United States
Department of
Agriculture

Forest Service

**Southern Forest
Experiment Station**

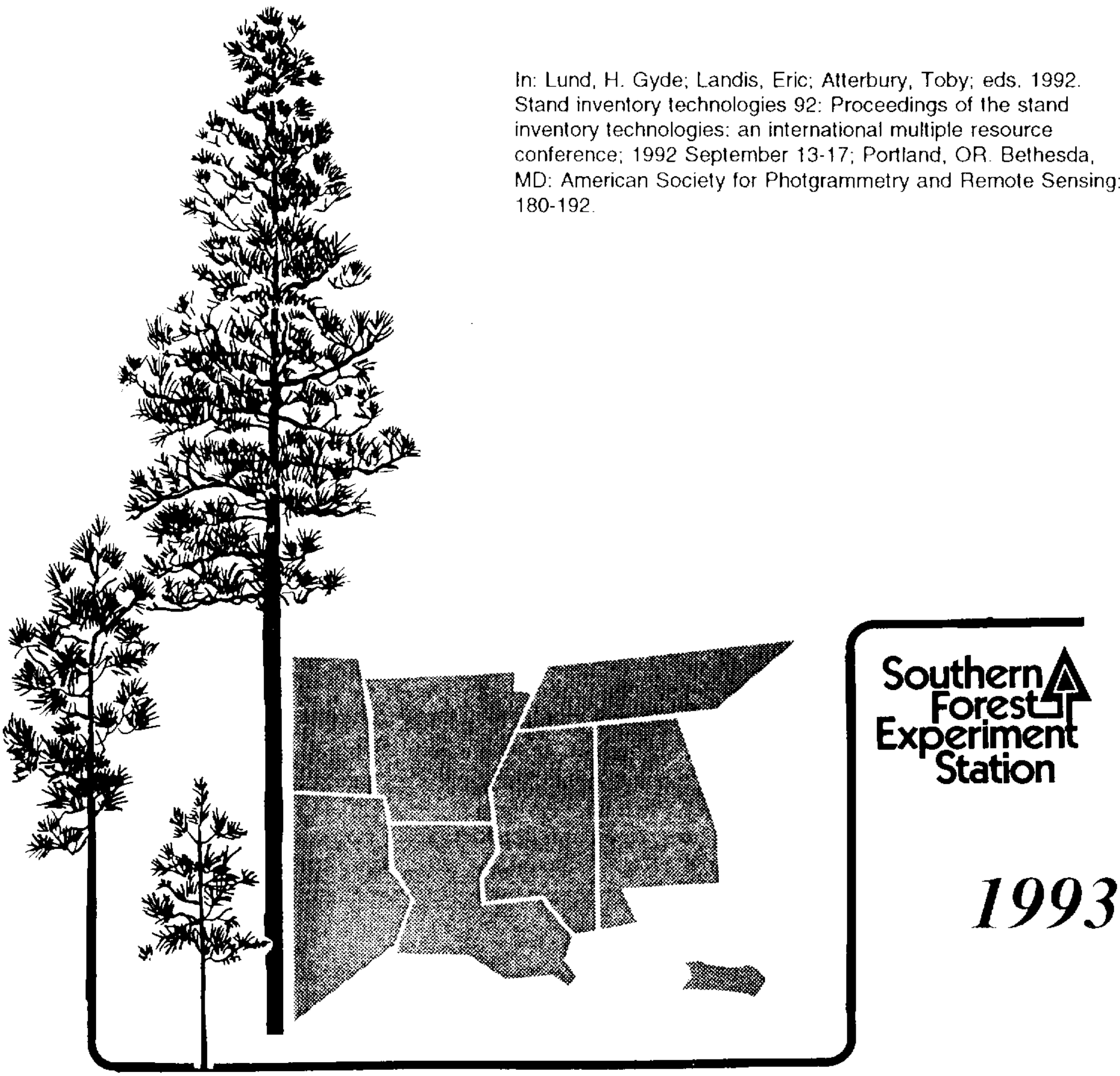
New Orleans,
Louisiana

Proceedings Reprint

THE MULTIPLE RESOURCE INVENTORY DECISION-MAKING PROCESS

Rudis, Victor A.

In: Lund, H. Gyde; Landis, Eric; Atterbury, Toby; eds. 1992. Stand inventory technologies 92: Proceedings of the stand inventory technologies: an international multiple resource conference; 1992 September 13-17; Portland, OR. Bethesda, MD: American Society for Photgrammetry and Remote Sensing: 180-192.



THE MULTIPLE RESOURCE INVENTORY DECISION-MAKING PROCESS

Victor A. Rudis
Research Forester, Forest Inventory and Analysis Unit
USDA-FS, Southern Forest Experiment Station
P.O. Box 906, Starkville, MS 39759 USA

ABSTRACT

A model of the multiple resource inventory decision-making process is presented that identifies steps in conducting inventories, describes the infrastructure, and points out knowledge gaps that are common to many interdisciplinary studies. Successful efforts to date suggest the need to bridge the gaps by sharing elements, maintain dialogue among stakeholders in multiple disciplines, and foster an interdisciplinary infrastructure. Included is a list of components associated with ecological concerns and human influences that are tied to a timber-oriented forest inventory sample design.

INTRODUCTION

I have been asked to discuss how to sample for multiple resources. I first discuss the decision-making process that is the basis for selecting resources and conducting inventories. Included is a discussion of <u>components</u>, i.e., observations or attributes, and why they are sampled. I provide examples from the United States Department of Agriculture, Forest Service (USDA-FS), Forest Inventory and Analysis (FIA) units with the focus is on stand-level and landscape-level components. Finally, I point out some of the opportunities associated with multiple resource forest inventory programs for the coming decade.

THE INVENTORY PROCESS

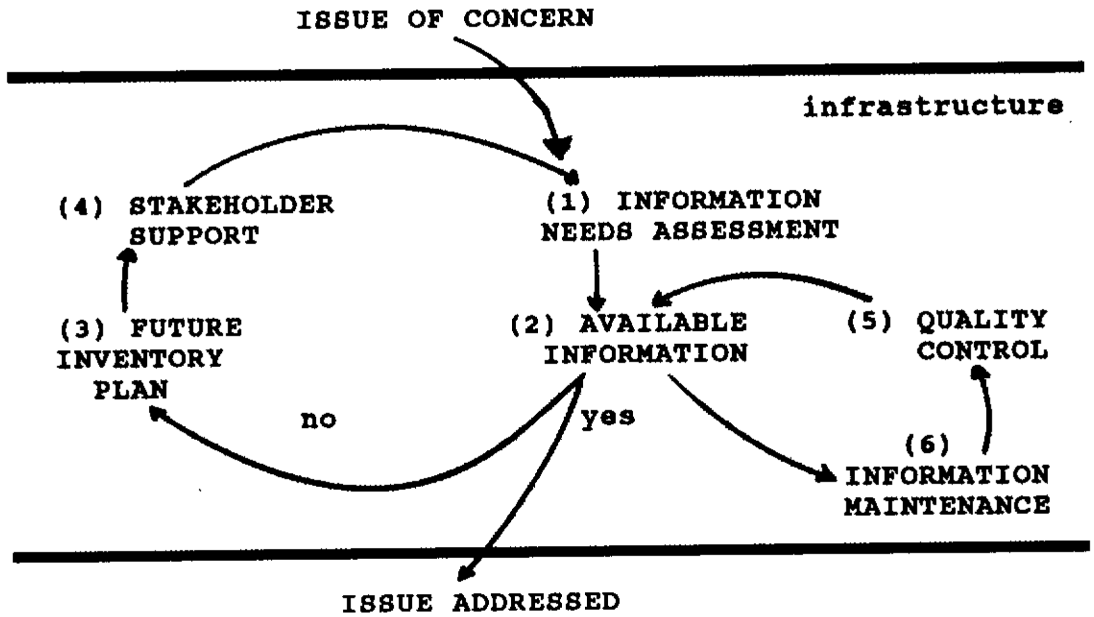
Understanding the decision-making process is crucial to conducting any inventory. What follows is one view of the conduct of multiple resource inventories gleaned from a recent compilation of the literature (Rudis 1991b). I credit Senge (1990) with the tools for examining organizational decision making as a system, and Heberlein (1988) with outlining barriers to interdisciplinary studies. Any error in the application that follows is strictly my own.

Before beginning an inventory, one must answer two questions: First, "What are the resources of interest?" Second, "What should be sampled?" In theory, sampling for multiple resources is driven by the need for comprehensive knowledge about forest stands. A well-thought-out action plan usually precedes data collection.

An <u>element</u> is a step in the conduct of a decision-making process. Lund (1986) identifies six basic elements useful in conducting inventories: (1) identifying information needs, (2) using available information, (3) developing a plan to obtain additional information, (4) obtaining financial, administrative, and scientific support for monitoring efforts, (5) implementing quality control, and (6) maintaining the information. Progress in the inventory process follows from elements 1 through 6 and back to 1 in a circular fashion.

In practice, sampling is driven by issues of concern to resource managers, other decision makers, and advocates of selected viewpoints. Rather than being simply an association among elements, the inventory process is conceptualized as a system composed of elements, flows of communication among elements, and an infrastructure (see Figure 1).

Figure 1. The inventory decision-making system



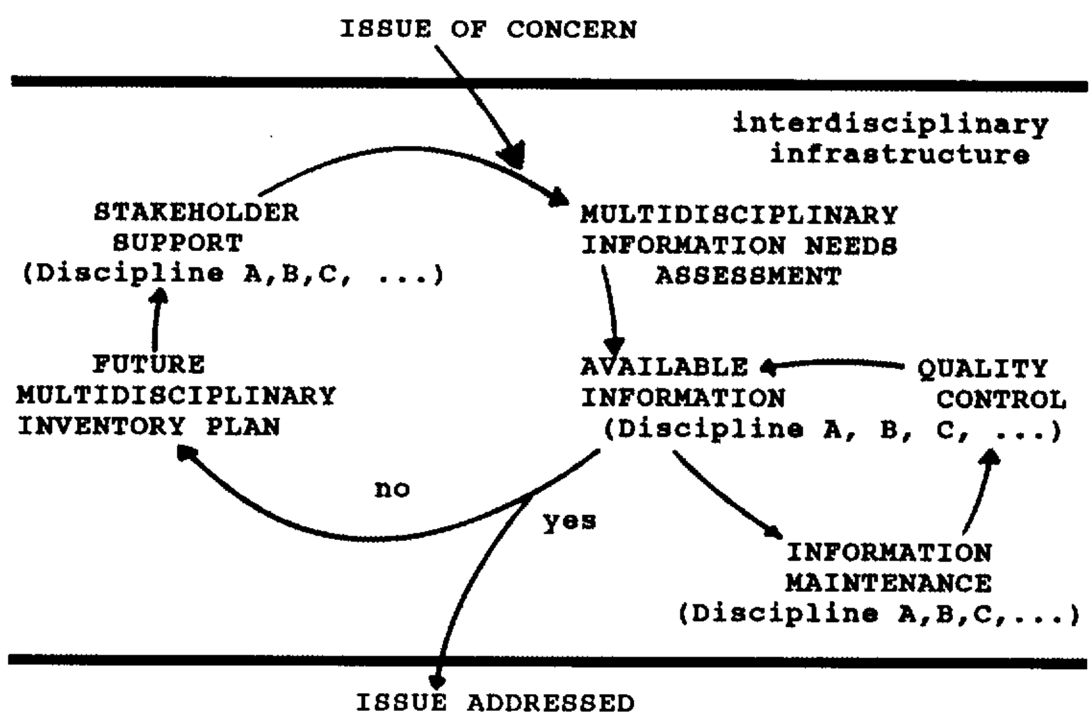
Elements are surrounded by an infrastructure, i.e., a social communication and organizational network. A public agency's infrastructure typically consists of scientists, funding sources, university departments, other public agencies, and private organizations. An individual who obtains direct benefits from the inventory effort is defined here as a stakeholder. Stakeholders include scientists and technicians in the inventory assessment, administrators of resource management agencies, private companies, and inventory information users. Users can include scientists and technicians outside the inventory assessment, as well as environmental and resource production advocates.

The decision-making process frequently begins with an issue of concern. One or more stakeholders with social, financial, administrative, or legal standing within the infrastructure adopts the issue as a priority. Inventory information needs are identified, and available data are used to address the issue. In some cases, issues are addressed through an information needs assessment and available information without direct interaction among other elements. In other cases, the process progresses through available information (element 2), maintenance of data and quality control (elements 5 and 6), planning additional inventories (element 3), and acquiring support among stakeholders (element 4). Monitoring, i.e., inventorying over successive occasions to assess changes, typically involves all elements.

For issues within a single discipline, information needed is limited only by the boundaries of the infrastructure. A common language, standardized concepts, journals, and other means of communication foster rapid assessment of inventory needs within the discipline. Stakeholders redirect budgets to assess additional components.

Every inventory can be viewed as a separate system with its own issues, elements, infrastructure, and solutions. Cross-disciplinary inventories share a few elements, such as a common data base. There is some overlap in administrative infrastructure, but communication among disciplines and organizations is limited. In an integrated inventory, multiple disciplines are represented in an information needs assessment and future inventory plans. Elements are shared, and the infrastructure is interdisciplinary (Figure 2). The model does not require that individual components be inventoried at the same place or time, only that effective communication occurs among disciplines.

Figure 2. The integrated inventory decision-making system



KNOWLEDGE GAPS

Because there usually is no interdisciplinary infrastructure associated with traditional forest stand inventories, the inventory system often lies somewhere between the models in Figures 1 and 2. Issues that involve more than one discipline require bridging the gaps among independent inventory systems.

Communication among single-discipline inventory systems is hampered by several obstacles. Obstacles include (a) lack of the skill needed to coordinate inventories among and across disciplines, (b) incompatible priorities and perceived responsibilities among disciplines, and (c) the absence of institutional structures that support interdisciplinary communication -- in this case, about forest inventories.

Skill

Skill is the ability to do something well, arising from a combination of talent, training, and experience. Skill is often lacking in integrated inventory assessments.

Developing the skill is a learning process. The foundation for such skill can be built by gathering information about associated disciplines. With time, progess can be achieved by effective communication among disciplines. A geographic information system (GIS) that registers mapped information onto a common land base provides visual images that can be very effective in bridging communication gaps among disciplines.

Priorities, responsibilities, and institutions

For over a decade, the USDA-FS National Forest System has been one of the few institutions responsible for producing multiple resources. Yet inventories of many multiple resources have been given a low priority. Critics assert that the National Forest System lacks adequate inventory data to address issues that transcend the agency's traditional role of managing the timber resource (Office of Technology Assessment 1992).

Potential support and responsibility for inventories and monitoring usually are drawn from agencies that are established and funded along functional lines. Often there is no consensus on the priority of many components that should be addressed. Few public institutions and their constituents are organized around multiple resource concerns. The same can be said for nonprofit and private institutions.

HOW TO PROCEED

An example with alternatives

Let us suppose that the issue is, "How does an observed change in timber resources affect American black bear (*Ursus americanus*) populations?" The issue can be addressed through alternative I, an assembly of available information from separate inventories of timber stands and black bear populations; alternative II, an inventory of key habitat components of forest stands that integrate data needs for both resources; or alternative III, a combination of the first two.

Alternative I requires knowledge of the elements of both timber and black bear inventories. Where available, a GIS is employed to register timber and wildlife data onto a common land base. GIS integration also retains the inconsistencies in the spatial and temporal scales of resolution associated with independent inventories.

Linking separate black bear population surveys with black bear habitat inventories requires a credible defense of the inevitable assumptions that must be made. A high degree of certainty about the data may be needed by stakeholders who are not involved in the inventory process. Hence, an understanding of the infrastructure of both systems is important. Conducting independent inventories usually is more expensive than alternative II, as some information is redundant.

Alternative II offers data that are easier to organize, as all information about the stand resides in a common data base. A GIS is useful but not strictly necessary for some routine applications. However, there are problems. First, the forest stand is not an adequate scale of measurement for assessing black bear populations. Knowledge of surrounding land cover also is required. Second, biologically important components are only indirectly associated with the stand. Important components could include diseases, predators, hunting regulations, and climate, among others. Third, links are not established between an integrated inventory and existing independent inventories. As a result, decisions or conclusions derived from the inventory data are suspect. Stakeholders who stand to lose the most are more likely to question the analyses obtained.

In alternative III a consensus among stakeholders is employed to assess the key components of an integrated inventory. The process also uses independent inventories to bridge the gap among stakeholders with information from other disciplines. Information from samples of integrated inventory data is combined with data from independent inventories through an on-line data base or GIS. Conflict in spatial and temporal scales among data sets is discussed, sometimes at length, with stakeholders to achieve consensus.

Stakeholders omitted from the inventory process are expected to question analyses obtained. Field measurements taken on the ground are maintained in raw form in addition to those summarized by stands or other resource units. This built-in flexibility permits reanalysis of field data for different scales and under different assumptions.

Assimilating other perspectives

The perspectives that each discipline provides can be assimilated in several ways. First, hire or establish cooperative agreements with specialists from different disciplines to conduct the inventory. Second, convene an advisory group of experts from potential stakeholder organizations to reach a consensus on important components, as with the U.S. Forest Health Monitoring program (Conkling and Byers 1992). Third, establish multidisciplinary centers to foster interdisciplinary problem-solving and informal communication among disciplines (Hutter 1991). Fourth, make single resource inventory data available to and usable by other disciplines. Fifth, keep track of other disciplines' data interests, inventory components, and methods of analysis used.

A prudent approach, of course, is to incorporate all suggestions where feasible. Each can foster advancement toward an integrated infrastructure.

Selecting multiple resource inventory components

Selecting components that apply to all resources is unlikely. Single-resource-oriented data summaries, undocumented observations, and judgments of resource supply may have limited value to other resource disciplines. Valuable measurement techniques are those that can be repeated at two or more points in time to monitor changes. Valuable observations are those that can be repeated by other individuals with the same results. Valuable samples are those that can be nested within sampling frames used by other disciplines.

Criteria for component selection vary with the makeup of stakeholders. Components of the sample typically are organized according to the goals of the inventory effort. A biodiversity sampling effort, for example, could select species groups that form critical ecological functions within an area (Chapin and others 1992). A vegetation sampling effort could include components according to their functional life form (Rudis 1984). A wildlife sampling effort might include components associated with habitat suitability for selected wildlife species (Ohmann 1992).

Components are indicators of current resource conditions. An indicator is defined as a characteristic that, when measured, quantifies biological, physical, social, or economic conditions. The use of indicators can streamline inventories by minimizing the number of components needed to assess current resources. Indicators include the presence or abundance of plant and animal species, artifacts of human use, and physical characteristics. The presence of selected indicators also can suggest activities, such as harvesting, livestock grazing, the use of prescribed fire, and recreational use.

Components are indicators of change. The use of permanent sample plots allows one to monitor changes in conditions listed above. Indicators of change in ecological resources can include responses, exposure, and stress (Norton and Slonecker 1990). Responses include visible damage to tree canopies. Exposure includes the accumulation of toxic substances in plants. Stress includes social or economic measures that suggest deleterious effects from air pollution.

Components are scale-dependent. As an example, U.S. Forest Health Monitoring components are organized around three scales of resolution. These are: (1) detection of differences across regional landscapes; (2) evaluation of causes, extent, and severity within smaller landscapes; and (3) site-level assessment of baseline changes to predict causes and rates of change and to identify species responses to change (Conkling and Byers 1992, U.S. Department of Agriculture, Forest Service, and others 1992).

AN APPLICATION

An application illustrates the inventory system model and provides an example of potentially useful components. The example comes from the USDA-FS, Forest Inventory and Analysis (FIA) unit surveys.

Inventory system

There is a legal mandate for comprehensive forest survey information through the Forest and Rangeland Renewable Resources Research Act of 1978 (Public Law 95-307 [92 Stat. 353]). However, the historical timber-oriented infrastructure of FIA surveys often has limited the components examined and issues addressed. Stakeholders with social, financial, administrative, or legal standing traditionally have come from those with timber resource interests.

Six semi-autonomous FIA units are responsible for forest surveys in the United States. FIA units are responsible for conducting surveys of all private and nearly all public forests in the eastern United States, and all private and some public forests in the western United States. There is considerable coordination among FIA units in the design of inventories and the assessment of timber resources. However, many of the components regarding wildlife, range, recreation, and water resource values are selected independently. One reason may be that the composition of stakeholders varies across unit boundaries and sometimes even across States within each unit. Most of the stakeholders are State-level forestry agencies and forest industry consultants. Some FIA units receive additional support from agencies and land-grant universities in other disciplines.

Components

FIA surveys usually address many multiple resource issues at the landscape scale of resolution through integration of forest and nonforest components aggregated by political, physiographic, and forest type. Many of the components are sampled from widely dispersed stands on plots 0.1 to 8 hectares (ha) in size.

The principal criteria for selecting components were established in the late 1970's to emphasize tangible forest outputs. Components included timber, water, range, wildlife habitat, and recreation. Components associated with biomass, biodiversity, and intangibles such as aesthetics have been added in response to selected stakeholder requests.

I use the Southern FIA unit as an example. The traditional primary objective has been to characterize timber resources. Few field components are collected on nonforest land. Detailed information, including supplementary components, is gathered only on forested plots. Observations are taken in relation to 0.4-ha forested plots that are permanently marked and spaced systematically at 4.8-kilometer (km) intervals. Forest area is determined from aerial photos. Photo-interpretation is field-verified along a systematic grid at 2.4-km intervals throughout the south central United States.

Whenever possible, observations are retained in an easily retrievable form. In this way, analysis of observations can be reclassified with other assumptions or reanalyzed to suit other resource questions. Data are also provided from routine timber computations, resource classification, and judgments of uses present.

Multiple resource components in Table 1 are derived from the Southern FIA unit (FIA Research Work Unit 1989). These components are intended as a supplement to traditional timber resource measures. For timber components, see May (1989).

Primitive-oriented recreation value can be classified from areas that are distant from roads (Rudis 1986). Wilderness value can be classified on the basis of an area's distance from roads, large forested blocks, and evidence of recent human use (Rudis 1987, Rudis 1991a). Areas near water sources can be classed as having the most recreation opportunities (Rudis 1987). Proximity to water also can be used to gauge an area's value as beaver habitat, and as habitat for other forest-dwelling wildlife that seek open water. Proximity to water also can be used to inventory an area's value for water-quality protection.

A forest area's proximity to nonforest features helps to address timber resource availability. Forests in or near populated areas are suggested as unlikely sources of future timber in the southern United States (DeForest and others 1991). Timber management and cost-sharing assistance are likely to be less important near urban areas. Timber value may be lower in or near agricultural areas and near large water bodies. A high proportion of areas near water may be unavailable for certain resource production activities, such as clearcutting or aerial herbicide application.

The proportion of area within the vicinity of access roads, fences, or signs suggests the area restricted from public access. As human intrusions, fencing and signs may limit a wilderness experience. Fences also restrict some species of wildlife.

Sampling on the way to a plot varies with the travel pattern of field observers. Observers see only a limited area around the vehicle, the plot, and the distance from vehicle to plot. The sample area is larger in sparsely populated political subdivisions and smaller in densely populated ones. This type of sampling describes the human influences in the area, but users should recognize the potential bias in observations.

By inventorying indicators of human use from samples, analysts create a map of the uses--and by inference the social processes--that degrade or improve forest ecosystems. Monitoring human influences on permanent plots can be combined with an inventory of forest resource characteristics to assess potential causes of forest ecosystem changes.

Other uses of the data include mapping individual tree species as indicators of moisture conditions (Rudis 1988). The data also can be used to estimate the occurrence and causes of fire (Rudis and Skinner 1991), to estimate agroforestry activities (Rudis 1992) and disturbances to forests with potential old growth characteristics (Devall and Rudis 1991), and to map harvest activities (Rudis and Tansey 1991).

Table 1. Multiple resource components that supplement timber resource measures in the Southern FIA unit

---

I. Proximity of the plot to nonforest features. Data are derived from aerial photos and road maps and are verified in the field. Components include
- -Size of permanent water bodies or water courses and distance within a radius of 0.4 kilometers (km)
- -Distance from urban or built-up land, agricultural land, and all-weather roads, within a radius of 4.8 km.

II. Access condition within 0.4 km of the plot. Observations are made on the way to the plot and include
- -Road access (e.g., paved, gravel, dirt)
- -Presence and condition of fences for restricting livestock
- -Presence of hunting restricted or "posted" signs
- -Presence of other signs, including no trespassing.

III. Indicators of vegetation disturbance. These include
- -Presence and age of burned or charred remains of a fire
- -Presence and type of livestock grazing evidence
- -Presence and use of trails or roads on the plot
- -Presence and age of logging debris
- -Type of timber harvest and management activities since the previous survey
- -Natural disturbances since the previous survey 8 to 10 years ago.

IV. Indicators, i.e., artifacts, associated with human use. Some artifacts are human intrusions that may reduce aesthetics or conflict with other resource uses. Some artifacts indicate past recreational use. Included are
- -Beverage or food containers, discarded machinery
- -Active or abandoned homestead buildings or fences
- -Boundary markers, flagging, markers for cutting, etc.
- -Garbage, garbage dumping, evidence of logging activity
- -Shotgun shells, tree stands, other evidence of hunting
- -Wildlife management indicators, e.g., deer or turkey food plots in forest clearings.

V. Indicators of wildlife habitat. In addition to components in I through IV above, others include
- -Stand age, stand size, composition, and change between inventories
- -Presence and stocking of large live, rotten, and dead trees by diameter class and forest type
- -Presence of species of flora and fauna indicative of selected environmental conditions, including endangered species
- -Size of contiguous forest tract. Boundaries are nonforest areas 37 meters or more in width.

VI. Soil and water components. In addition to proximity to permanent water listed in I above, components include
- -Presence and type of temporary or permanent water sources
- -Physiographic class, slope, and aspect.

CONCLUDING REMARKS

Becoming familiar with the infrastructure and stakeholders in separate disciplines are important steps in bridging knowledge gaps. As the inventory proceeds, dialogue with potential stakeholders in other disciplines may be needed to rebuild a consensus as new information, techniques, and analyses are developed.

Key inventory components are never truly known, but are based on dialogue and agreement among stakeholders. Consensus is not always obtained, however. In practice, the priorities of one or more components are agreed upon by a few stakeholders with social, financial, administrative, or legal standing. Components secondary to these are added as other stakeholders obtain standing.

Often components are retained through tradition and are dropped when priorities shift toward other stakeholders. Some components have limited relevance for inventories of resources but are important for monitoring purposes. Other components appease selected stakeholder interests. These components inevitably are dropped after analyses suggest their redundancy or limited utility. True key components may emerge as experience among disciplines increases and as an interdisciplinary infrastructure develops over time.

On the horizon are many promising new techniques to make multiple resource inventories more useful. In a GIS environment, several components can be more efficiently associated with inventories conducted by other disciplines. Recording human influences and timber data together provides basic data upon which to build skill in interdisciplinary resource analysis. Geostatistical techniques and ecological theories exist to describe the spatial mosaic or the interconnectedness of data from samples taken across a landscape (Forman and Godron 1986, Isaaks and Srivastava 1989). Techniques also exist to measure the aesthetics of a landscape (Rudis and others 1988) and its social and economic relationship to people (Fortmann and Huntsinger 1989). Finding the reasons for occurrence patterns also may require the involvement of basic biophysical sciences as well as the applied sciences of anthropology, landscape ecology, remote sensing, and social science.

REFERENCES

Chapin, F.S., III, Schulze, E-D., Mooney, H.A. 1992, Biodiversity and ecosystem processes: Trends in ecology and evolution, Vol. 7, pp. 107-108.

Conkling, B.L., Byers, G.E., eds. 1992, Forest health monitoring field methods guide: Internal report, U.S. Environmental Protection Agency, Las Vegas, NV, 146 p.

DeForest, C.E., Harris, T.G., Jr., Cubbage, F.W., Nelson, A.C. 1991, Timberland downtown?: southern forest resources along the urban-rural continuum. In: Mengel, D.L, Tew, D.T., eds. Ecological land classification: applications to identify the productive potential of Southern forests, General Technical Report SE-68, USDA-FS Southeastern Forest Experiment Station, Asheville, NC, pp. 137-138.

Devall, R.M., Rudis, V.A. 1991, Older stands characterized and estimated from sample-based surveys. In: Henderson, D., Hedrick, L.D., eds. Restoration of old growth forests in the Interior Highlands of Arkansas and Oklahoma, Ouachita National Forest, Hot Springs, AR and Winrock Institute for Agricultural Development, Morrilton, AR, pp. 121-137.

FIA Research Work Unit. 1989, Forest survey inventory work plan, Alabama 1989-1990, USDA-FS, Southern Forest Experiment Station, Starkville, MS, 61 p. + Appendices.

Forman, R.T.T., Godron, M. 1986, Landscape ecology, John Wiley and Sons, New York, 619 p.

Fortmann, L., Huntsinger, L. 1989, The effects of nonmetropolitan population growth on resource management: Society and natural resources, Vol. 2, pp. 9-22.

Heberlein, T.A. 1988, Improving interdisciplinary research: integrating the social and natural sciences: Society and natural resources, Vol. 1, pp. 5-16.

Hutter, W. 1991, Interdisciplinary research in the Netherlands: Interdisciplinary science reviews, Vol. 16, pp. 205-207.

Isaaks, E.H., Srivastava, R.M. 1989, Applied geostatistics, Oxford University Press, New York, 561 p.

Lund, H.G. 1986, A primer on integrating resource inventories, General Technical Report WO-49. USDA-FS, Washington, DC, 64 p.

May, D.M. 1989, Forest survey information systems in the South Central United States. In: Adlard, P., Rondeux, J., eds. Forest growth data: capture, retrieval and dissemination, Faculty of Agriculture Gembloux, IUFRO, Gembloux, Belgium, pp. 189-196.

Norton, D,J., Slonecker, E.T. 1990, The ecological geography of EMAP: Geo info systems, Nov/Dec, pp. 33-43.

Office of Technology Assessment. 1992, Forest Service planning: accommodating uses, producing outputs, and sustaining ecosystems, U.S. Congress OTA-F-505, U.S. Government Printing Office, Washington, DC, 206 p.

Ohmann, J.F. 1992, Wildlife habitats of the north coast of California: new techniques for extensive forest inventory, Research Paper PNW-440, USDA-FS, Pacific Northwest Research Station, Portland, OR, 48 p.

Rudis, V.A., comp. 1984, Work group H: vegetation management techniques. In: Schlatterer, E., Lund, H.G., eds. Proceedings of the inventory integration workshop, USDA-FS Range and Timber Management Staffs, Washington, DC, pp. 145-149.

Rudis, V.A. 1986, Emerging patterns in the distribution of roadless forested areas in the Midsouth. In: Kulhavy, D.L., Conner, R.N., eds. Wilderness and natural areas in the Eastern United States: a management challenge, Center for Applied Studies, School of Forestry, Stephen F. Austin State University, Nacogdoches, TX, pp. 265-270.

Rudis, V.A. 1987, Recreational use of forested areas by Alabama residents, Research Paper SO-237. USDA-FS, Southern Forest Experiment Station, New Orleans, LA, 37 p.

Rudis, V.A. 1988, Nontimber values of east Texas timberland, Resource Bulletin SO-139, USDA-FS, Southern Forest Experiment Station, New Orleans, LA, 34 p.

Rudis, V.A. 1991a, A recreation and landscape perspective of Alabama's changing forest environment: the human character of forests. In: Jones, R.H., ed. Proceedings of the conference: Alabama's forest resources: past, present and future, Auburn University Press, Auburn, AL, pp. 93-114.

Rudis, V.A. 1991b, Wildlife habitat, range, recreation, hydrology, and related research using Forest Inventory and Analysis surveys: a 12-year compendium, General Technical Report SO-84, USDA-FS, Southern Forest Experiment Station, New Orleans, LA, 61 p.

Rudis, V.A. 1992, Agroforestry's regional importance: forest resources and owner characteristics associated with livestock grazing in the South Central United States. In: The 4th North American symposium on society and resource management: book of abstracts, The School of Natural Resources, University of Wisconsin, Madison, WI, pp. 127-128.

Rudis, V.A., Gramann, J.H., Ruddell, E.J., Westphal, J.M. 1988, Forest inventory and management-based visual preference models of southern pine stands: Forest science, Vol. 34, pp. 846-863.

Rudis, V.A., Skinner, T.V. 1991, Fire's importance in South Central U.S. forests: distribution of fire evidence. In: Nodvin, S.C., Waldrop, T.A., eds. Fire and the environment; ecological and cultural perspectives, General Technical Report SE-69, USDA-FS, Southeastern Forest Experiment Station, pp. 240-251.

Rudis, V.A., Tansey, J.B. 1991, Placing "man" in regional landscape classification: use of Forest Survey data to assess human influences for Southern U.S. forest ecosystems. In: Mengel, D.L, Tew, D.T., eds., Ecological land classification: applications to identify the productive potential of Southern forests, General Technical Report SE-68, USDA-FS Southeastern Forest Experiment Station, Asheville, NC, pp. 135-136.

Senge, P.M. 1990, The fifth discipline: the art and practice of the learning organization, Doubleday Currency, New York, 424 p.

U.S. Department of Agriculture, Forest Service, U.S. Environmental Protection Agency, National Association of State Foresters. 1992, National forest health monitoring: assessing the condition of our forest resources, NA-TP-06-92. 1 p. Available from: J. Barnard, 3041 Cornwallis Rd., Research Triangle Park, NC 27709, USA.