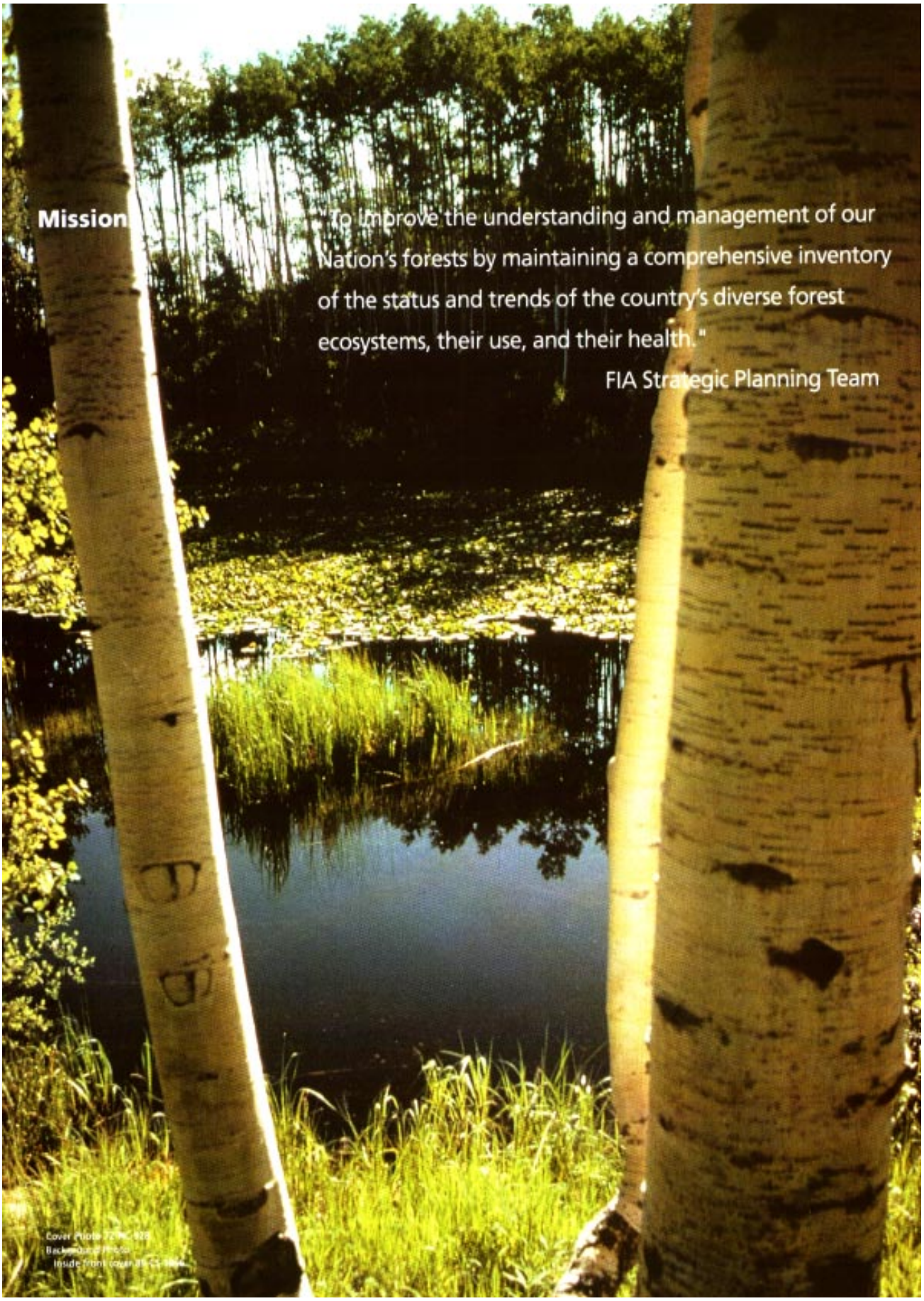
# A Blueprint for Forest Inventory and Analysis Research and Vision for the Future



**Mission**

"To improve the understanding and management of our Nation's forests by maintaining a comprehensive inventory of the status and trends of the country's diverse forest ecosystems, their use, and their health."

FIA Strategic Planning Team

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## Introduction

Since its beginning, Forest Inventory and Analysis (FIA) has played an integral role in the management of the Nation's timber resources and in the orderly inventory of these resources which is required for the development of effective management scenarios. It has helped guide industrial expansion into the most suitable and opportune locations. It has acted as watchdog in identifying problems already created or developing in the timber supply. It has provided key forest resource information for planners and policy makers, and has also provided expert advice and assistance in solving complex resource questions. It has been internally motivated to improve the reliability and usefulness of forest resource statistics and the analysis of resource findings. In recent years, an increased number of major decisions affecting the Nation's forests have been made with reference to and reliance upon Forest Inventory and Analysis findings and forest resource evaluations.

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91-C5-0273

High standards set in FIA's early days and maintained over the years have established a tradition for full, unbiased, and factual presentation of forest resource information. These same high standards must be sustained in the future if FIA is to retain its credibility and usefulness. Therefore, all change, expansion, or shifts in program emphasis must be made with utmost care to ensure that all information produced is based on adequately tested procedures and sound research.

It is with this background that the Forest Inventory and Analysis program proposes to approach the formulation of a new and broader program for the future.

## Mandates

The Forest Inventory and Analysis program, initially known as the Forest Survey, was conceived over eight decades ago when the U.S. Congress acknowledged the need for information about the supply and condition of the Nation's natural resources. The Organic Act of 1897, which established the National Forests, included provisions for the inventory and management of these lands. Later, the Forestry Research Act (McSweeney-McNary) of 1928 directed the Secretary of Agriculture to make and keep current a comprehensive inventory and analysis of the Nation's forest resources. The Resources Planning Act of 1974 (RPA) amended the earlier research act and directed the Secretary of Agriculture to, "...make and keep current a comprehensive inventory and analysis of the present and prospective conditions of and requirements for the renewable resources of the forest and rangelands of the United States..." The Forest and Rangeland Renewable Resources Research Act of 1978, which replaced the earlier Forestry Research legislation, repeated the amendment contained in the RPA.

The National Forest Management Act of 1976 states: "...to serve the national interest, the renewable resources program must be based on a comprehensive assessment of present and anticipated uses, demand for, and supply of renewable resources from the Nation's public and private forest and rangelands...." This law expanded the activities of the nationwide Forest Survey to cover all renewable natural resources. Recent legislation, such as the Forest Ecosystems and Atmospheric Pollution Research Act of 1988, directs the Secretary of Agriculture to "...increase the frequency of forest inventories in matters that relate to atmospheric pollution and conduct such surveys as are necessary to monitor long-term trends in the health and productivity of domestic forest ecosystems." This legislation directs FIA to monitor the forest health of the Nation. In cooperation with State and Private Forestry, under the Forest Stewardship Act of 1990, FIA is developing a methodology to assess the current status of the urban forest resources of the Nation.

## Purpose

The purpose of this blueprint is to chart a course for the Forest Inventory and Analysis program that will serve as a guide throughout the 1990's. It contains the basis for our varied activities, covers our relationships with our clients and cooperators, and contains our vision of where we are and where we are going. We are proud to be part of the USDA-Forest Service whose stated mission is "...to care for the land and to serve the people". We have an important role to play in achieving this overall mission. Our forest inventories provide the necessary foundation for building a program of land stewardship. And we serve the people by providing unbiased, accurate, current, and relevant forest resources information that meets their diverse needs. Likewise, we are proud to be part of the Forest Service Research organization, which serves society by "developing and communicating the scientific information and technology needed to protect, manage, and use the natural resources of forests and range lands." As part of Research's foundation program, we develop basic statistics that are needed as background for many research proposals and problem analyses. Although much of our energy is expended in gathering data and reporting statistics, our program includes a dedicated and capable cadre of scientists who evaluate forest resource trends, develop techniques, and adapt the latest technology to allow us to remain in the forefront of inventory organizations throughout the world. As our mandated responsibilities grow and our client base becomes more diverse, FIA must become more responsive to the public's information needs.

**Forest Inventory and Analysis zones of research responsibility**

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# Issues and Trends

## Long Term

Four issues stand out as being related to renewable natural resources and will directly affect the FIA program.

**Increasing Pollution** This issue includes such topics as acid precipitation, the effects of global climate change, deterioration of forest health, and lower forest productivity.

**Dwindling Resources** This issue encompasses lack of regeneration, overharvesting, desertification, a loss of biological diversity, dwindling old-growth forests, and forest and ownership fragmentation.

**Increasing Population** This issue is closely linked to urbanization, land clearing, and increased pressure on remaining forest systems to supply necessary goods and services.

**Proliferation of Information** In the future we will continue to need accurate, timely resource information and easy access to data.

## Short Term

We must anticipate research needs rather than react to crises. To do this, we must be aware of upcoming trends. For the 1990's, we see the following major trends affecting forest resources:

**A Changing Forest Land Base** The ability of our forests to supply timber products is declining in response to growing pressures to supply a broad spectrum of commodities and nonmarket goods and services. To keep pace with dynamic land-use change, the inventory remeasurement cycles should be shortened and appropriate variables should be collected to adequately characterize other resources values.

**Rising Noncommodity Uses** The extent and condition of forest resources, on which these uses depend, need to be thoroughly documented. In-depth analyses are needed to estimate outdoor recreation demand and potential increases in use, wildlife habitat suitability and extent, watershed conditions, grazing use, and biological diversity. To get a complete picture of these resources, all forest land, including wilderness areas and parks, should be included in forest resources inventories and featured in reports..

**Environmental Health Change** Forest health and productivity are affected by a large number of interacting factors. Air quality problems and the potential for anthropogenic climate change have increased the need for timely information on the health and productivity of the Nation's forests. Addressing these issues requires efforts from many disciplines to provide new kinds of monitoring data. A key role will be the establishment of a baseline set of field locations that can be monitored to detect changes in the health and condition of major forest ecosystems over time.

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## Alliances

The FIA program has many partners in accomplishing its mission. Some traditional and major current cooperators and their relationship to our program include:

**Forest Service-NFS**

National Forest System administrators are major land managers, especially in the West, and are responsible for intensive management-level inventories on National Forest System lands. In the East, the FIA program conducts extensive inventories on the National Forests, as well as other public and private land, and furnishes standard statistics for Resource Planning Act (RPA) decadal assessments. In the West, the NFS furnishes input for State-level inventories and RPA assessments.

The two inventory activities are complementary. Land management questions can best be answered by map-based NFS inventories, while questions that are regional in nature and that affect all forest land ownerships can best be answered by the FIA sample-based inventories. As the Forest Health Monitoring program is implemented, FIA will be establishing and maintaining field plots at FIA photo- or field-plot locations on all forest land ownerships and thus will have opportunities to strengthen our partnership with NFS.

**Forest Service-S&PF**

State and Private Forestry programs offer opportunities for cooperation in several areas. Forest Pest Management (FPM) is a major partner with FIA in implementing the national Forest Health Monitoring program. The FIA role is in the early phases of monitoring: answering questions of what, where, and when by recording the condition of forest ecosystems, estimating baseline conditions, and detecting changes from the baseline. FPM assists in detecting changes and takes the process one step further by determining the causes of the detected changes. When cause is identified, then corrective actions can be identified and implemented.

Under the Forest Stewardship Act of 1990, "...an assessment of the current status of urban forest resources..." is required. No uniform national methodology has been developed for conducting these assessments. FIA has the technical skills and design capabilities to develop this methodology and a nationwide organization that is capable of producing consistent national statistics.

**Forest Service-IF**

The Tropical Forestry program under the responsibility of International Forestry recruits experts to assist in training professionals from developing countries and helping them to manage their forests for sustainable development. FIA scientists are experts in resource inventories and analyses and the application of Geographic Information Systems (GIS) and remote sensing technology to resource assessment needed for this program.

## States

The States have a long tradition, both directly and through the National Association of State Foresters, of cooperating with the FIA program in many ways. Individuals within State agencies serve on important forest inventory advisory committees. During periodic reinventories, States may provide financial support to intensify the sample intensity. State personnel provide training to FIA field crews in insect and disease detection, and provide personnel, field equipment, vehicles, and aerial photography for both forest inventory and forest health monitoring activities. State forestry staffs also assist FIA in gathering data on commodity drain and forest landowners at specified intervals, and they review forest resources reports and assist in disseminating results to the clients and data requesters.

## Forest Industry

Forest industry has long been an active cooperator with and supporter of the FIA program. Forest industry provides FIA access to fee and leased forest lands to conduct inventories and forest health monitoring. The industry participates with FIA through the Research Committee of the American Forest Council to provide review and advice on technical inventory matters. Industry is a major user of FIA resource inventory data and, both individually and collectively, is an active supporter of the FIA program.

## Soil Conservation Service

A formal agreement between the SCS and FS states that "...Forest Service will be responsible for forest resource inventories..." and "...FS and SCS will work together on inventory...to identify data needs, avoid duplication of efforts, and assure that data collected by each agency are mutually usable." It further states that SCS and the FS will "...develop common methodology and standards, and broaden opportunities for sharing information." In recent years, cooperation during several statewide inventories has resulted in the verification and upgrading of SCS soils maps and the addition of soils information when evaluating forest productivity. The two agencies both have inventory responsibilities and plan to cooperate closely during current and future SCS National Resources Inventories and FS Resource Planning Act Assessments.

## Environmental Protection Agency

The Forest Service is cooperating with the EPA-Environmental Monitoring and Assessment Program (EMAP) in the continued development and national implementation of forest health monitoring. Detection monitoring, one of the three tiers of interrelated monitoring activities, is the most extensive level and involves the FIA program. Detection monitoring provides a direct linkage to the EMAP sampling grid. EPA and FIA scientists are collaborating in specifying the monitoring requirements for forest ecosystems. EPA-EMAP-Forest will also provide ancillary data that will help in interpretation of detection monitoring results. Over the next 5 years, we envision that the planning and implementation of the nationwide monitoring program will be completed. During this period EPA will contribute funding, training, staff, and laboratory analysis for samples collected in the field.

## Conservation Groups

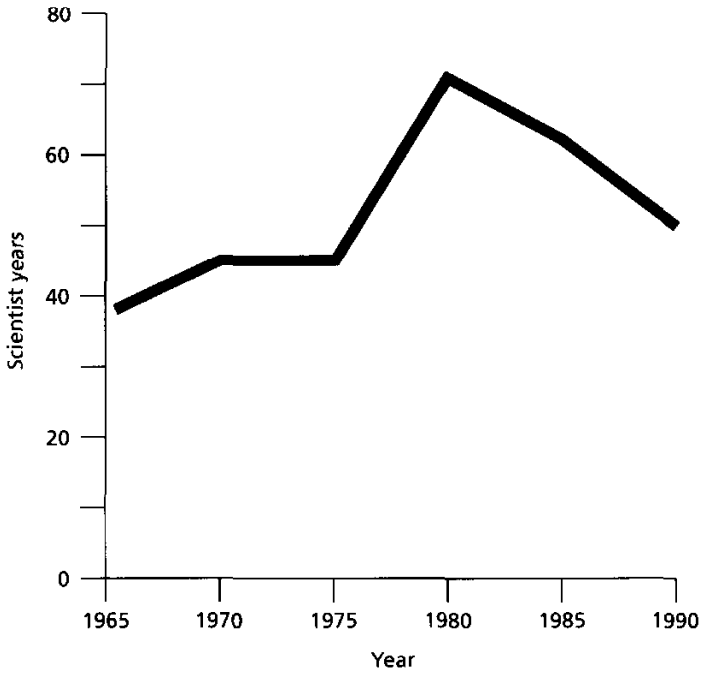
In recent years, conservation groups, including the Wilderness Society, Friends of the Earth, Audubon Society, and the Sierra Club, have made increasing use of FIA multiresource inventory data and analyses. With increased recognition of the value and uses of this information, these groups and others will become active supporters of the FIA program. These groups provide useful guidance on how to inventory and assess forest resources more effectively.

## Universities

The universities participate actively in recruitment of students for both seasonal and permanent FIA positions. In addition, researchers at universities are involved in formal cooperative agreements with FIA research units for research and analysis using resource inventory data. Forestry extension activities at universities are an important means for transferring FIA findings and technology.

Recent mandates provide Forest Inventory and Analysis with a new charter for the 1990's. More important, however, is our recognition that the various pieces of new legislation offer tremendous new opportunities for the Forest Service, the Research stations, and other researchers as well as the Forest Inventory and Analysis program. In the past, Forest Service researchers have worked somewhat independently of one another, each pursuing individual and often unrelated goals within a single discipline. In addition, much research has been conducted as case studies applicable only to local situations; as a result, the findings cannot be expanded to broader regional applications. When making regional resource evaluations, another problem is that individual disciplines or specialties tend to develop their own terminology, standards, and methodology, often inconsistent with other disciplines. This lack of comparability makes it very difficult, if not impossible, to relate results to a common resource situation or common land base.

Collectively the Resources Planning Act, the Forest Ecosystems and Atmospheric Pollution Research Act, and the Forest Stewardship Act offer an opportunity to develop a strong, coordinated research effort dedicated to meeting the special needs of the Acts, and at the same time, provide motivation for many different specialists and disciplines to work together toward common goals.




**Historic FIA scientific effort**

Within this context, Forest Inventory and Analysis proposes an expanded research program in three traditional areas of emphasis and a new research program in two areas of national concern.

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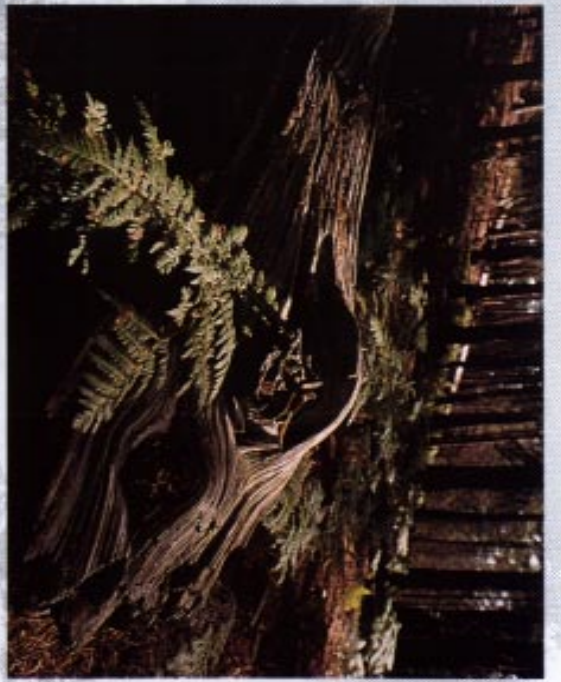

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## Traditional Research Areas

### Comprehensive Inventory of the Forest Ecosystems of the United States

Forest land covers 736 million acres, or 32 percent of the land base in the United States. These forests provide important economic, social, and aesthetic values to the Nation's 250 million inhabitants. Comprehensive inventories will be planned and conducted to provide current information on the extent, condition, and use of the renewable forest resources. Focus will be on the efficient collection and compilation of forest resources data required for periodic national assessments and statewide resource evaluations. Research and analysis of past, current, and prospective trends in the renewable forest resources as they relate to the Nation's overall economic and social needs will identify the value and importance of all of the forest resources, note the interactions among various management activities, and identify opportunities for altering prospective trends. Timely, accurate, and comprehensive data on the forest ecosystems in the Nation are essential for the formulation of sound forest management policies and programs. In response, we will:

- Identify new kinds of information that better describe the forest resources, and the landowners that control them.
- Obtain baseline data on forested wetlands and old-growth forests across the Nation and develop analytical methods for portraying them.
- Undertake the inventory of woodland and productive reserved forest lands of the Nation.
- Improve techniques and procedures for measuring biomass on forested and other land and estimate the amount of carbon stored in forest ecosystems.
- Develop procedures to quantify landscape features when addressing fragmentation and other issues pertinent to contemporary management concerns.

## Identification of Non-Commodity Variables Needed for the Nation's Resource Planning Act Assessments

Starting in 1976, particular attention was given to link variables indicative of more than one forest condition or attribute. Classifications and measurements made at sample locations focused on special information needs for evaluating wildlife habitat, recreation use, range suitability, water quality, erosion hazards related to forestry practices, and the use-interaction relationships associated with the numerous forest conditions.

The primary goal of a comprehensive inventory is to quantify and describe these distinct plant communities as to site, origin, vegetative composition, and stage of development and to determine what benefits are present. The inventory merges information on the understory plant communities and noncommodity attributes with conventional information on trees at the same sample locations. The inventory further quantifies and describes man's intervention and control over the natural development of these plant communities through conventional forestry practices and actions. In essence, the comprehensive inventory is designed to establish the basic ecological relationships vital to periodic assessments and evaluations.

To meet the challenge, we will:

- Develop closer alliances with diverse multiresource data users.
- Assist NFS in developing definitions, field procedures, and analytical methods for portraying old-growth forest ecosystems.
- Develop data requirements, definitions, and analytical methods to assist in evaluating wildlife habitat condition and extent, measuring biological diversity, and tracking threatened and endangered species.
- Expand the basic inventory of trees to include all vegetation for the purpose of establishing a long-term, statistically valid sample of the condition of the entire forest ecosystem.

## Forest Industry and Timber Production Analyses

Studies of timber products output will be conducted in cooperation with State forestry agencies, forest industries, and professional and trade associations. These data and data obtained from extensive inventories will allow scientists to plan and conduct research studies on timber use and its relation to inventory volume, and to estimate the amount of logging residues and other removals associated with cultural practices and changes in land use. Timber recovery studies and information on forest products and timber industry production provide the necessary input for maximizing investment returns. Legislators, public and private resource managers, planners, and analysts utilize this information to formulate policy and to make resource management decisions.

In response we will:

- Conduct thorough analyses of change between successive inventories, examining gross growth, mortality, and removals.
- Estimate and analyze changes in timber utilization.
- Conduct studies of total roundtimber removals from all lands.
- Conduct analyses of biomass/energy potentials and their impact on traditional timber uses.

## New Research Areas

### Implementation of Forest Health Monitoring

The USDA Forest Service and the Environmental Protection Agency are jointly developing a forest monitoring program to provide regional assessments of the status and trends of forest condition. As an initial step in the development of this program, a pilot study on five indicators of forest condition (growth efficiency, visual symptoms, foliar nutrients/ chemical contaminants, soil productivity, and vegetation structure) was conducted during the 1990 summer field season in New England. These indicators are being considered for use in the remaining Eastern States and in the West as the program is implemented in future years.

Our efforts will include:

- Investigating forest sampling strategies that are best suited to forest health monitoring.
- During analyses, determining how to link forest health data collected in the field, remotely sensed data, and other data (e.g., climate parameters and pollution loadings).
- Identifying key environmental health indicators which directly, or indirectly, reflect forest ecosystem condition. Determine if forest indicators discriminate between forest stands of known "good" and "bad" health.
- Determining how to monitor and track long-term trends in the health and productivity of the forest ecosystems.
- Identifying the field data measurements required to adequately assess both human-induced and natural environmental stresses.
- Developing sound mensurational and data processing procedures applicable to forest health monitoring.
- Conducting studies to determine the kinds of information that can be acquired from remote sensing.

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**Urban Forest Inventory Research**

Backyard forests as well as single trees/groups of trees in urban/suburban settings are receiving increasing attention as a source of wildlife habitat, specifically for songbirds and small mammals in predominantly urban or suburban areas. Small forested tracts that do not meet FIA's definition of forest land are being used as inner-city environmental education centers. Greenways are increasingly used by city dwellers as a focal point for recreation, exercise, and other leisure activities. In addition, research is currently being conducted to identify the tree species that are best suited for planting as windbreaks and noise barriers, to abate hydrocarbon emissions, and as potential for summer shade to reduce energy costs in cities and suburbs. A baseline estimate of tree biomass in urban settings is necessary to be able to monitor the effectiveness of urban tree planting programs and to identify the size and species distribution of trees. Cities and urban land should be first stratified into subclasses, such as residential, transportation rights-of-way and median strips, recreational greenways, and industrial settings, so that biomass estimates, and the extent and type of use associated with the subclasses, may be identified. To meet this challenge, we will:

- Develop a methodology for delineating and stratifying urban forest land.
- Test, and if necessary, modify existing procedures of land classifica tion and estimation in order to conduct forest/tree inventories in densely populated areas.
- Evaluate the extent of forest urbanization at present, track changes in "urbanized forest land," and evaluate the effects of urbanization on levels of forest management and ecosystem retention.
- Design appropriate sampling procedures to study ecological systems along urban-rural gradients and to examine remnant forest patches, species composition, and vertical and horizontal vegetative structure.

- Investigate new ways of describing the urban forest, such as leaf area indices or foliar volume.

- Develop total tree biomass equations for urban trees by evaluating crown structure and relating canopy biomass to stem diameter for trees in urban settings. Determine the current extent and distribution of tree biomass by species and size.

- Identify the level of use and the extent of management for recreation and wildlife habitat associated with urban land uses, such as backyard forests, land supporting trees and shrubs but less than 1 acre in size, and strips of isolated trees along fences and streams in agricultural settings.

- Evaluate the current levels of removals and mortality of trees in urban land uses and develop trend data by species and land-use classes.

- Assess the impacts of urban expansion and other developments on the forest resources. Provide information on the forest area and tree volume found in close proximity to areas developed for permanent or seasonal homes, campgrounds, recreational resorts, and industrial complexes.

## Guiding Principles

In implementing this new and expanded plan of work, we will be guided by the following principles:

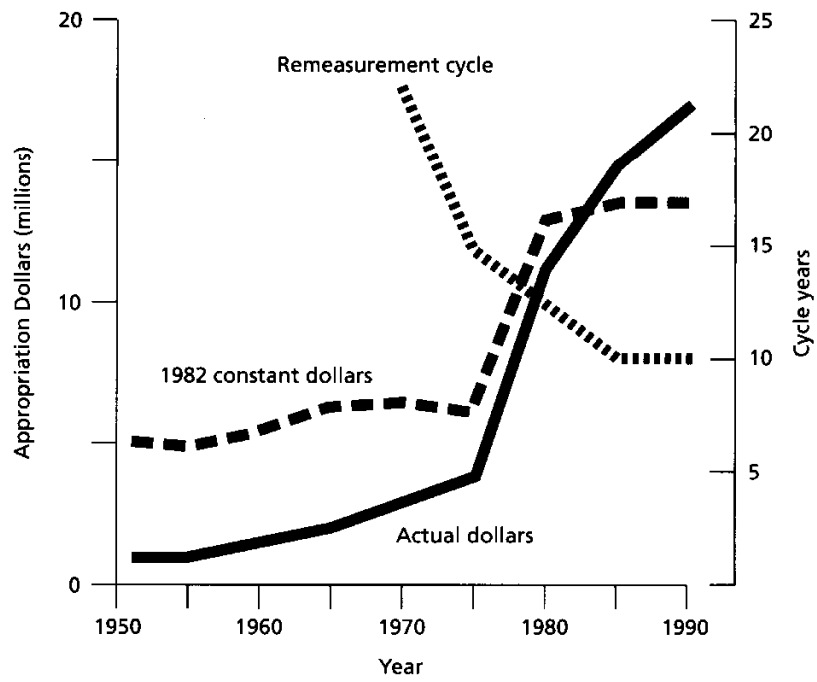
- Although our primary mission is to serve the people of this Nation, we recognize that many of the problems require a multinational or global approach.
- We will take the lead in inventorying and monitoring changes in the Nation's forests, forest resources, and forested ecosystems.
- In regard to common national and international data reporting problems, we will strive to establish universal protocols that ensure comparability of statistics.
- We will operate to maintain the best possible working relationships with our clients and cooperators.
- We will actively participate in developing inventory methods and new techniques that will assist the National Forest System in meeting the requirements of the National Forest Management Act.
- We will maintain our emphasis on conducting statewide forest resources inventories, while conducting a balanced program of research to advance knowledge on multiresource assessments and forest health monitoring.
- We will recruit, train, and retain a competent and highly dedicated work force from all segments of the Nation's population, and we will encourage creativity and innovation in our people.

## Goals for the 1990's

In the short term (the next 5 years) the FIA program will concentrate on attaining these general, high-priority program goals:

### Base Program

- Maintain maximum 10-year inventory remeasurement cycle in all regions.
- Expand FIA comprehensive inventory coverage to all forest lands, of all ownerships and statuses.
- Develop and maintain data bases and a uniform data delivery system to address State, regional, and national forest-resource information issues, and provide adequate documentation and interactive access for data requesters.




**Historic FIA funding and cycle length**

### Forest Health Monitoring

- In cooperation with EPA, the States, and other Federal agencies, establish and maintain an extensive Forest Health Monitoring network across all forest ecosystems.
- Identify, measure, and monitor key indicators of the forest that allow an assessment of forest productivity; resiliency; biodiversity; and ecosystem stability, distribution, condition, and structure.

**Techniques Development**

- Implement research and technical development of inventory and monitoring design and resource analysis methods.
- Identify those remote sensing products, or combination of products, best suited for monitoring forest area change in the United States.
- Develop appropriate methods for identifying, defining, and inventorying urban forests and forested wetlands.
- Validate most appropriate methodology for estimating the components of change and its use during extensive forest inventories.

**Other Activities**

- Maintain and update the 1987 RPA Assessment data base and statistical summary tables for 1992.
- Update the national survey of forest land owners of the United States.
- Expand the national biomass assessment to include the western woodland ecosystems.
- Provide technical experts to assist international agencies and developing nations in conducting forest resources inventories and adapt ing emerging technologies.

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