Chapter 17.

Monitoring the Sustainability of the Southern Forest

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Abstract—*The ecological and economic sustainability of southern forests is being questioned because there are many competing uses for these forests and because there are large regional shifts in forest land use. To adequately understand the state of our forests and their use with respect to sustainability, several significant changes have been made in programs of the U.S. Department of Agriculture Forest Service's Forest Inventory and Analysis (FIA) and Forest Health Monitoring Research Work Units. These changes are enabling these units to better assess the status of and sustainability of our forests. The FIA Program has replaced the 70-year-old periodic forest survey sampling design with a continuous annual sampling program. The new sampling design provides for continuous monitoring and reporting, with the emphasis on current status and trends in forest resources and many of the criteria and indicators of sustainable forest management as identified by the Montreal Process. The program is a collaborative partnership among the Southern State forestry agencies and the U.S. Department of Agriculture Forest Service, Southern Research Station. The process used to develop the new annual forest inventory program has provided the opportunity to build stronger partnerships with State forestry agencies, universities, nongovernmental organizations, and the forest industry. These new and renewed partnerships are of considerable value in defining, interpreting, and reporting on criteria and indicators related to sustainable forestry. Recent collaborative research has produced methods for estimating forest area and area change from satellite imagery, initiatives on how to quantify and report nontimber forest products, and potential uses of remote sensing instruments for on-plot measurements; e.g., global positioning system units, lasers, and camera systems.*

INTRODUCTION

The ecological and economic sustainability of our Nation's forests is being questioned. The definition of forest sustainability is not fixed. As knowledge of forest processes and uses expands, conceptions and components of sustainability will change. At a minimum, sustainability must include both ecological and human dimensions: underlying ecological integrity of soil, water, atmosphere, biological diversity and productivity must relate to human needs for food, water, health, shelter, fuel, and culture. The U.S. Department of Agriculture Forest Service (Forest Service), Forest Inventory and Analysis (FIA) and Forest Health Monitoring (FHM) Programs have been expanding their roles to include analyses of biological diversity and productivity as influenced by soil, water, and atmospheric composition. For example, in the past decade these two programs have been modified to provide the monitoring data and analyses required for the investigation of environmental concerns about air pollutant impacts and effects of climate change on forests.

Concern over perceived and real trends in forest resource conditions has led to numerous requests for improvement in the quantity, quality, and timeliness of information about forests and enhanced access to this information. To address these concerns, FIA and FHM contribute data and analyses to a variety of national and global assessments. The FIA and FHM data address at least 38 of the 67 criteria and indicators of sustainability for reporting under the Montreal Process. FIA and FHM data are essential to those who produce reports required by the Resources Planning Act (RPA) and are increasingly employed to support regional resource assessments used as a basis for forest planning. In response to these needs, FIA and FHM have implemented an annual forest inventory and monitoring program nationwide.

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THE FIA MISSION

The FIA Program has been in continuous operation since 1930. It is the only consistent, credible program that provides forest data for all public and private land within the United States. The program reports on the current status of and trends in forest area, in species composition, in tree size, volume, growth and mortality, and in harvest removals. The FIA and FHM Programs provide additional information on attributes considered to be indicators of forest health. The FIA Program also collects and reports information on wood production and utilization rates by various products, and on forest land ownership.

The FIA Program provides the most objective and scientifically defensible information available about the extent of forests, change in forest area, change in tree species composition, and rates of tree regeneration, growth, mortality, and harvesting.

This information is used to help formulate State and Federal policy decisions, including international reporting; serve as a starting point for more intensive studies on key ecosystem processes; formulate business plans that are economically and ecologically sustainable; and inform the public about the health and sustainability of the Nation's forests.

Historically, the FIA Program has reinventoried each State's forests at intervals of about 10 years. Prior to the annual inventory, FIA had established that (1) forest land remains the predominant land use in the South, (2) the forest land base in the South has been stable for several decades, (3) the pine component of the South's forest is moving steadily toward more planted and fewer natural stands, (4) fears of a southern pine growth decline related to air pollutants have abated, and (5) growth rates on forest industry lands have continued to increase over the last four decades. The annual inventory program enables FIA to identify changes in trends much more quickly than the previous decadal scale design allowed.

FOREST HEALTH MONITORING MISSION

The purpose of FHM is to make statements about the status of and trends in the health of forest ecosystems in the United States. The FHM Program was established in 1991 to address environmental concerns about how natural factors such as insects, disease, and extreme weather events, and anthropogenic stresses such as air pollutants, climate change, population growth, and nonnative species affect forests.

The National Acid Precipitation Assessment Program (NAPAP) Forest Response Program of the mid-1980s was in many ways a precursor of the FHM Program. During the mid-1980s there was increased concern that many forests in the United States were exposed to acidic deposition and other pollutants and that these regionally distributed pollutants might be damaging forests (Barnard and others 1990). Suspected declines in either the productivity or health of southern pines, red spruce, and sugar maple have been attributed to causes of this kind. Many of the policy and research questions asked by NAPAP are similar to those addressed by the current FHM Program.

The FHM Program covers all forested lands through a partnership involving the Forest Service, State Foresters, and other State and Federal Agencies and academic groups. The FHM Program uses data from ground plots and ground surveys, aerial surveys, and other biotic and abiotic data sources to address forest health and sustainability issues. There is one key difference between FHM as implemented in the United States and similar monitoring efforts for Western Europe. Efforts in Europe have opted for onsite monitoring of pollutants and weather variables, while efforts in the United States have relied on the monitoring of bioindicator plants and other variables to monitor the effects of natural and anthropogenic stresses. A key example is that of monitoring the potential impact of ozone. It is known that high levels of ozone do not injure plants unless their stomata are open. High ozone and temperatures often occur at the same time, and these episodes often occur when stomata are closed. Thus, FHM has opted to monitor bioindicator species that are sufficiently sensitive to specific pollutants. This allows for assignment of injury to specific causes and for more accurate estimation of the spatial distribution of injury.

The FHM Program is implemented through five major activities. (1) Detection monitoring uses nationally standardized ground and aerial surveys to evaluate the status of and change in forest conditions. (2) Evaluation monitoring determines the extent, severity, and causes of undesirable changes in forest health identified through detection monitoring. (3) Research on monitoring techniques creates sampling designs and analytical techniques used to develop bioindicators of forest health, provide early detection of invasive species, and devise methods for monitoring urban and riparian forests. (4) Intensive site monitoring enhances understanding of cause-effect relationships by linking the current status of and trends in surveyed attributes and bioindicators to process-level studies of specific issues such as calcium depletion and carbon cycling. (5) Analysis and reporting produces peer-reviewed publications about analysis and interpretation of sampled populations and reports on forest health at national and regional levels.

Since 1999, the FHM ground plot network used for detection monitoring has been integrated with the more intensively sampled forest inventory network maintained by the FIA Program. Currently, FIA has one plot per 6,000 acres, and FHM has one plot per 96,000 acres. Also, FIA has adopted annual survey methods similar to those used in the FHM Program. The merger of the FIA and FHM plot networks and increased coordination of survey methods enable both programs to produce annual estimates of forest area, forest inventory, and bioindicators of forest health. Moreover, the FHM (phase 3) field plots expand the suite of attributes sampled. The FHM attribute list now includes tree crown conditions, cover and diversity of lower vegetation (shrubs, forbs, grasses, and vines), soils, lichen diversity (as an indicator of air quality), indicator plants for ozone presence, and coarse woody debris. This expanded sampling provides data that can be used to estimate forest carbon and forest fire fuel loads. Readers are encouraged to visit http://fia.fs.fed.us/library.htm#manuals for a thorough explanation of all FHM indicators.

The assessment of forest health should be based on definable criteria. The Forest Service's monitoring programs have adopted the Montreal Process and criteria and indicators for evaluating forest health and conditions to provide information for sustainable forest management.

Some of the challenges and concepts that must be considered in integrating and redesigning inventory and monitoring programs are discussed in the following section.

DESIGNING AN INVENTORY AND MONITORING SYSTEM

In designing an inventory and monitoring system, it is important to recognize that definitions of sustainability change over time and vary according to location and interests. Changes in forest type and condition have accelerated, and the rapid pace of change likely will continue in the South. The combination of real change, introduction of new sampled attributes, and definitional changes over time calls for a resilient and simple sampling frame. This goal is very different from the situation in most inventories, in which the sampling strategy is directly tied to the need to efficiently estimate one or two closely related attributes of interest.

Fortunately for the continuity of FIA inventory work, the types of measurement data that were used to estimate forest resources 30 years ago remain equally useful today. Nevertheless, a dominant consideration in planning a long-term monitoring program is the inevitability that a highly efficient sample design, one that optimizes on one or very few resources of interest, will go out of date. Examples in forest inventory work include the use of overly detailed stratification and variable probability of selection based on volume or value per unit area. Design features that involve complex sample structure create potentially serious difficulties, whereas an equal-probability design permits greater adaptability and flexibility. To minimize sample design obsolescence, structure should be employed sparingly and with awareness of its undesirable effects. Variable probability sampling designs and other complex sampling schemes are less amenable to the multiple and changing objectives that long-term monitoring designs must address, and therefore should be avoided (Overton and Stehman 1996).

Simplicity is desirable for many reasons. It is not only that sample elements will change over time (as when forest plots become parking lots); it is also that overall objectives change. Another reason for simplicity is the growing recognition that data collected by federally funded monitoring programs should be accessible to the public at large (Cowling 1992). With a relatively simple sample design, it is more likely that valid results and conclusions can be reached by various public users of the databases.

The simplicity and resiliency needs of the southern FIA Program have resulted in the use of an equal-probability systematic sample design (Roesch and Reams 1999). The new annualized sample design employs five annual panels, whereby plots measured in year one will be remeasured in year six (fig. 17.1). The southern FIA Program has historically used a completely overlapping single-panel design for periodic inventories and is implementing a similar design in its annual surveys (Reams and Van Deusen 1999). To transition from the single-panel periodic survey measured once every 10 years to an annual survey, FIA subpaneled the periodic plot list into five panels. Panels represent a sample in which the same elements (plots in this case) are measured on

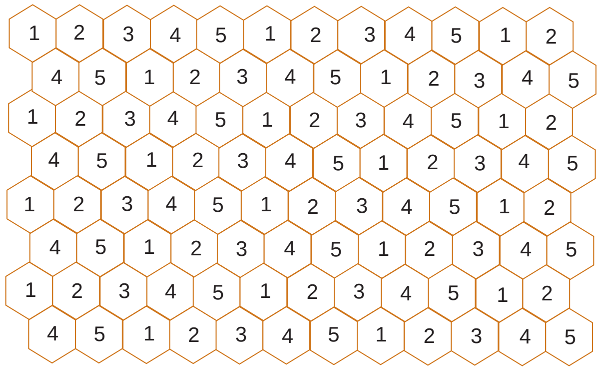

Figure 17.1—An interpenetrating pattern for a five-panel design. No element has another member from the same panel as an immediate neighbor. There is one plot per hexagon (Roesch and Reams 1999).

two or more occasions. Panel designs permit studies of individual change and therefore allow for the accounting of gross change that would be masked in a nonoverlapping design. In southern's FIA Program, the use of a panel design is largely due to the importance of estimating gross changes in growth, mortality, and removals.

Once the new five-panel design is fully implemented, the increased flexibility in inventory estimation techniques will be realized. Annualized estimates like the simple moving average that is very similar to the periodic estimates are providing the foundation of first-generation annual inventory estimates (Roesch and Reams 1999). There are circumstances in which the 5-year moving average will overestimate or underestimate current inventory. These situations are most obvious when there is either an abrupt shift in inventory or a strong trend in the attribute of interest. For example, if a hurricane occurred during the measurement of panel 3, inventory estimates based on a 5-year moving average would overestimate inventory in the affected areas. In such a case, prior panels must be dropped from the estimation process, and only panels measured after the hurricane can be used for inventory estimation (Reams and others 1999).

The time-series nature of the annual survey provides increased flexibility in inventory estimation. Several new approaches have been presented by the scientific community and are being considered for possible implementation. These estimation methods include mixed estimation (Van Deusen 1996), updating using individual tree growth models (McRobert and others 2000), and imputation (Reams and Van Deusen 1999).

SUSTAINABILITY ASSESSMENTS

The past decade has seen increased concern among natural resource managers, the science community, and the public at large over the current status of and emerging trends in forests at international, national, and regional scales. As a result, large-scale assessments of forest sustainability related to one or more major public policy themes or initiatives are becoming increasingly necessary (Reams and others 1999). FIA data, analyses, and interpretations provide the basic information for all types of large-scale forest assessments within the United States. The FIA data also provide the basic inputs used to model future forest distribution and composition, and the availability of forest resources (Wear and Greis 2002).

Sustainability has at least five elements (Floyd and others 2001). These include (1) maintaining resources over time, (2) a concern for future generations, (3) an estimate of future needs, (4) knowledge of current rates of resource use and rates of regeneration, and (5) a widely accepted view of some appropriate level of resource use.

In an effort to monitor forest sustainability as it is defined by the Montreal Process, the Forest Service has identified seven criteria of sustainability with many measurable indicators for each criterion. A criterion is a category of conditions or processes by which sustainable forest management may be assessed. A criterion is characterized by a set of related indicators, which are monitored periodically to assess change. An indicator is a quantitative or qualitative variable that can be measured or described, and which, when observed periodically, demonstrates trends.

The seven criteria of forest sustainability are (1) conservation of biodiversity; (2) maintenance of the productive capacity of forest ecosystems; (3) maintenance of forest ecosystem health and vitality; (4) conservation and maintenance of soil and water resources; (5) maintenance of forest contribution to global carbon cycles; (6) maintenance and enhancement of long-term multiple socioeconomic benefits; and (7) legal, institutional, and economic framework.

The degree to which the FHM and FIA Programs address the ecological criteria and indicators defined in the Montreal Process and agreed upon in the 1995 Santiago Agreement are displayed in table 17.1. The FIA and FHM Programs provide a significant level of information

Table 17.1—The degree to which the FHM and FIA programs are currently addressing the criteria and indicators of the Montreal Process as specified in the 1995 Santiago Agreement[a]

Criterion	Indicator	Measurement	FHM and FIA[b]
Biological diversity			
Ecosystem diversity	Areal extent of forest types	Percent total forest	***
		Percent nonprotected— by forest type and age class	*
		Percent protected— by forest type and age class	*
	Fragmentation of forest types		***
Species diversity	Forest-dependent species	Total number— no. of forest-dependent species	**P
		Status of risk species— no. of breeding populations	*
Genetic diversity	Proportion of former range		?
	Population levels of representative species— species/diverse habitat/ total range		*
Productive capacity	Timber production— area and net area available; population estimate is coarser than those provided by FIA		***
	Total growing stock— merchant and nonmerchant available	Plantations— area/growing stock, native and exotic species	***
		Annual removal wood products— compared to sustainable volume	*
Ecosystem health and vitality— based on area and percent forest affected	Insects and disease		***
	Competition from exotics		**P
	Abiotic stressors	Fire	***
		Storms	***
		Flooding	***
		Salination	***
	Management/use	Land clearance	***
		Domestic animals	*
	Air pollutants	S, N, O_3, etc.	**P
		UV-B	?
	Biological indicators of key processes— nutrient cycling, reproduction, etc.	Epiphytes	***
		Insects	*
		Fauna	*
		Vegetation communities	**P
Soil resources— based on area and/ or percent	Physical properties	Erosion	***
		Compaction	**
		Other physical properties	***
	Chemical properties	Organic matter	***
		Nutrients	***
		Toxins	**
	Protective functions— watersheds, floods, avalanche, riparian		**

continued

Table 17.1—The degree to which the FHM and FIA programs are currently addressing the criteria and indicators of the Montreal Process as specified in the 1995 Santiago Agreement[a] (continued)

Criterion	Indicator	Measurement	FHM and FIA[b]
Water resources—based on historical patterns	Stream flow and timing		*
	Biological diversity		*
	Physical properties	Temperature	*
		Sediments	*
	Chemical properties	pH	*
		Dissolved oxygen	*
		Electrical conductivity	*
Global carbon cycles—contributed by forests	Total ecosystem biomass/carbon pool—e.g., forest type, age class, etc.		**
	Sequestration/release of carbon	Standing biomass	**
		Coarse woody debris	**P
		Peat	*
		Soils	***
	Forest products		*

FHM = Forest Health Monitoring; FIA = Forest Inventory and Analysis; S = sulfur; N = nitrogen; O_3 = ozone; UV-B = ultraviolet-B.
[a] Criteria six and seven and corresponding indicators are not included because the FIA and FHM Programs are not designed to sample and report these measures.
[b] * = techniques for measurement or estimation developed in other programs; ** = techniques for measurement or estimation under development in FIA/FHM Programs; **P = techniques for measurement or estimation under development and tested in regional FIA/FHM pilot studies; *** = techniques for measurement or estimation developed in FIA/FHM Programs and implemented nationally; ? = unknown whether regional monitoring methods exist.

for the first five criteria, but very little for criteria six and seven. Criteria six and seven are not listed in table 17.1.

FIA and FHM data will continue to provide the basic information at the forest area, plot, and tree level for all types of regional, national, and international forest assessments. The Heinz Center report on the state of the Nation's ecosystems (Heinz Center 2002), national resource assessments such as RPA (Powell and others 1993), the recently completed Southern Appalachian Assessment (Southern Appalachian Man and the Biosphere 1996), and the monitoring of forest carbon stocks (Heath and Birdsey 1997) rely heavily, and in many cases exclusively, on FIA and FHM data to describe and estimate current forest conditions and trends.

Well-planned and executed annual survey systems can provide the basic baseline and monitoring information to address the many scientific questions regarding societal issue-driven assessments of sustainability. Annual inventories that are cost-effective, publicly trusted, and provide unbiased information about forest resource trends, are requisites for the development of sound policy.

PRODUCTS OUTPUT REPORTS

FIA and FHM field-plot systems provide the inventory data used to estimate current volume and volume changes induced by removals and mortality. FIA also conducts canvasses of primary wood-using facilities. This component of the FIA Program complements the field survey by providing independent estimates of removals. Primary mills are those that process roundwood in stem length, log, bolt, or chip form directly from the woods. Examples of industrial roundwood products are saw logs, pulpwood, veneer logs, poles, and logs used to make composite board products. Mills producing products from residues generated at primary and secondary processors are not canvassed. Trees chipped in the woods are included in the estimate of timber drain only if they are delivered to a primary domestic manufacturer (Johnson 1998).

This timber products output (TPO) information is used to track trends in industrial production by mill type and by product mixes across mills. Typical mill types include pulp mills, sawmills, veneer mills, composite panel mills, and other industrial mills; e.g., those that produce charcoal, excelsior, logs for log homes, shavings, and firewood. The TPO information is often used by industry analysts to estimate current rates of demand.

In addition to timber, hundreds of plants, fungi, and microorganisms are being collected and harvested for personal and commercial use. These nontimber forest products (NTFP) are harvested from within and on the edges of forests. They may include fungi, moss, lichen, herbs, vines, shrubs, or trees. Many different parts of plants are harvested, including roots, tubers, leaves, bark, twigs and branches, fruit, sap and resin, and wood. NTFPs can be classified into four major product categories: (1) culinary, (2) wood based, (3) floral and decorative, and (4) medicinal and dietary supplements (Chamberlain and others 1998, 2002).

To date, inventory and monitoring of NTFPs have been limited because there has been no legislative mandate for such activities. However, there is increasing awareness that NTFPs should be recognized as renewable resources, managed scientifically, and collected on a sustainable basis. Forest managers have identified a number of critical problems hindering efforts to improve forest management for NTFPs. These problems include (1) lack of baseline information on the distribution, abundance, condition, and rates of change for NTFP populations of interest; (2) lack of knowledge about the biology and ecology of the flora from which these products originate; (3) diversity of the products and of the collectors; (4) lack of market knowledge; and (5) insufficient personnel and resources to assign to NTFP management.

Emerging policies could significantly change how the Forest Service addresses NTFPs. A new bill would require the Secretary of Agriculture to determine sustainable harvest methods and harvest levels for these products and to establish methods to ensure that revenues are returned to the local units from which they were generated. Implementation of this bill may require tracking the distribution, abundance, condition, removals, and final markets of NTFPs.

In anticipation of these new reporting requirements, a study has been initiated to determine the importance of NTFP industry throughout the South. The lack of knowledge about the role of this industry in rural communities hinders efforts to allocate resources to improve management. This study is an initial effort to define the overall industry, identify obstacles to the collection of data needed to estimate the volume and value of NTFPs, and formulate protocols for regular monitoring of output from the varied segments of this industry.

Assessments of NTFP outputs have never been undertaken in the South. For the most part, lists of enterprises that could be contacted and surveyed do not exist. We are able to utilize some lists, such as those of ginseng dealers in each State. For the most part, we are starting from scratch to develop a framework that will allow for regular contact with NTFP enterprises. On a regional basis, this requires canvassing county agriculture agents to get their estimates of the numbers of enterprises within their geographic areas of responsibility. County agents are asked to estimate the number of firms that deal in four segments of the NTFP industry; i.e., medicinal, edible, floral, and specialty wood. Figure 17.2 presents the perceptions of county agents in 7 of the 13 Southern States.

To undertake assessments of the output by State will require identifying and contacting enterprises in each county. To assess the challenges of undertaking NTFP assessments at this level, the project is carrying out a pilot

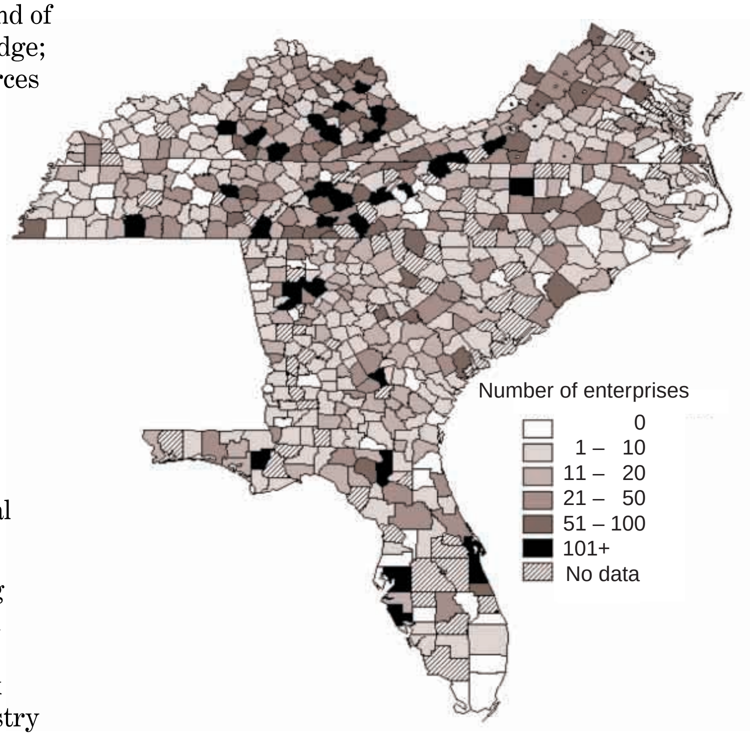

Figure 17.2—Number of nontimber forest products enterprises by county for seven Southern States.

study in western North Carolina. Leads to enterprises are being obtained through initial contacts with local experts. We expect this project to produce a sample frame of NTFP enterprises that will allow for regular monitoring of enterprises in western North Carolina. This work will provide insights that can be used to extend monitoring of NTFPs to other States.

REMOTE SENSING

The 1998 Farm Bill that required the merger of FIA and FHM survey activities into an annual inventory and monitoring program also requested that FIA and FHM make fuller use of remote sensing technology. Nationally, FIA and FHM are transitioning to the use of satellite imagery to estimate and map forest area, and area change. Studies completed in cooperation with the Virginia Department of Forestry and Virginia Polytechnic Institute and State University found that satellite-based methods provide forest area estimates comparable to those produced by the traditional FIA photo-based method (Wayman and others 2001). Wynne and others (2000) cite several reasons for making a transition to greater reliance on satellite-based remote sensing: (1) the long-term viability of the National Aerial Photography Program is in question; (2) satellite imagery provides an opportunity for more frequent updates; (3) certain analyses important for forest inventory, such as spectral change detection to improve removal estimates, can be performed more easily; and (4) a spatially explicit enumeration of the entire landscape can be produced in a more automated fashion. This map can be used to estimate the sizes of strata.

The use of remote sensing technology to collect on-plot measurements is being investigated. Given the intensive data needs mentioned previously, field collection is time consuming and costly. Increasingly on-plot remote sensors are being used and developed to reduce collection time and increase the precision of measurements for some variables.

Active and passive remote sensors are being used to locate forest plots, precisely locate and map objects with geographic coordinates, and collect data on many quantitative variables. FIA uses global positioning systems (GPS) (Hofmann-Wellenhof and others 2001, Kaplan 1996) to locate plot centers.

Other on-plot inventory applications include ultrasonic or laser rangefinders (Fairweather 1994, Liu and others 1995). These tools are used to map locations of objects, e.g., trees, subplots, etc., and determine distances, e.g., plot radii or limiting distances, with much greater accuracy and speed than GPS. These rangefinders can be combined with clinometers or angle gauges to obtain other dimensional information, e.g., diameters, heights, stem form, etc. (Clark 2000, Fairweather 1994, Williams and others 1999).

Other applications of on-plot remote sensors in forestry include using charge-coupled device (CCD) cameras to quantify understory and biomass (Ramachandran and others 2000, Ter-Mikaelian and Parker 2000); using CCD cameras to record stand structure, regeneration, and scenic beauty (Rudis and others 1998); using light meters, densitometers, and digital hemispherical cameras in canopy closure and regeneration studies (Comeau and others 1998); using radio frequency identification for tagging wildlife (Mans and Eradus 1999) and trees (Wilson, in press); and using remote sensors in wildlife monitoring (Demarais and others 2000).

Though these sensors exist and are finding application in forestry, most of them are prototypes and are still in the development process. The following improvements will make these devices standard equipment for inventory foresters:

- Confluence of sensors (GPS, camera, distance, etc.) and processing (numerical methods, models, optimizations) within Geographic Information Systems for rapid solution of problems
- Automated processes allowing the flow of many observation data stream inputs into models, analysis, and onward to the final report
- Advances from hand-held computers to portable data assistants (Kerns and others, in press) to wearable computers (Baber and others 2001)
- Reduced power consumption
- Increased data storage
- Capability for wireless transmission of data from woods to office
- Creation of weatherproof, durable instruments
- Reduced instrument costs
- Improved filters for interference, i.e., light, humidity, sound
- Easier operation

- Improved means of validation
- Revitalization of sampling methods previously underutilized due to previously impractical data needs (Osawa and Kurachi 1997)

The southern FIA Program will continue to take advantage of new technologies where they aid in meeting the objectives of accurate and cost-effective data collection. The exploration, expansion, modification, and development of on-plot remote sensing systems will be required in order to achieve the objectives of FIA in the future.

SUMMARY OF INVENTORY AND MONITORING ENHANCEMENTS

In the 1998 report of the Second Blue Ribbon Panel on FIA and the 1999 Farm Bill, a number of enhancements were suggested to:

- Improve and expand information on ecosystems and noncommodity values
- Recognize and identify ownership, regulatory, and social impacts on forest productivity
- Integrate the FIA and FHM Programs
- Implement the use of satellite imagery for estimation and mapping of forested ecosystems
- Produce the most current resource data possible
- Implement a uniform approach on all ownerships
- Increase consistency and compatibility among FIA units
- Enhance coordination between FIA and public agencies
- Improve service to all groups

In response to these needs, FIA and FHM have introduced improvements in their sampling programs and have designed pilot studies for undersampled populations such as urban and riparian areas and noncommodity values. Since 1999, the FHM ground-plot network used for detection monitoring has been integrated with the more intensively sampled forest inventory network maintained by the FIA Program. A study has been initiated to better understand the importance of NTFP industry throughout the South. The FIA Program has initiated a national ownership survey to identify and quantify the ownership, regulatory, and social impacts on forest productivity. An annual survey is now being implemented consistently across ownerships, with the cooperation of State and Federal partner agencies. Nationally, FIA and FHM are transitioning to the use of satellite imagery to estimate and map forest area and area change. The national compatibility of data collection, database production, estimation, and reporting is ultimately leading to improved service to all of FIA's partner and customer groups.

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