A Knowledge Base for FIA Data Uses

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Abstract.—Knowledge management provides a way to capture the collective wisdom of an organization, facilitate organizational learning, and foster opportunities for improvement. This paper describes a knowledge base compiled from uses of field observations made by the U.S. Department of Agriculture Forest Service, Forest Inventory and Analysis program and a citation database of more than 1,400 bibliographic entries from the past quarter-century. This synthesis provides highlights of early novel uses from the 1930s through 1976, suggests evolving approaches toward comprehensive assessments, and refers to the usefulness of forward-looking efforts to document the types of users, available attributes requested, and information in demand.

Introduction

The challenges of assessing forest lands for their ability to provide products, services, and values to an increasingly diverse society have grown progressively complex. Integrated knowledge is essential when selecting relevant attributes for measurement and common procedures for data collection, management, and analysis. For any organization concerned with efficient collection and distribution of data about field observations, a strategic business plan that considers the multiple processes involved in addressing current and satisfying future customer needs will be necessary.

Knowledge management, a formal term with many definitions (Full Circle Systems 2003), provides a way for an organization to capture the collective wisdom about such processes, facilitate appropriate responsiveness to challenges, and foster innovation. Feedback from customers in the form of documented attributes of interest, the kinds of analysis requested, and the multiple and varied interpretations of data provides some of the knowledge needed for long-term planning. The same is true for public agencies, whose supporters include not only the customary end users of data, but also legislators, nongovernmental organizations, businesses, and individuals. An agency's decisionmakers need information about promising new ventures when funding is increased or may need to take cost-cutting actions and periodically reassess priorities in years of lean funding.

This brief synthesis is intended to facilitate organizational learning of U.S. Department of Agriculture Forest Service Forest Inventory and Analysis (FIA) program staff, affiliates, and potential cooperators. Recent efforts now being used to capture what data are being used, what issues the data are addressing, and the FIA program's knowledge of data uses and users are problematic. The paper highlights a retrospective compilation of the last quarter-century's reports that used FIA-based field observations for novel uses (Rudis 2003a). Included are early efforts involving nontraditional uses, other disciplinary perspectives, and evolving approaches to conducting comprehensive forest resource assessments. Recent findings and new opportunities to assemble knowledge of unpublished data uses and users also are described.

Early Milestones

A search of the literature on FIA-associated data reveals an evolving program (Rudis 2003a, 2003b). When FIA surveys were initiated in the 1930s, the chief goal was to identify timber resources, such as lumber and naval stores. But almost from the beginning, a broader audience was attracted to the information provided, particularly land use, forest land area, and forest types. Not long after the first reports came out, this single-purpose forest survey became a source of spatial information for an array of users. Map displays always have been a popular cross-disciplinary feature of forest survey reports and continue to this day to serve a diverse audience.

In the 1950s, a second generation of reports included county-based representations of otherwise tabular FIA data,

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including tree distributions of individual species for Mississippi (Sternitzke and Duerr 1950), timber supplies for Florida counties (Larson 1952), and hickory timber volume in the South (Cruikshank and McCormack 1956). The audience for the data remained diverse, but reports of the time focused primarily on directly measured attributes of timber supply.

A decade later, the American Forestry Association sponsored a series of regional, community-based assessments of forest management across the country. This effort produced three book-length (300-plus page) reports that synthesized biological and physical attributes, ownership patterns, and geopolitical contexts for three regions, as represented by three States: California (Dana and Krueger 1958), Minnesota (Dana *et al.* 1960), and North Carolina (Pomeroy and Yoho 1964). Information assembled came from the forest survey as well as a much wider range of sources than was common in later decades. These reports served and may continue to serve as models of an accomplished synthesis from vastly different disciplines and sources. Although dated, they remain a treasure trove of information for people who want to compare historic land use, forest ownership patterns, and land management practices across regions.

Beginning in the 1960s, the forest survey began to expand into other disciplinary arenas. The then-pioneering concept of a "multipurpose" inventory focused on the feasibility of combining deer browse inventories with forest surveys in the Southeastern United States to address wildlife management concerns (Moore *et al.* 1960). In the 1970s, understory plants were used to identify potential wood productivity in the Pacific Northwest (MacLean and Bolsinger 1973) and forest range resources in the south-central United States (Pearson and Sternitzke 1974). Other reports were generated to document tree damage agents; e.g., laminated root rot (Gedney 1976). At the same time, growing recognition that more sociological information was needed to assess the availability of timber for harvest led to coordinated studies of nonindustrial owner intentions in the Northeastern United States (Kingsley and Finley 1975).

By the mid-1970s, laws were enacted requiring comprehensive forest resource assessments, which included reports of associated social issues and related resources such as range, recreation, water, and wildlife habitat. Efforts varied widely by region and are reported elsewhere (Rudis 1991, 2003a, 2003b).

Evolving Approaches Toward Assessments

Varied approaches toward forest resource assessments have been taken, and many were intended to be comprehensive. Rudis (2003a) provides details, but in brief, such approaches have ranged from those designed by (1) a singular discipline with a single data source for a single-discipline audience to address a single purpose, (2) a representative team of selected disciplines with a limited array of data sets to focus on a specific issue or topic, or (3) multiple disciplines and data sources to address a selected range of objectives. In the past quarter-century, FIA assessments have evolved from the first approach principally by making efforts to reach a broader audience.

Individual scientists and teams in selected disciplines also have made use of publicly available FIA data to address specific issues in subject matter journals; e.g., for modeling biogenic emissions (Wiedinmyer *et al.* 2001), urbanization of forest ecosystems (Kline *et al.* 2001), and conducting regional assessments of early successional habitat for wildlife (Trani *et al.* 2001). In recent years, awareness of the FIA program has reached the point where its data are cited commonly in national studies of forest resource issues; e.g., stewardship of private forest land (Best and Wayburn 2001). The prominence of studies that synthesize FIA data with other data sets cannot be overemphasized. Such studies often surface in widely read interdisciplinary journals; e.g., *Science* (Caspersen *et al.* 2000), newspapers, or other popular media.

Adapting and incorporating data and knowledge from other resource inventories and disciplines are hallmarks of a truly comprehensive forest resource assessment. The extensive time required to align data from disparate inventories and communicate relevant knowledge among scientists in other disciplines, however, is a common problem in preparing such assessments (Rudis 1993). Multidisciplinary forest assessments that focus on specific regions or issues are popular approaches toward streamlining the development of an integrated data set and an interdisciplinary synthesis.

An approach toward such an undertaking for an environmental analysis of land cover and land use in the early 1980s produced one of the first integrated data sets, now known as the GEOECOLOGY database (Olson *et al.* 1982). A landmark, multidisciplinary, team-oriented scientific effort conducted in

the 1990s assessed timber harvesting in the State of Minnesota (Jaakko Poeyry 1994), with support provided to collect additional data and analysis to fill in some of the then-recognized knowledge gaps. Narrowing the scope and streamlining data integration to complete the task in a time-efficient manner reduces the burden of commitment by individual team members and facilitates timely reporting of results. One recent approach in Arkansas employed a 6-month maximum analytical time frame and a series of reports on new FIA survey data by invited experts with different perspectives (Guldin 2001). Another approach relied on a 1- to 2-year analysis primarily of existing data, models, or published studies, and a multiple-team synthesis, e.g., the Southern Forest Resource Assessment (Wear and Greis 2002).

In all these approaches, common challenges are the limited time available to fill strategic cross-disciplinary information gaps and the paucity of protocols for modeling and analyzing data from several disciplinary perspectives. One interdisciplinary need, for example, is a way to link ecological land type classification systems with timber growth (Song 1994). Addressing such a seemingly intractable problem often is left to imaginative early-career researchers, most notably graduate students. I compiled and indexed abstracts of known graduate student reports (Rudis 2003b). I highlighted an array of new approaches to analyzing FIA data, which integrates the data with other relevant data sets or enables viewing the data through the lens of other disciplinary perspectives or concepts.

Knowledge of Data Users and Uses

Efforts to document uses of FIA data began in 1989 with an informal query of nontraditional uses; however, expanded efforts found many more novel uses. Over time, the list of citations has been updated as an online citation database (Rudis 2002-04). Citations include reports of studies that used FIA's regional, field-sample-based forest surveys, as well as graduate student reports, collected works, and selected documents concerning integrated assessments and multidisciplinary surveys. The list also includes representative timber resource assessments since 1975. The primary focus of this database is on nontraditional and original technical uses associated with FIA data from 1975 through 2001. Recent citations also include entries that reference other data collected on FIA plots from sampling protocols established by the Forest Health Monitoring Program (Mangold 1998).

To obtain knowledge of data uses that may not be associated with publications, current sources of information include tallies of data requests made through FIA customer service centers, which includes requester data. Requests for National FIA Spatial Data Services (http://www.fs.fed.us/ne/fia/spatial/ request.html) indicate the types of customers that request spatial data retrievals. LaPoint (2005) noted that the largest group of requesters for this data in fiscal year (FY) 2003 was from academic institutions. The complete list of the groups and percentages follow:

- Individuals from academic institutions—32 percent.
- Other Forest Service personnel—15 percent.
- Other Federal personnel—16 percent.
- Other State personnel—13 percent.
- FIA staff—7 percent.
- Forest industry—7 percent.
- Nongovernmental organizations—4 percent.
- National Forest System—1 percent.
- Others—5 percent.

For the same period, the Southern Research Station FIA recorded that 16 percent of data requests came from universities and a similar number came from environmental groups.[2] This type of data, when considered with additional information about the types of requesting organizations, attributes used, and periodic tracking by year, may provide valuable feedback for decisionmakers to discern topical issues, set data collection, analysis, and distribution priorities, and modify or retain attributes frequently requested by such users.

The Internet server that maintains the FIA MapMaker (http://www.ncrs2.fs.fed.us/4801/FIADB/fim_tab/wc_fim_tab.asp) is a Web-based application for generating tables and shaded maps, as well as a potential source of information about both FIA data uses and users. Security software automatically records the Internet Protocol address and domain name of the

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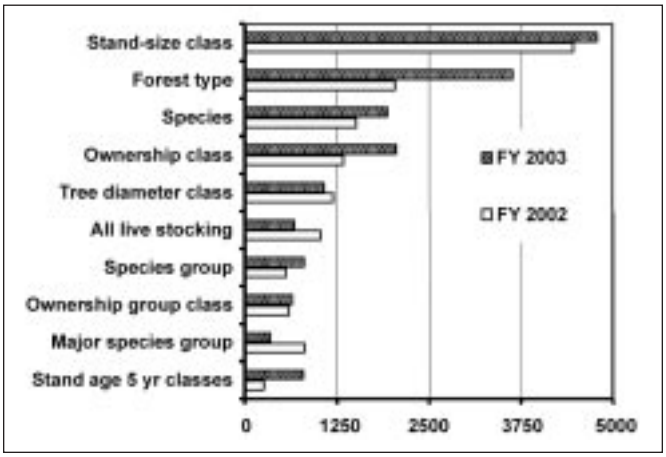
user, and can be programmed to tally the attributes requested. Domain names by themselves are not definitive, but they do provide clues to the broad categories of users. In FY 2002, the categories of domain names and percentages of individual accesses were the following (Miles 2002):

- Forest Service (fs.fed.us)—34 percent.
- Commercial firms—19 percent (forest industry—7 percent, other or unknown—12 percent).
- AOL.com—2 percent.
- Miscellaneous (net—12 percent).
- Academic institutions (edu)—12 percent.
- Government (gov) and nonprofit organizations (org) combined—1 percent.
- Other unknown—20.

Figure 1 illustrates the top 10 attributes requested from the FIA MapMaker Web site for FYs 2002 (Miles 2002) and 2003 (Miles 2003), other than county and State. A quick glance suggests that stand size and forest type are most requested, and that there has been some change in the frequency of attributes requested. Interpretation of figure 1 should proceed with caution, however, as attribute requests may be closely tied to the organization and availability of choices presented on the Web site.

For future planning, customer service requests from FIA MapMaker, other FIA-sponsored Web sites, and other customer service centers may supply insight into current and changing interests for already available online data, as well as information in demand but not currently available. Software may be applied to the discovery of knowledge from extensive records of customer requests. Cooley *et al.* (2000) provides an overview of the terminology and references for techniques to analyze Web user activities. Cooley *et al.* (1999) suggests initial data preparation of Web server data logs is a key to obtain more sophisticated information.

Figure 1.—*Top 10 attributes requested of the FIA database by number of requests, exclusive of county and State, fiscal years 2002 and 2003 from data supplied in Miles (2002, 2003).*



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