An Overview of Inventory and Monitoring and the Role of FIA in National Assessments

W. Brad Smith, Associate National Program Manager for Forest Inventory and Analysis, USDA Forest Service Research & Development, Washington, DC

Abstract—*This paper presents a brief conceptual overview of inventory and monitoring and the role of the Forest Inventory and Analysis (FIA) program in national assessments. FIA has become a focal point of national inventory and monitoring and kept national leadership as well as forest resource research and management professionals apprised, through periodic reports to Congress and others on the status, condition and health of the Nations forests across all ownerships for over 75 years.*

Introduction

The Forest Inventory and Analysis program within the Forest Service is the only inventory and monitoring programs in the U.S. that carries out large-scale descriptive forest vegetation inventory and monitoring across all forest land ownerships with consistent, compatible protocols for landscape scale information reporting. And, these inventories have been the scientifically reliable basis of national assessments of the Nation's forests for more than 5 decades. A general overview of the nature and application of inventory and monitoring will be followed by an overview of specific role of FIA in national assessments.

Nature of Inventory and Monitoring

In simple terms, monitoring is the process of checking or observing something, relative to a standard or baseline, for a particular purpose, followed by interpretation and possible action. The notion of comparison to a baseline explicitly implies repeated measurements when considering inventories. The timing, content, and scale of these measurements must depend on the both the need for the information and the availability of data from other ancillary sources required for possible analysis. Coordination between agency units (State and Private Forestry, Research, and National Forest System) and external partners (public participants; Federal, State, and local agencies, tribal governments, universities, and special interest groups) is mandatory for effective inventory and monitoring activities aimed at addressing issues or policies which cross multiple spatial and legal boundaries. Vegetative inventory and monitoring is considered one of the principal tools the Forest Service will use to assure that the goal of achieving and maintaining sustainable forest ecosystems is being accomplished.

More specifically, inventory and monitoring is defined as the process of repeating vegetative inventories and developing analyses to assess resource trends and provide the basis for broad policy decisions. In this context, inventory and monitoring (referred to as simply 'monitoring' henceforth) can be divided into the broad generic categories of descriptive and prescriptive monitoring (Barnard and others 1985). Descriptive monitoring (also referred to as strategic or landscape-scale monitoring) provides information on an extensive landscape and broad environmental scale for public policy development and analysis. An example of this type of monitoring would be the Forest Inventory and Analysis (FIA) grid inventory. Prescriptive monitoring (also referred to as management or operational monitoring) is much more resource intensive and aimed at providing information for local managerial action. Prescriptive monitoring usually provides detailed information for a limited geographic area and is aimed at developing or evaluating management plans for particular tracts of land. Examples of this type of monitoring include stand exams, wildlife surveys, recreation surveys, etc.

Vegetative landscapes consist of large numbers of individual elements distributed over wide areas making it logistically and economically impractical to use complete census as a monitoring tool of choice. Sampling, in some form, is the only practical solution to obtaining reliable information on the content, structure and condition of the resource. Since trend information over time is important, a process for linked repetition of the sampling, or monitoring, is critical. A key consideration in all types of monitoring is the accuracy level required for the variables of interest, which, in turn, impacts the number and orientation of samples needed.

Statistical sampling of natural resources generally involve three fundamental components 1) area classification or stratification in which relatively homogeneous environments are recognized; 2) direct measurement of observable characteristics of interest; and 3) indirect measurement where characteristics, such as volume or condition, are inferred from models based upon measurements taken in the second component (Barnard and others 1985). Remote sensing and GIS systems are primary tools in the first component; sampling theory, plot design, and collection apparatus dominate the second; and ecological theory, mathematical formulation, and analytical process dominate the third component.

Application of Inventory and Monitoring

The remainder of this paper will focus on descriptive or landscape-scale monitoring. One of the first descriptive inventory estimates for the forests of the U.S. was provided by Franklin Hough (1878-1882). Concerns arose, however, about the subjective method of data collection and reliability of the information. Since that time, foresters in this country have relentlessly pursued better ways to provide statistically reliable information that describe the extent, condition, and trends in the forest resources of the nation. By the turn of the 19th century Graves (1907) described many alternative designs for large-scale forest assessment including plot cruises over extensive forest areas. Later, systematic cruise designs using fixed area plots were recommended by Sewall (1911) and Clark (1913) which would provide greater measurement precision and produce reliable estimates of the resource at low cost. The science of large-scale descriptive forest inventory in the U.S. was being born.

By 1920, several further attempts had been made to estimate the volume contained in the nation's forests (Martin, 1983), but none would yet bear up under the rigors of modern statistical evaluation. This shortcoming, coupled with nagging concerns over the status of the Nation's forests and ongoing depletion of the timber supply, ultimately led to the passage of the McSweeney-McNary Act in 1928 by the federal government. This Act, which also created the federal Forest Research organization in the Forest Service, directed the Secretary of Agriculture "to make and keep current a comprehensive survey of the present and prospective requirements for timber and other forest products in the United States..." This directive became the legal mandate for the national Forest Survey. The new Forest Research organization would use much of the earlier work on sampling as a foundation for more rigorous approaches.

The U.S. Forest Service, under the authority of the McSweeny-McNary Act, initiated FIA (then called Forest Survey) in Oregon, in 1930. Shortly thereafter, in 1931 and 1934, the Southern Forest Experiment Station and Lakes States Forest Experiment Station, respectively, launched forest surveys. In the Northwest the survey statistics were gathered by compilation of existing data with new data collected for areas where information was lacking. In the South (Lentz 1931). and Lake States (Gafvert 1938), a systematic lineplot survey was established. While the Compilation Method and Lineplot method (Lentz 1931) were most common, these early implementations still lacked the desired statistical rigor for the task at hand. And, sampling methods but were generally constrained by terrain and the availability of adequate spatial information (maps or photography) relative to the forests to be measured.

By the late 1930's sampling theory for large-scale inventories had greatly progressed, and with the advent of more widely available aerial photography, the current method of double sampling for stratification began to take shape. This approach, described by Bickford (1952), used aerial photos to determine or stratify the location and extent of the forest and ground plot measurements to quantify and describe strata attributes. The formal theory for this approach, presented by Schumacher and Chapman (1942) and Yates (1949), has survived the rigors of statistical and scientific scrutiny for nearly five decades and continues to form the basis of Forest Service descriptive or landscape-scale vegetative sampling for providing consistent, reliable State, regional, and national assessment information.

By the end of the 1960's, an inventory had been completed in every State except Alaska using this approach. And, while the field plot design and its attendant data measurements have been modified over the years in response to changing information needs and the need to link to new technologies such as satellite and aerial remote sensors, this basic sampling approach continues to demonstrate incredible adaptability and reliability. This relentless pursuit of scientific excellence would position the Forest Service to provide the first reliable national inventory report in the early 1950's (USDA Forest Service 1958), and provide a sound basis for supplying new types of resource information a rapidly changing clientele demanded. In 1967, FIA would codify a standard for consistent monitoring in the Forest Survey Handbook FSH4809.11, which contained core definitions, variables, and tables for reporting timber inventories.

Changing Mandates

During initial Forest Service state-wide inventories and several repeat inventories, under the auspices of the McSweeney-McNary Act, forest conditions deemed less valuable from a timber perspective were often overlooked (Van Hooser 1992). By the 1970's, a growing awareness of the complex interactions among the many forest uses led to the Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974, The National Forest Management Act (NFMA) of 1976, and the Forest and Rangeland Renewable Resources Research Act of 1978. The RPA required an Assessment of the nation's forest and rangeland resources every decade and development of a long-range program to guide natural resources policy. All three laws expanded the inventory mandate to cover all renewable resources on the nation's forest and rangelands.

FIA responded in the late 1970's by expanding predominantly timber-oriented inventories into broader, multi-resource activities. All forest inventory field units began to gather data on wildlife habitat, recreation, soil, and water resources. An example of the magnitude of the change is reflected in the number of variables now being measured by FIA. Before 1974, most FIA field units collected fewer than 60 timber variables on each plot. Today, more than 150 items may be recorded at each location (VanHooser 1992). More than half of these are related to land use, vegetation structure, and other site descriptors that may have no direct relationship to timber supply. And, since 1980, FIA researchers and cooperators have published hundreds of reports and articles on non-timber resources (Rudis and others 1991).

Environmental concerns about pollution effects on forest condition prompted passage of the Forest Ecosystem and Atmospheric Pollution Research Act of 1988. This Act directs the Forest Service to monitor long-term trends in the health and productivity of forest ecosystems. In response, the Forest Service began establishing a network of "sentinel plots" in cooperation with the Environmental Protection Agency's Ecosystem Monitoring and Assessment Program (EMAP). Information collected at these locations annually is much more detailed than regular FIA forest surveys with collection of soil and foliage samples for detailed analysis as well as other sophisticated indicator measures requiring highly trained ecologists, botanists, entomologists, pathologists, and soil scientists. These sentinel plots, known as the Forest Health Monitoring (FHM) detection network, consists of a grid of plots installed at 1/16th the intensity of the national plot grid maintained by FIA. The FHM detection plot network was integrated into the national FIA grid in 1998.

As inventory focus moved from timberland to all forest land, forests that were reserved, marginally productive for timber, or in proximity to urban areas have been given more attention. In 1992, Forest Service leadership directed that the FIA inventory grid would be extended across all agency forest lands regardless of status or location (Leonard 1992, Reynolds 1996) in order to provide a more comprehensive vegetative inventory. Since this directive was issued, hundreds of plots have been established in Wilderness, National Parks, urban areas, and what were previously deemed marginally productive forest lands from a timber perspective. FIA had become a true 'forest' inventory.

Prior to passage of the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA), timber was the main focus of most Forest Service inventories both descriptive and prescriptive. Post RPA, all Forest Service vegetative surveys have taken on a more multi-resource flavor. The primary focus of ecosystem-based inventories is repeatable, objective observations that strive to enumerate and measure basic forest attributes that define ecosystem composition, structure and function. The advent of new technologies in geo-positioning, remote sensing, and geographic information systems (GIS) offers tremendous potential for linking field sample data in a spatially explicit (mapped) way to analyze large landscapes (Powell 1994).

In 1995, an initiative from the White House Office of Science and Technology Policy (OSTP) Committee on Environment and Natural Resources CENR began to take shape that would realize the importance of a network approach to integrated inventory and monitoring of the nation's resources. This effort proposes a framework that builds on existing systematic observations and monitoring of ecological systems; promotes compatible standards, methods and protocols; and provides a strategy developing information for resource assessments at various temporal and spatial scales (OSTP 1996).

The conceptual framework is shown in figure 1. Monitoring is divided into three general classes (starting at the base of the triangle): 1) those that characterize specific properties of large regions by continuous measurement (remote sensing based inventories); 2) those that characterize specific properties of large regions by sampling (for example, FIA); and (3) those that can census properties and processes of specific locations (LTERs, Intensive Ecosystem Monitoring Sites such as Hubbard Brook, etc).

The texture and dynamics of complex forest ecosystems requires information from all three of these levels to efficiently and effectively address the difficult management issues we face today with limited financial and physical resources. At the top of the hierarchy is a

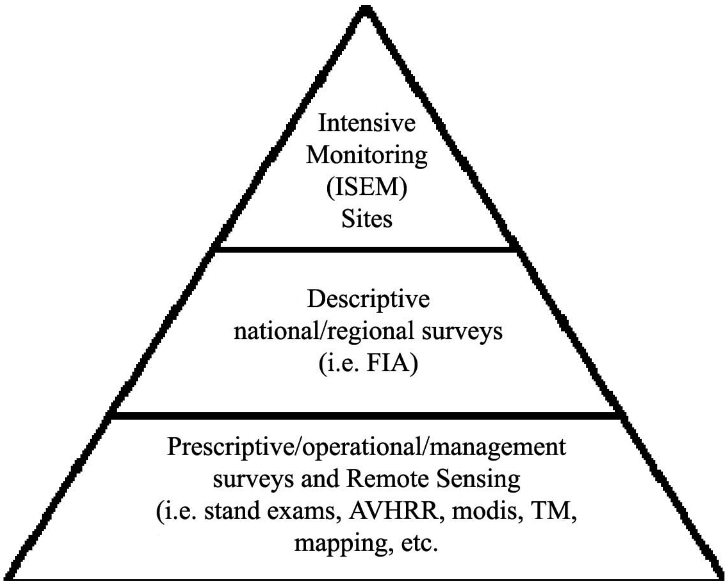

Figure 1. Conceptual framework for achieving the multiple goals of environmental monitoring and research.

small number of intensively monitored sites (index sites) where physical, chemical, and biological measurements of different ecosystem components are measured simultaneously at the same location on a long-term basis. The middle level, ground based regional and national surveys, provide common core data on a large number of locations. This level also provides data to place index site data into a broader context and is useful in calibration and validation of regional/national ecosystem models. At the lower level, inventories utilize linkage variables that allow incorporation of progressively more remote sensing data to develop site specific plans and applications. Information from this tier also provides additional validation information for models developed at the top and middle levels. The primary benefit of such a framework is access to appropriate information that can be utilized across many programs, both public and private, and applied to specific issues and questions at varying scales.

FIA's descriptive inventories provide a basic suite of vegetative data across all landscapes measured in a consistent and compatible manner on the national grid. Simple examination of these data may suggest hypotheses for the geographic distribution of forested ecosystems, associated characteristics and habitats for forest-dwelling species, or trends in regional ecological landscape dynamics and land-use practices (Rudis 1991). In the process of establishing an inventory implementation plan for a given resource area, whether it is wilderness or not, Forest Service researchers work with the principal managers, scientists and publics that are interested in monitoring information from that area to determine if additional data could provide useful indicators of resource condition, health, or change.

A key feature of FIA's national grid inventory is its systematic design which does not predicate sample location on a pre-stratified boundary system (for example, stands, watersheds, ecoregions, etc). The systematic grid allows the user to draw boundaries of interest knowing that a systematic, representative group of plots will be available for analysis. This establishes national grid data as a useful tool to compare or validate other sampling techniques by providing an independent estimate of variables of interest, e.g. using national grid data in global monitoring models (Iverson and others 1990, Lund 1990, Tueber 1990, VanHooser and others 1990).

FIA and National Assessments

Since its inception under the McSweeney/McNary Act of 1928, FIA has been envisioned as the source of consistent, scientifically sound information to guide assessment and management of the Nation's forest resources. The first National Assessment of the Nation's timber resource, based on predominantly amounts of FIA field verified information, was the 1952 Timber Resources for America's Future (USDA Forest Service, 1958) and would set the tone for future efforts. There were earlier reports in 1920, 1932, 1938, and 1945. However, these were based significantly on expert opinion and sparse field data. By 1950, FIA inventories had been completed in 29 States containing 72 percent of the forest land in the 48 States. Since the initial focus of the inventory was on timber, not surprisingly, the 19 missing States were primarily in the Great Plains, interior West, and Northeast.

The success of the 1952 Assessment would spark and all out effort by the Forest Service to complete an inventory the entire U.S. before a second assessment in 1963. The period between 1950 and 1962 would be a golden era for forest inventory in the U.S. with FIA completing inventories in 45 States containing 97 percent of all forest land outside of Alaska and Hawaii. This would include a re-inventory of 20 States. Only Nevada and Alaska would remain with virtually no FIA data in 1963.

A third national assessment would occur in 1970 before the passage of the Forest and Rangeland Renewable Resources Planning Act (RPA) in 1974 which would mandate such assessments with reports to Congress every 10 years.

The RPA legislation requires the Secretary of Agriculture to conduct an assessment of the Nation's renewable resources every 10 years. The original Act had four requirements for the Assessment:

1. an analysis of present and anticipated uses, demand for, and supply of the renewable resources,
2. an inventory,...of present and potential renewable resources…

3. a description of Forest Service programs and responsibilities...; and
4. a discussion of important policy considerations, laws, regulations, and other factors expected to influence… forest, range, and other associated lands.

Subsequent amendments to the RPA added two requirements:

5. an analysis of the potential effects of global climate change on the condition of renewable resources…; and
6. an analysis of the rural and urban forestry opportunities to mitigate the buildup of atmospheric carbon dioxide and reduce the risk of global climate change.

Since the 1930's FIA has supported many of these requirements by providing over 250 Statewide forest inventories; eight national assessments (USDA 1958, 1965, 1973, 1982, Waddell et al. 1989, Faulkner et al. 1993, Smith et al 2001, Smith et al 2004); two national biomass studies (USDA 1981, Cost et al. 1990); three national private forest land ownership studies (Birch 1982, 1996, Butler 2004 in process); a national satellite forest cover map of the U.S. (Zhu and Evans 1994); hundreds of primary mill, utilization, and residential fuelwood studies (May 1998, Smith 1991); hundreds of reports on nontimber issues (Rudis 1991); and online access to FIA data at http://fia.fs.fed.us. And, FHM detection monitoring plots established in the late 1980's are now fully integrated into the FIA grid in 42 States covering 83 percent of the Nation's forests reporting on the health of our forests

Other National Reporting Activities

FIA is responsible for many periodic reporting products associated with status and trends in forested ecosystems. The following needs are presently important. It is expected that other reporting needs will arise in the future. A key attribute of the FIA inventory program is that it contains sufficient scope of data to enable response to new clients and needs as they arise.

State of the Nation's Ecosystems Report

This report, developed for the White House Office of Science and Technology Policy (OSTP) by the John Heinz III Center for Science, Economics, and the Environment to provide indicators of sustainable forestry. Nearly two-thirds of the data for the forestry section of the report comes from FIA.

The National Report on Sustainable Forests

After the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests ("Montreal Process") was formed in Geneva in June 1994 to advance the development of internationally agreed upon criteria and indicators to monitor sustainable forests. A set of indicators of sustainable forests were then set forth in Santiago, Chile in February 1995. This set of seven Criteria and 67 Indicators are known as the "Santiago Declaration" (Canadian Forest Service 1995). The first five Criteria contain 28 biological indicators. FIA provided critical support for 18 of 28 biological indicators to monitor and report on U.S. forest sustainability. The U.S. used these criteria and indicators to develop a national report on sustainable forests (http://www.fs.fed.us/research/sustain).

International Reporting

The FIA responds to many international requests for national estimates of status, condition, and trends, in America's forests. Within the last two decades there has been an increasing awareness of global forestry issues. The Committee on Forestry, FAO has formulated a comprehensive global Forest Resources Assessment (FRA) program consisting of four components: 1) country capacity building, 2) assessments of the multiple benefits of forests, 3) assessment based on existing reliable information, and 4) remote sensing survey. The U.S. participated along with 54 other countries in the Temperate and Boreal Forest Resource Assessment (United Nations, 2000) and the Global Forest Resource Assessment 2000 (http://www.fao.or/forestry).

Conclusion

FIA has evolved over the last 75 years into a premier forest monitoring program working with partners and clients to continuously improve our product. And, while FIA focuses considerable attention on making sure our data are compatible across scales and ownerships within the U.S., we have not ignore the need to pursue similar goals at the international level. Visit FIA's web site at http://www.fia.fs.fed.us for more information or read papers by VanHooser and others (1992) or Gregoire (1992) for more on inventory and FIA history in the U.S.

References

Barnard, J.; Myers, W.; Pearce, J.; Ramsey, F.; Sissenwine, M.; Smith, W. 1985. Surveys for Monitoring Changes and Trends in Renewable Resources: Forests and Marine Fisheries. The American Staitician, November 1985. Vol. 39, No. 4 (Pr. 2).

Bickford, C. A. 1959. A test of continuous forest inventory for national forest management based on aerial photographs, double sampling, and remeasured plots. Soc. Amer. For. Proc., San Francisco, Calif. pp. 143-149.

Birch, T. W. 1982. Private Forest-land Owners of the United States, 1978. Res. Bul. WO-1. Washington, DC: U.S. Department of Agriculture; Forest Service. 64p.

Birch, T. W. 1996. Private Forest-land Owners of the United States, 1994. Res. Bul. NE-134. Radnor, PA: U.S. Department of Agriculture; Forest Service. 183p.

Canadian Forest Service. 1995. Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests: The Montreal Process. CFS Pamphlet, Natural Resources Canada, Hull, Quebec. 27p.

Clark, K. M. 1913. Method of forest survey and estimate in Nova Scotia. Forestry Quarterly 11:201-208.

Cost, N.D; Howard, J.; Mead, B.; McWilliams, W. H.; Smith, W. B.; Van Hooser, D. D.; Wharton, E. H. 1990. The biomass resource of the United States. Res. Bul. WO-57. Wash., DC: U.S. Department of Agriculture Forest Service, Washington Office. 18 p.

Faulkner, J. L.; Powell, Douglas S.; Zhu, Zhiliang; and MacCleery, Douglas W. 1993. Forest Resources of the United States, 1992. Gen. Tech Rep. RM-234. Ft. Collins, CO: U.S. Department of Agriculture; Forest Service. 142p.

Graves, H. S. 1907. Forest Mensuration. John Wiley & Sons, New York. (p.190-243).

Gregoire, Timothy G. 1992. Roots of Forest Inventory In North America. In Inventory Working Group session at the SAF National Convention held at Richmond, VA, on 25-28 October 1992.

Hough, F. B. 1878, 1880, 1882. Report upon forestry. Washington, DC: Government Printing Office. vol. I (1878), 650 p.; vol. II (1880), 618p.; vol. III (1882), 318p.

Iverson, L.R.; Preto, G., Cook, E. A.; Graham, R. L.1990 Estimating forest cover over Southeastern United States using TM-calibrated AVHRR data. In: Lund, H. Gyde; tech. coords. Global natural resource monitoring and assessments: preparing for the 21st century: Proceedings of the international conference and workshop; 1989 September 24-30; Venice, Italy. Bethesda, MD: American Society for Photogrammetry and Remote Sensing: 1252-1262.

Kellogg, R.S. 1909. The Timber Supply of the United States. Forest Resource Circular No. 166. Washington, DC: U.S. Department of Agriculture; Forest Service. 24p.

Lentz, G. H. 1931. The forest survey in the bottom-land hardwoods of the Mississippi delta. J. Forestry 29:1046-1059.

Leonard, George M. 1992. Forest Service correspondence. Re: Strategic Vegetation Inventory Grid. October 15, 1992.

Lund, H. G. 1984. The United States experience in the field of forest and range land inventory. In: Encuentro national sobre inventories forestales. Memoria; 25-28 July 1984, Chihuahua, Mexico. Publicacion Especial No. 45. Mexico, D. F., Mexico: Subsecretaria Forestal; Instituto National d Investigaciones Forestales; 1984: 411-435.

Martin, G. L., Jr. 1983. Forest inventory and valuation practices. In: Encyclopedia of American Forest and Conservation History (R. C. Davis, ed.), Vol. I., Macmillan Publ. Co., New York.

May, D. M. 1998. The North Central Forest Inventory and Analysis Timber Products Output Database – A Regional Composite Approach. Gen. Tech. Rep. NC-200. St. Paul, MN: U.S. Department of Agriculture; Forest Service. 16p.

OSTP (White House Office of Science and Technology Policy). 1996. Integrating the Nation’s Environmental Monitoring and Research Networks and Programs: A Proposed Framework. Draft Report of the Enveironmental Monitoring Team, Committee on Environment and Natural Resources (CENR), National Research and technology Council, March 1996. 86p.

Powell, D. S.; McWilliams, William H.; Birdsey, Richard A. 1994. History, Change and the U.S. Forest Inventory. The Journal of Forestry, December 1994. Vol. 92, No. 12.

Reynolds, G. F. 1996. Forest Service correspondence. Re: Re-establishmentof the Permanent Plot Grid. February 14, 1996.

Rudis, V. A. 1991. Wildlife Habitat, Range, Recreation, Hydrology, and Related Research Using Forest Inventory and Analysis Surveys: A 12-year Compendium. USDA Forest Service: Southern Forest Experiment Station, New Orleans, LA. USDA Gen. Tech. Report SO-84. 61p.

Schumacher, F. X. and R. A. Chapman. 1942. Sampling methods in forestry and range management. Duke Univ. Schl. of Forestry Bulletin 7. 213 p.

Sewall, J. in. 1911. A Canadian forest survey. Forestry Quarterly 9:400-405.

Smith, W. B. 1991. Assessing removals for North Central forest inventories. Res. Pap. NC-299. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 48 p.

Smith, W. B; Vissage, J.; Sheffield, R.; Darr, D. 2001. Forest Statistics of the United States, 1997. Gen. Tech. Rep. NC-219. St. Paul, MN: U.S. Department of Agriculture; Forest Service. 191p.

Smith, W. B; Vissage, J.; Miles, P.; Pugh, S. 2004. Forest Statistics of the United States, 2002. Gen. Tech. Rep. NC-241. St. Paul, MN: U.S. Department of Agriculture; Forest Service. 124p.

Teuber, K. B. 1990 Use of AVHRR imagery for large-scale forest inventories. In: Jackson, Ben D., ed. Special issue: the international forested wetlands resource: identification and inventory: Proceedings of the international conference; 1988 September 19-22; Baton Rouge, LA. Forest Ecology and Management. 33/34: 621-631.

United Nations, Forest Resources of Europe, CIS, North America, Aiustralia, Japan, and New Zealand. UN-ECE/FAO Contribution to the Global Forest Resources Assessment 2000. Geneva Timber and Forest Study Paper No. 17. UN-ECE Timber Section, Geneva, Switzerland. ECE/TIM/SP/17. 445p.

U.S. Senate. 1933. A National Plan for American Forestry (Copeland Report). 72nd Congress, 1st Session, Document No. 12, March 1933. 1534p.

USDA Forest Service. 1958. Timber resource for America’s future. Forest Resource Report No. 14. Washington, DC: U.S. Department of Agriculture; Forest Service. 713p.

USDA Forest Service. 1965. Timber trends in the United States. Forest Resource Report No. 17. Washington, DC: U.S. Department of Agriculture; Forest Service. 235p.
USDA Forest Service. 1973. The outlook for timber in the United States. Forest Resource Report No. 20. Washington, DC: U.S. Department of Agriculture; Forest Service. 367p.
USDA Forest Service. 1981. Tree Biomass—a state-of-the-art compilation. Gen. Tech. Rep. WO-33. Washington, DC: U.S. Department of Agriculture; Forest Service. 34p.
USDA Forest Service. 1982. An analysis of the timber situation in the United States 1952-2030. Forest Resource Report No. 23. Washington, DC: U.S. Department of Agriculture; Forest Service. 499p.
USDA Forest Service. 1993. A Blueprint for Forest Inventory and Analysis Research and Vision for the Future. Prog. Aid-1512. Washington, DC: U.S. Department of Agriculture; Forest Service. 20p.
USDA Forest Service. 1998. Integrating Surveys of Terrestrial Natural Resources: The Oregon Demonstration Project. Inventory and Monitoring Institute Report No. 2. Ft. Collins, CO: U.S. Department of Agriculture; Forest Service. 20p.
USDA Forest Service. 2001. Forest Inventory and Analysis National Core Field Guide, Volume I: Field Data Collection Procedures For Phase 2 Plots, Version 1.5.
Van Hooser, D. D.; Cost, N. D.; and Lund, H. G. 1992. The History of The Forest Survey Program In The United States. In Proceedings of the 100th IUFRO World Congress, Berlin Germany, September 1992.
Waddell, K.L.; Oswald, D. D.; and Powell, D. S. 1989. Forest Statistics of the United States, 1987. Resource Bulletin PNW-RB-168. Portland, OR: U.S. Department of Agriculture; Forest Service. 106p.
Zhu, Z.; Evans, D. L. 1994. U.S. Forest Types and Predicted Percent Forest Cover from AVHRR data. Photogrammetric Engineering and Remote Sensing. V60, No. 5, p525-531.