Forest Inventory and Analysis

Tree Mortality

FIA Fact Sheet Series

Changes over time in the structure of forest resources are largely driven by stand dynamics (rates of regeneration, growth, and mortality), as well as timber removals and changes in land use.

Tree mortality is a normal process that is an important facet of stand dynamics. Information about tree mortality can be used to determine if there are any unusual spatial or temporal patterns in mortality rates; or if the balance between growth and mortality is adequate to sustain a forest ecosystem.

Mortality data contribute to the investigation of several key forest ecosystem attributes such as sustainability, productivity, and aesthetics.

Data Collection. Forest Inventory and Analysis (FIA) maintains a systematic network of permanent ground plots (Figure 1). After initial plot establishment, trees are tracked at subsequent remeasurements until they die or the plot is converted to a nonforest land use. Individual plots are remeasured in cycles of approximately 5-7 years in the eastern U.S., and 10 years in the western U.S.

Trees 1.0-4.9 inches in diameter at breast height (dbh) are measured on 1/300-acre microplots, and trees 5.0-inches dbh and larger are measured on 1/24-acre subplots. As new trees grow into the microplots and subplots, they too are tracked until death. Crews identify which trees have died since the previous inventory with a series of codes used to track tree history. They also record the apparent cause of death.

FIA crews also measure tree heights, which are used in estimates of tree mortality requiring height, such as volume of mortality.

Data Quality. All data are recorded from FIA Phase 2 and Phase 3 ground plots by experienced field personnel, after thorough training and certification.

The main factor affecting the quality of mortality field data is difficulty in determining cause of death. Misclassifications are minimized by audits of field personnel.

Data Analysis. Mortality is commonly expressed in terms of loss of volume or basal area per year. Mortality is usually analyzed at the stand level (e.g., average annual mortality per acre per year); or at the population level (e.g., total annual mortality per year for a given region). Timber removals (cut trees) are not included in mortality estimates. Although removals are estimated in the same manner as mortality, they are reported separately.

Dead trees are sometimes decayed when plots are remeasured, so it is not always possible to measure tree size at the time of death. It is also difficult to pinpoint the time of death. Estimates of tree size at the time of death are thus modeled on the basis of initial tree dbh and height, and mortality trees are "grown" to the midpoint of the measurement cycle. Mortality can thus be expressed as two separate components:

- mortality—the volume of mortality based on dbh at the midpoint of the measurement interval (includes mortality growth).

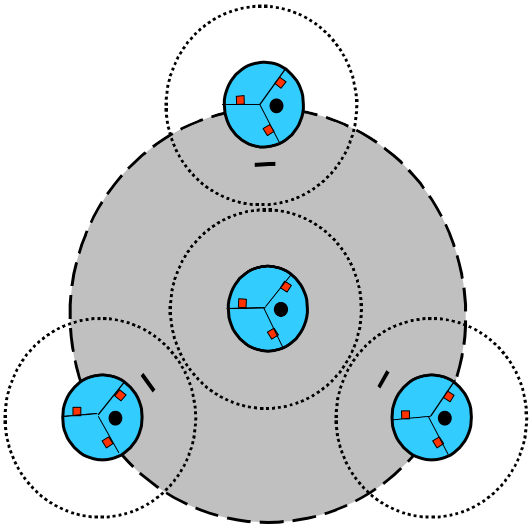
- mortality growth—the estimated growth of mortality trees between time *t* and the midpoint of the measurement interval.

Additional Information. More detailed information regarding FIA mortality and change estimation can be found in Chapter 4 of *Forest Inventory and Analysis National Sample Design and Estimation Procedures*, which is posted on the web site: http://www.srsfia.usfs.msstate.edu/FIA_Internet/statistics_band/stat_documents.htm.

Fact Sheet Author: William A. Bechtold

For more information regarding the FIA Program:
- See our "FIA Contacts" Factsheet
- Visit our web site: http://www.fia.fs.fed.us

Phase 2/Phase 3 Plot Design



Subplot	**24.0 ft (7.32 m) radius**
Microplot	**6.8 ft (2.07 m) radius**
Annular plot	**58.9 ft (17.95 m) radius**
Lichens plot	**120.0 ft (36.60 m) radius**
Vegetation plot	**1.0 m^2 area**
Soil Sampling	**(point sample)**
Down Woody Debris	**24 ft (7.32 m) transects**

Figure 1. FIA field plot design