



# The FORSight Resource

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## Upcoming Events...



<http://www.wfc2009.org/en/index.asp>

### 2009 Southern Mensurationists Conference

San Antonio, Texas  
October 25 - 27, 2009

<http://www.somens.org/index.php/smen/2009>

### 6th Timberland Investment World Summit

New York, NY  
October 26-28, 2009

<http://www.timberlandworldsummit.com/index.php>

### The Value of Forest Genetics

Tuscaloosa, AL  
December 1-2, 2009

<http://www.ncsuforestrycoops.org/vaoffogeforp.html>



### Loblolly Pine Growth and Yield Research Cooperative Annual Meeting

Summerville, South Carolina  
December 2-3, 2009



### Seventh Southern Forestry and Natural Resource Management GIS Conference

Athens, Georgia  
December 7-9, 2009

<http://www.soforgis.net/2009/>



## Forest Inventory—The FIA Program

In this issue FORSight takes a detailed look at the FIA program: what it does, the potential uses for the data it provides, and some of the issues about which an analyst needs to be mindful before proceeding with that next project.

The Forest Inventory and Analysis Program (FIA) was created by Congress in the McSweeney-McNary Forest Research Act of 1928 and amended by the Forest and Rangeland Renewable Resources Planning Act of 1974. The program was initially mandated to determine the extent, condition, volume, growth, and depletions of timber on all forestlands within the United States.

With passage of the 1998 Farm Bill, the program's scope was broadened to include other non-timber attributes, and merge FIA and FHA (Forest Health Monitoring) plots to better evaluate forest health. At the same time, the program was enhanced by changing from a periodic survey to an annual survey, with more analysis and reporting, and easier access to program databases.

### FIA Organization

FIA is divided into four regional work units which are responsible for creating and maintaining the forest inventory for all states included within the region (Figure 1). The States within each regional work unit are divided into survey units, which are typically county groups. The program is managed by Research and Development within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems.

### Survey Design

Frayner and Furnival (1999) described changes in FIA sampling designs and field measurements since the 1930s. Various sampling designs evolved to provide

efficiency and suitability to local conditions while maintaining simplicity and avoiding needless complexity.

The current FIA program utilizes four related surveys: (1) forest monitoring – a three phase sample used to track status and trends in forest extent, cover, growth, mortality, removals, and overall health; (2) ownership study – a questionnaire-based survey of landowner plans, desires, values, and intentions; (3) timber product output – a questionnaire-based survey of wood processing facilities used to track the commercial production of wood products; and (4) utilization studies – studies conducted on logging sites to record how much wood is actually removed during harvest.

The forest monitoring survey uses a three-phase sampling scheme, where phase 1 uses remote sensing for stratification; phase 2 uses ground plots, which are either visited or photo-interpreted and measured for forest and tree information; and phase 3 uses a subset of phase 2 plots, which are sampled for additional health indicator attributes. Phase 2 field sample locations are uniformly distributed on a grid across the landscape with approximately one FIA sample location every 6,000 acres. The grid has 5 interlaced panels, with each panel containing 20% of the FIA plots. Plots in the eastern and western US are re-measured every 7 (15% per year) and 10 (10% per year) years, respectively,

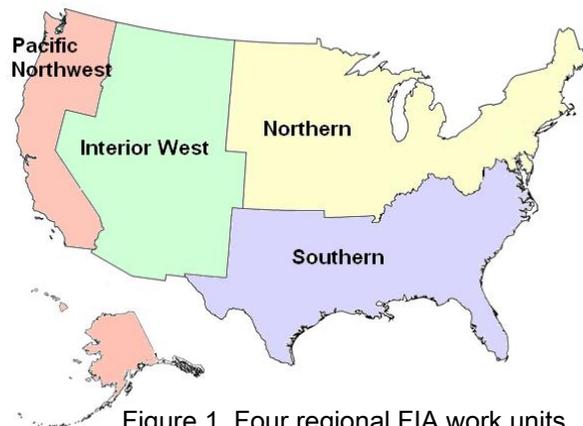


Figure 1. Four regional FIA work units.

using a nationally standardized plot design (Figure 2). The northern and southern work units, however, have reduced their plot re-measurement interval to 5 years (20% per year) through federal-state partnerships. Surveys in all states use common data collection and database management procedures (FIA Program 2007).

### The FIA Database

The FIA database (FIADB) contains nineteen data tables and eleven reference tables from the Phase 1 and 2 portions of the annual forest inventory. Information about the database, including a data dictionary for each table is included in the FIA Database Description and User's Guide (FIA Program 2009).

Data are collected and analyzed by each regional FIA work unit to produce reports at state, regional, and national levels. In addition to published reports, actual data are available in a FIADB version 4.0 Microsoft [Access 2003 database](#) for individuals and organizations conducting their own analyses, and inventory tables and maps can be generated through standard reports and custom retrievals using [online FIA databases and FIDO 2.0](#).

### Data Uses

Rudis (2003) documented previous uses for FIA data, and reported a citation database of more than 1,400 bibliographic entries for studies conducted between 1930 and 1976. Federal and state agencies, universities, forest industry, nongovernment organizations, and others have used FIA data to:

- ◆ Formulate sound forest policy and assess the sustainability of current and past policies.
- ◆ Develop improved forest management plans and evaluate the effects of previous management practices on forestlands.
- ◆ Conduct scientific investigations that involve changes in forest ecosystems over time.
- ◆ Develop business plans that are both economically and ecologically sustainable.
- ◆ Keep the public or clients informed about forest health and sustainability.

Potential uses of FIA data by users outside the FIA community is growing, which can be attributed to new data added to the plot measurements, an expanding database from new and re-measured plots, and the availability of new analysis procedures.

### Data Issues

The FIA Database Description and User's Guide (FIA Program 2009) states that users should acquire a "basic understanding of FIA sampling and estimation procedures to use the FIADB effectively". FORSight Resources has considerable experience working with FIA data and FIA program personnel. Based on our experience and depending on project objectives, potential users should be aware of the significant amount of time that may be required for learning the database.

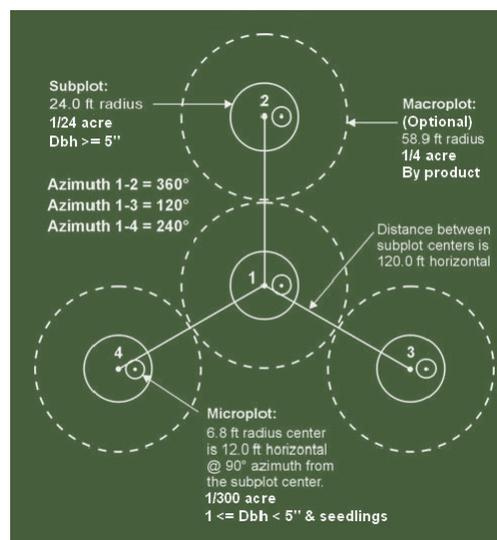


Figure 2. Standardized FIA plot design.

FORSight recently completed a project to estimate volume yields and growth rates for growing stock trees in several geographic regions. The following are examples of data issues that we encountered and successfully solved during the project:

**Condition Class** – In the annual survey, condition class is used to identify changes in land use and vegetation occurring on forested and non-forested lands. For example, differences in reserved status, owner group, forest type, and stand size class define conditions for forested lands. During periodic surveys, sample plots were either moved or subplots were re-arranged such that only one

condition class was sampled. However, plot location and orientation remain fixed for the annual survey. Instead, boundaries are mapped between conditions, with each condition occurring on the plot assigned a condition proportion, and all conditions observed on the plot summing to 1. While mapping conditions provides more information at a finer spatial resolution, producing summaries by condition class is much more cumbersome and time-consuming.

**Defined Population** – FIA inventories are extensive inventories that provide reliable estimates for large areas based on previously defined stand attributes and adjusted expansion factors. For example, the FIA quantifies the changes in growing stock to include both cull increment (growing stock trees re-classified to cull trees) and cull decrement (cull trees re-classified to growing stock trees) trees on re-measured plots. The population and corresponding growth estimates change if growing stock does not include cull increment and decrement trees

To obtain population estimates for any grouping of data, the FIA database stores an adjustment factor for each set of data being compiled. Each time the data are stratified differently, the adjustments and expansion factor may change for each fixed plot size. Depending on project objectives and the population of interest, the user is responsible for assembling the required data, and then applying or calculating the correct expansion factors.

For example, the FIA estimates volume yield and growth including re-measured plot data with reversions (land reverted from a non-forest to a forest use, or from other forest to timberland) and diversions (land diverted from forest to reserved forest, or a non-forest land use). If plots with reversions and diversions are excluded from the population of interest, then growth estimates are calculated by combining plot growth data using the correct weighting factor.

**Tree Volume Estimation** – Different volume equations and estimation procedures are currently adopted by each FIA work unit, with the Lake States

and Northeast using different procedures in the northern unit. The annual FIA database provides individual tree species-specific net merchantable inside-bark ft<sup>3</sup> and bdfv volumes, and inside bark bole weight in green tons. Merchantability specifications (minimum dbh, stump height, and minimum top dob) are fixed by product (total and sawlog) for hardwoods and softwoods. A custom-coded Access VBA program is needed, if a project requires alternative volume equations, additional volume units (e.g., cords and Doyle bdfv), different product specifications, or greater stem taper detail. For example, suppose a private ownership is separated by the Ohio River with forestlands in Ohio and Kentucky, which are located in the northern and southern units, respectively. The FIA database, however, calculates tree volumes differently in each work unit.

**Data privacy** – For this project, two regions were still in the first cycle of the annual inventory, and no data was available from the re-measurement of the annual inventory plots. Therefore, growth could only be estimated based on growth between the last periodic inventory and the first annual inventory. However, the FIA protects the privacy of private landowners when growth estimates are based on less than 3 re-measured sub-cycles. The link between periodic data and the annual data is broken by renumbering all of the existing plots. For this periodic-to-annual re-measurement data, trees from the current inventory can not be associated with the previous periodic inventory, and growth can not be calculated using data downloaded from the FIA website.

Do not despair though! FIA Spatial Data Services does have a process to provide customers with the information needed that does not compromise the security of the plot locations. In our case, FORSight Resources signed a non-disclosure agreement that allowed us to be provided access to the needed re-measurement data.

In conclusion, the USFS FIA program provides some tools for retrieval and summarization of basic FIA data. Often a more detailed analysis is required for woodbasket studies, wood supply/

**FORSight Resources** provides world-class expertise to companies and agencies facing critical natural resource decisions. The company's offerings include forest planning, acquisition due diligence, forest inventory & biometrics, GIS & data services, custom system/application development and hardware/software sales.

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demand studies for timberland owners, or mill location studies for biomass plants. In these cases the analyst must develop a deep understanding of the plot design, database design, tree and plot coding, growth estimation, and volume estimation routines.

#### References

- Forest Inventory and Analysis Program. 2007. Forest inventory and analysis national core field guide Volume I: Field data collection procedures for phase 2 plots (version 4.0). US Department of Agriculture, Forest Service, Washington Office. 224 p. Download the manual by clicking [here](#).
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Autumn comes to a mountain meadow.  
Photo courtesy K.R Walters

Never go to bed mad. Stay up and fight.  
— Phyllis Diller