Forest Inventory: Role in Accountability for Sustainable Forest Management

Lloyd C. Irland[1]

Abstract.—Forest inventory can play several roles in accountability for sustainable forest management. A first dimension is accountability for national performance. The new field of Criteria and Indicators is an expression of this need. A more familiar role for the U.S. Department of Agriculture Forest Service Forest Inventory and Analysis (FIA) program is for assessment and outlook development in States and regions. This essay poses three big challenges for FIA today: sustain and build on the Annual Forest Inventory System, show relevance to nontimber and science user groups, and improve measures of ecological health.

Introduction

I was introduced to Forest Inventory and Analysis (FIA) data by Professor Lee James at Michigan State, who in the mid 1960s thrust a copy of the 1965 Timber Trends Report (USDA Forest Service 1965) into the hands of an eager young forestry student. Since then, I have been a regular FIA data user, and a frequent source of suggestions to the FIA units. While in State Government, I helped coordinate efforts to develop State funding for plot augmentation and other improvements to Maine's FIA efforts. As a writer and consultant, I regularly mine FIA information. The various units have been helpful in supplying unpublished data, going back to the days when it would be furnished on microfiche. Looking back only 15 years, the amount of progress is truly extraordinary.

Interest is growing in taking a global perspective to forest inventory, with national inventories viewed as elements in a global assessment, just as States or provinces are elements in the U.S. and Canadian national timber budgets. Some even aspire to comparisons, by way of the Criteria and Indicators (C&I) process, which show how different nations are doing. Due to unresolved difficulties at national levels (see, e.g., Irland 2007), and inconsistent definitions for data, an international perspective is not promising at the moment.

Accountability

Accountability sounds simple but it is not. Different stakeholders are concerned with different aspects of the forest. To mention accountability immediately raises the question of who is responsible. In the United States, responsibility is spread among levels of Government, agencies, and property owners. For many aspects of the forest resource, when the question is "Who are you going to call?" we do not know the answer.

Different Stakeholders and Perspectives

Timber Sustainability, Growth/Drain

Despite the way the political winds are blowing these days, I am convinced of the continuing relevance of accountability especially when handled in a somewhat more inclusive way and with more neutral terms than in the past (Ince 2000, Irland 2003, Nilsson *et al.* 1999).

Habitat

To my surprise, FIA data and analysis is less used for this question than it should be. Certainly a good start has been made, with national overviews by Flather, Brady, and Knowles (1999), and Noss, Laroe, and Scott (1995).

Health/Ecological Condition/Biodiversity

This huge gap in our monitoring capacity will not be soon filled. In fact, we do not even have a sensible way to proceed

[1] Lecturer and Senior Research Scientist, Yale School of Forestry and Environmental Studies, 360 Prospect Street, New Haven, CT 06511. Phone: 203–436–3981. Fax: 203–432–3809. E-mail: irland@aol.com.

(EPA 2002, NCSSF 2005, The Irland Group 2001). FIA has to respond in a measured manner, but avoid getting drawn into this black hole of limitless demands for new data. Yet, FIA data does offer ways to depict key changes and to offer diagnostics on overall conditions related to ecological health (e.g., Dahms and Geils 1997; O'Laughlin and Cook 2003; Shaw, Brytten, and Blander 2005; USDA Forest Service and BLM 1996).

Land Use

Land use is an emerging social concern and is an area where FIA has established strengths, as I will note below.

Carbon Budgets

Carbon budgets are an example of a new social concern for which the FIA system happened to be there, ready and waiting, with a rigorous national data set that can respond to this need (see, e.g., Smith, Heath, and Woodbury 2004). As Kyoto-like policies continue to be debated, we will enter dangerous waters here, and will need to be on our guard against misuse or misunderstanding of this information.

Accountability for Interpretation

Interpretation includes many things, including seeing that data and interpretations are presented with clarity, especially where data limitations are being pushed and need to be clearly identified. Somewhere in the forestry profession, we will need Truth Squads who can point out misinterpretations of forest conditions and abuses of FIA data by whatever interest group provides the latest example of selectively edited and partial views of what is happening in the forest. Government is understandably reluctant to speak directly about the bad news. In the future, there will be bad news and we had better get used to it. Data producers such as FIA have an obligation to make the data easy to use and understand, and especially to counsel less familiar users on limitations (see, e.g., Luppold and McWilliams 2004).

Accountability at National Level: Key Points on C&I

In the eagerness to implement C&I, a number of critical points have received limited consideration (Irland 2007). These have no immediate answers, but can no longer be ignored. Some of the problems originate in the definitions of the Criteria themselves. A few major challenges appear evident, based on the 2003 National Report (USDA Forest Service 2004), which represents a national application of the Montreal C&I. Those involved are engaged in detailed discussions on all of these questions.

The Aggregation Problem

In an ecologically diverse Nation of continental scale, averages may mean little. How much total growing stock is standing in the forests is good to know, but how to interpret this statistic in terms of sustainable forest management (SFM) may be ambiguous, and the meaning of the national aggregate may be limited. The 2003 National Report summarizes 22 forest type groups, a highly aggregative way to view the forest. The Nature Conservancy defines 1,505 forest associations, plus almost 1,500 more for woodland and shrubland (Noss and Peters 1995, Stein, Kutner, and Adams 2000). The FIA data system probably could not support disaggregation down to 1,505 forest types, but using only 22 cannot lead to very helpful conclusions about changes in the forest.

Credible Measures of Ecological Health

Credible measures of ecological health are lacking. Unfortunately, this lack of measures is often covered up by improvisations and euphemisms. Those conducting assessments are presently unwilling to use the best local or regional examples when national coverage is lacking. The FIA effort can undoubtedly relate to this problem, but at the same time, its sample design may not offer the best platform for many of the issues.

Improved Ways to Present Data

Improved ways to present data on forest conditions and trends are needed. I think FIA is getting better at this and look forward to further progress. It is not an easy matter to present tables and charts that illuminate without oversimplifying the case.

As the C&I process is currently structured, governments grade themselves. It is time to find a way to empower a truly independent body to conduct period assessments, according to C&I or other criteria. Previous examples include the Heinz Commission's report (2002) and the Millennium Ecosystem Assessment (2005).

The FIA community is a major data provider for analysts working with some of the C&I. The community also has a major responsibility for quality control, providing tough-minded, technically sound reviews of how the data are being used. At times, such comments may not be entirely welcome.

Accountability at Regional Levels: A Few Examples

Type Definitions Can Obscure Realities

In Maine, we were confronted with a severe budworm outbreak from about 1972 to 1985. In the wake of the damage, extensive salvage cutting was conducted. Emerging young stands developed in a variety of patterns. Especially troubling was that in many areas spruce-fir stands were being replaced by dense shrubby stands of early successional hardwoods and species such as pin cherry (*Prunus pensylvanica*) and raspberries (*Rubus idaeus*). These were in patches of varying sizes, some in the hundreds of acres. The 1995 FIA data showed that the area of the spruce-fir type group had fallen markedly since 1982. This figure was widely cited as proof of mismanagement and a deteriorating resource.

Lost in this debate were a few points. First, the type group is much larger than just the spruce-fir types, so the net change number included changes in other softwood types as well. Also, the definition of forest type used in FIA is not entirely transparent. To complicate matters, the forest type algorithm had been changed in the interim. Finally, type change was depicted as a black and white matter—either a stand is or is not spruce-fir. Yet, by depicting type as black and white, realities were obscured. It makes a huge difference whether an acre fell from 75 percent spruce-fir stocking to 50 percent, or from 75 percent to zero. In either case, that acre might be tallied as moving out of the spruce-fir type. Also, uncertainty remains about the extent to which clearcut areas of low spruce-fir stocking will naturally recover softwood stocking over normal stand development.

I was part of an informal probe of this information, in which we screened stocking conditions and change by deciles of spruce-fir stocking. This approach yielded a much richer picture. As a byproduct, we could see that the change in the typing algorithm accounted for a portion of the apparent type change. This example is but one instance in which new processing and computational capabilities enable analysts to probe complex questions in much richer ways.

Better Present Age Class Data/Trends

In dealing with the Maine spruce budworm outbreak in the late 1970s and 1980s, we were frustrated by the difficulty in translating FIA data into age class information that we could use in assessment and modeling. Far too many ad hoc workarounds were necessary. In contrast, a focus on age class seems to have been routine in other regions for some time. Certainly not all stands are even aged, but this is no reason for inadequate attention to age class issues.

Land Use Changes

Sprawl and land use issues are being highlighted as major concerns for the future of American forests. These issues are relevant whatever your specific resource interest might be. The land use change matrices prepared routinely by some of the FIA units are highly informative about the dynamics of land use change. This kind of summary is needed nationwide. Using this data set to shed light on land use change is a perfect example of bringing the FIA capability into important debates on national issues. FIA is one of the only sources of consistent measurement on this point, so the importance of tracking land use can only increase (see, e.g., relevant sections of Wear and Greis 2002).

Measuring Forest Disturbance

The role of disturbance in shaping ecosystems has emerged over recent decades as a powerful source of insights. Using FIA data to track different sources of disturbance, including cutting, can make important contributions. FIA has been engaged in this

effort since at least the publications of Gansner *et al.* (1990) at the Northeastern Station. The recent South Carolina report (Conner *et al.* 2004) contains a useful summary placing timber cutting in context of other disturbances. Hopefully, this kind of summary will become a part of the standard presentation in all states.

Regional and State Assessments

The regional scale of assessment that breaks out of the traditional box of State-by-State reporting has been an increasingly important application of the FIA capability (Wear and Greis 2002, USDA Forest Service and BLM 1996, Dahms and Geils 1997). Also, individual States have conducted outstanding assessment work that relies heavily on the FIA information. Examples that come quickly to hand, without prejudice to others, include Oregon (Oregon Department of Forestry 2004), California (California Department of Forestry and Fire Protection 2004), and Maine (Maine Forest Service 2005). A number of States, such as Minnesota and Maryland, have done extraordinary work integrating FIA and other data into massive Geographic Information System (GIS) systems for assessment, monitoring, and at times for analyzing policy or management decisions (Minnesota Department of Natural Resources 2001).

Three Big Challenges for FIA

Sustain and Build on Annual Forest Inventory System

The early years of the Annual Forest Inventory System (AFIS) brought questions in the user community about whether it could be a periodic synthesis of a State's forest position with high statistical accuracy. In the event, the 5-year report produced for Maine has put that concern to bed. It is not only an excellent overview, but it breaks new ground in presentation in a number of ways. Gaining full clarity on the growth/removals balance has not yet been achieved but it appears to be within our grasp.

An additional concern was whether annual funding could be sustained at the State and Federal levels. It is encouraging to hear that FIA has strong support from U.S. Department of Agriculture (USDA) Forest Service senior management. Maine has been able to stay the course. Matters have not gone as well in some other States. Everybody wants something from the FIA but we can't please them all. FIA managers are aware that they must not lose the essentials as they continue adapting to new data needs. More particularly, they will have to resist efforts to get us to address things not well suited to the sample design and analytical system.

Within the United States, the building blocks continue to be the States—if they are unable to follow through with funds and cooperation, the program will not be sustainable. I don't know if anyone has taken an outside look at the current status and funding outlook of the AFIS effort nationally. If not, it might be a good time now that Maine has finished its first 5-year report and others are emerging. We certainly need to have a good handle on progress nationally. I don't think the future financial sustainability of AFIS can be taken for granted. Hopefully, the next two suggestions could help in broadening support in useful ways.

Demonstrate FIA Relevance to Nontimber Issues and Value to Other Science Users

Numerous applications have shown the value of FIA data sets in tracking changes in various proxies for wildlife habitat. Many more nontimber applications are being showcased here. It is extraordinary that many scientists in other disciplines are totally unaware of this information and how to use it. The use of these data offers a major opportunity to advance FIA's contribution to the wider science community, and hopefully generate greater support for the program.

It's time to stop talking of terms such as *timberland*, which presume a resource value for a piece of forest. Terms such as *sawtimber stands*, in addition to using obsolete utilization standards, also presume a timber value for the forest that is often entirely irrelevant to the intended uses of the information. Defining stand size classes in a more neutral manner, not defined by outmoded product definitions, would be useful in any case. Traditional pulp, sawtimber, and related tabulations can be prepared and included in the appendix or otherwise for the timber-oriented audience. Try a thought experiment—how would we describe the forest in a region with no sawmills or pulp mills?

We need to take more advantage of unprecedented processing/sorting/graphics capabilities. Counties are probably obsolete, but there are States (Maine, Minnesota) where their wide range of size (up to a factor of 5 or 6) hinders interpretation. The FIA Survey Units attempt to provide geographic units of sufficient size to assure statistical significance and to capture important regional differences. If only for comparison with past data, I would not abandon them. Also, for certain kinds of geographic comparisons, analysis units of uniform size can be important (see, for an intriguing example, Stein, Kutner, and Adams 2000).

It is now time to integrate the national FIA data set into a suitable version of the ecological units being done on a separate track by the USDA Forest Service—the ecoregion maps by Bailey, Carpenter, and others. Gray (1995) illustrates this approach, using 90 ecologically defined "sections" for Canada. Building reporting around such units could yield important insights. It would demonstrate commitment to the emerging ecosystem paradigm and a willingness to step away from past timber-oriented definitions.

Much as we are gaining from current GIS modes of expression and analysis, we must not forget that better pictures or sophisticated geostatistics yield new views, but not really new data. The traditional dot map is not yet obsolete. The usefulness of displaying plot locations versus geospatially modeled surfaces needs further analysis. New mapping and other visualizing capabilities are doubtless one of the exciting trends in this field. FIA and user groups have done yeoman work building on FIA data sets for biomass and carbon measurement. This spatial initiative is a major success story and is another good answer to the old claim that FIA is a timber only effort.

FIA has made great strides in making its data easy to find. It's all on the Internet now. Comparable progress in making it easy to understand and apply is needed. New user groups are unfamiliar with much of the system, and have very distinct needs. We need to develop interpretive and how-to products aimed at various science audiences, help them to become familiar with FIA, and to use it more often. We also must address cultural gaps. As an example, I once reviewed a technical journal article assessing ecosystems in New Hampshire. The authors were clearly totally unaware of riches in FIA data sets. When I urged them to look into readily available publications that were highly relevant, they were not too interested in hearing about it. They were comfortable with their dot-map mindset that naturally emerges from people who spend all their time making lists of tiny little spots that host rare plants. Their view was certainly not wrong, but it was incomplete.

We need an academic program training resource analysts to use and improve existing data sets and apply them to a wide range of problems. It would support graduate students' research, emphasizing mid-career students, and would conduct seminars and training. It would be unselfish, spending resources around the country and not just on campus. Private support for such a venture is needed, and soon.

Build on FIA Strengths to Contribute to Ecological Health Monitoring

The huge hole in our data about trends in ecological condition and ecosystem health hinders our efforts on C&I as well as to our abilities to manage responsibly (see, e.g., EPA 2002; Heinz Center 2002; Irland 2007; The Irland Group 2001; NCSSF 2005). Until substantial progress can be made in filling these gaps, talk of SFM is academic. We need to be certain that real FIA strengths are being employed. It won't do to just measure more variables on each plot if the plot system poorly fits the matter of concern. Burdening the plot measurements just to satisfy critics is a bad way to respond to emerging needs.

Conclusions

Meeting the three big challenges will necessarily involve FIA with many other sections of the user community and the science community.

FIA is clearly overworked and underresourced. Somehow we must locate leaders who are in a position to help us address the funding issue, and soon. Further, I hope that by adopting my suggestions, we can broaden support in ways that will enable us to sustain the entire program into the future for all the public benefits it will bring.

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