



Forest Inventory and Analysis

Tree Crown Condition Indicator



FIA Fact Sheet Series

Many physical and biological components influence forest trees. Individual sapling and tree growth and vigor are determined by a variety of physiological and external effects, such as age, available light, water, and nutrients. Since tree crowns are a component of forest ecosystem structure, they directly affect the composition, processes, and vigor of the understory plant and animal components of the forest.

Why is the Crown Indicator Important? Information about crowns can be used to answer questions about forest ecosystems such as:

What proportion of trees (by species and forest type) in a region have more crown dieback or less crown density than normal?

Is there a regional change in the proportion of trees (by species and forest type) that show a change in crown condition?

The crown is one component of net primary production and its dimensions reflect general tree health. Large, dense crowns are associated with potential or previous vigorous growth rates. Small, sparse crowns suggest unfavorable site conditions (such as competition from other trees, moisture stress, or moisture excess) or other influences (such as insect defoliation, foliage diseases, or hail storms). Some changes in crown measurements may be temporary, especially when the stressing condition can be eliminated or reduced. Continued poor conditions however, may be reflected in a tree with increasingly poor vigor.

Tree crown information contributes to the investigation of several key forest ecosystem attributes: biodiversity, productivity,

sustainability, aesthetics, forest environment, and wildlife.

How is the Crown Indicator Measured? Seven measurements are made during crown evaluations:

Uncompacted live crown ratio: estimates the percentage of a tree's height which supports live, green foliage that is contributing to total tree growth.

Crown light exposure: estimates the amount of a tree's foliage receiving direct sunlight.

Crown position: estimates the position of a tree's crown relative to the stand overstory canopy zone

Crown density: estimates the amount of light blocked by branches, reproductive structures, and foliage within a tree's crown.

Crown dieback: estimates recent branch mortality in the upper and outer portions of the live crown.

Foliage transparency: estimates the amount of skylight visible through the live, normally foliated portion of the crown.

Crown vigor: estimates the overall health or general appearance of saplings.

Field personnel receive thorough training and certification at the beginning of each field season. Frequent audits of field personnel are conducted to improve data quality and minimize errors.

Where and When are Crowns Measured? The Crown Indicator measurements are only made on Phase 3 plots, which are a subset of the Phase 2 plots (see "Sampling and Plot Design" and "Phase 2 and Phase 3: Ground Measurements" Fact Sheets"). These measurements, except for crown vigor, are made on all live trees 5.0 inches (12.5 cm) diameter at breast height (*dbh*) [or

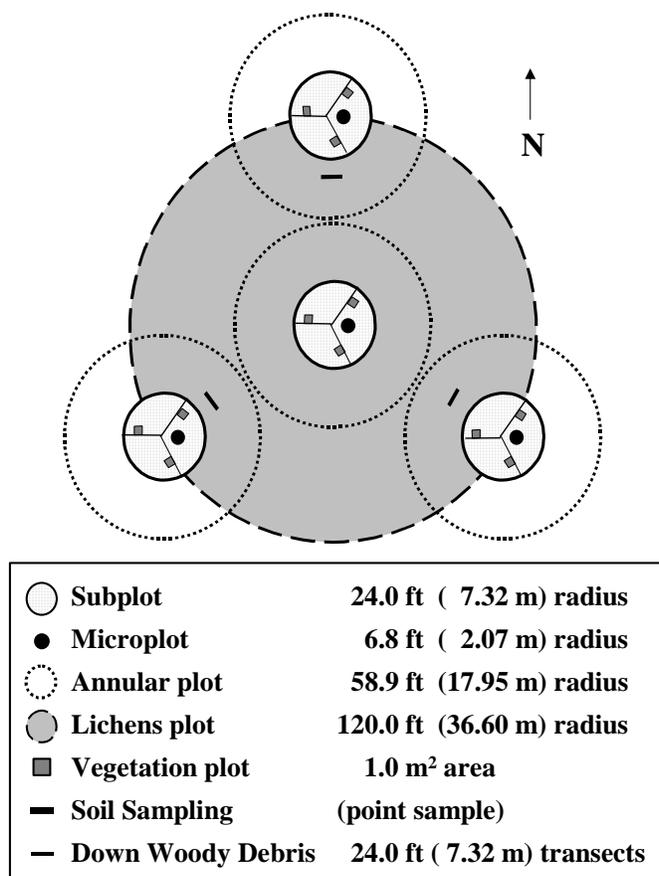
diameter at root collar (*drc*) for woodland species] and larger. The *dbh*, which is used in the calculation of tree growth, is measured at 4.5 feet (1.37 meters) above ground line on the uphill side of trees (*drc* is measured at ground level or just above root collar swelling). Vigor classification, uncompacted live crown ratio, crown light exposure, and crown position estimates are made on saplings (trees from 1.0 to 4.9 inches [2.5 to 12.4 cm] *dbh/drc*) that occur on the microplots (Figure 1). There are four 1/300 acre (1/740 hectare) microplots on each enhanced FIA field plot (Figure 1). FIA field personnel collect crown data during the field season when deciduous trees are foliated. This time period may vary annually, but it typically begins in early June and ends in early Sept.

Are There any Special Concerns When Measuring Crowns? Several environmental and site conditions can affect collection of crown data, including: (1) poor weather conditions such as gusting wind, heavy rain, and dark, overcast skies; (2) steep and/or unstable slopes; (3) dense vegetation under the trees that prohibits free ground movement; and (4) a thick tree canopy directly overhead that obscures full view of the tree. These effects are minimized by careful, thorough training and strict adherence to the data collection procedures.

How can Crown Data be Analyzed? There are three levels of crown indicators being evaluated by the FIA program. As the level increases, the complexity of the indicators also increases.

Level 1 - Absolute crown indicators: uncompacted live crown ratio, crown light exposure, crown position, crown density, crown dieback, foliage transparency, and crown vigor. These indicators consist of the crown measurements described above. They

Figure 1: FIA Plot Design with Phase 3 Measurements



are simple and readily identifiable measures of crown condition.

Level 2 - Crown structure indicators: crown volume and crown surface area. These indicators are computed from the Level 1 indicators and are measures of crown dimension and fullness. Crown diameters are not being measured in the current FIA program. To compute the crown structure indicators at this time, crown diameters are being modelled from previous FHM data sets.

-Crown defoliation indicator: This indicator is computed from the Level 1 indicators (crown density, crown dieback and foliage transparency) and is a measure of the thickness and quantity of foliage in the crown.

Level 3 - Composite crown indicators: composite crown volume and composite crown surface area. These indicators are computed from Level 2 indicators by combining crown structure and crown

defoliation indicators. Crown production efficiency is computed using the composite crown indicators and reflect a tree's potential to capture and utilize solar energy.

Are Related Data Sets Used?

Several data sets are used with enhanced FIA data in crown analyses.

Air quality data are obtained through the National Air Data Branch of the US EPA.

Pest incidence data are obtained from the USDA Forest Service Forest Health Protection units and State Pest Management programs.

Climatic data are obtained from the nearest National Oceanic and Atmospheric Administration weather stations, the National Trade Data Bank, and published scientific literature.

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For more information about the FIA Program:

- Visit our National FIA website: <http://www.fia.fs.fed.us>
- See FIA Field Methods for Phase 3 Measurements, Crown Condition Classification: <http://fia.fs.fed.us/library.htm#Manuals>
- See our "FIA Contacts" Fact Sheet