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North Dakota's Forests, 2005: Statistics, Methods, and Quality Assurance

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Abstract

The first full annual inventory of North Dakota's forests was completed in 2005 after 7,622 plots were selected and 164 forested plots were visited and measured. This report includes detailed information on forest inventory methods and data quality estimates. Important resource statistics are included in the tables. A detailed analysis of the North Dakota inventory is presented in Resource Bulletin NRS-31 (www.nrs.fs.fed.us/pubs/rb/rb_nrs31.pdf).

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FOREST INVENTORY METHODS

Strategic Model

The Forest Inventory and Analysis (FIA) program of the Northern Research Station (NRS) is part of the national enhanced FIA program that focuses on six strategic objectives (McRoberts 2005):

- A standard set of variables with nationally consistent meanings and measurements
- Field inventories of all forested lands
- Nationally consistent estimation
- Adherence to national precision standards
- Consistent reporting and data distribution
- Credibility with users and stakeholders

To ensure that these objectives are achieved, 10 strategic approaches have been prescribed:

- A national set of prescribed core variables with a national field manual that describes measurement procedures and protocols for each variable
- A national plot configuration
- A nationally consistent sampling design
- Estimation using standardized formulae for sample-based estimators
- A national database of FIA data with core standards and user-friendly public access
- A national information management system
- A nationally consistent set of tables with estimates of prescribed core variables
- Publication of statewide tables with estimates of prescribed core variables at 5-year intervals
- Documentation of the technical aspects of the FIA program, including procedures, protocols, and techniques
- Peer review and publication of the technical documentation for general access

The result of this approach is an inventory program with new features and a nationally consistent plot configuration, a nationally consistent sampling design for all lands, annual measurement of a proportion of plots in each state, nationally consistent estimation techniques and algorithms, and integration of the ground-sampling components of the FIA inventory and detection monitoring by the U.S. Forest Service's Forest Health Monitoring (FHM) program.

Plot Configuration

The national FIA plot design (Fig. 1) consists of four circular 24-ft-radius subplots (1/24th acre) configured as a central subplot and three peripheral subplots. Centers of the peripheral subplots are 120 ft from the central subplot and at azimuths of 360°, 120°, and 240° from the center of the central subplot. Trees with a diameter at breast height (d.b.h.) of 5 inches or greater are measured on these subplots. Each subplot contains a circular 6.8-ft-radius microplot (1/300th acre) with the center located 12 ft east of the subplot center on which each tree at least 1 inch but less than 5 inches d.b.h. is measured. Forest conditions having area of 1 acre or greater that occur on any of the four subplots are mapped on the subplot and recorded. Factors that differentiate forest conditions include forest type, stand-size class, stand origin, land use, ownership, and density. Macroplots are not used by NRS-FIA. They have a radius of 58.9 ft and are used for sampling intensification or for sampling relatively rare events. The 1/4-acre macroplot currently is used by the Rocky Mountain and Pacific Northwest Stations' FIA programs to sample large trees.

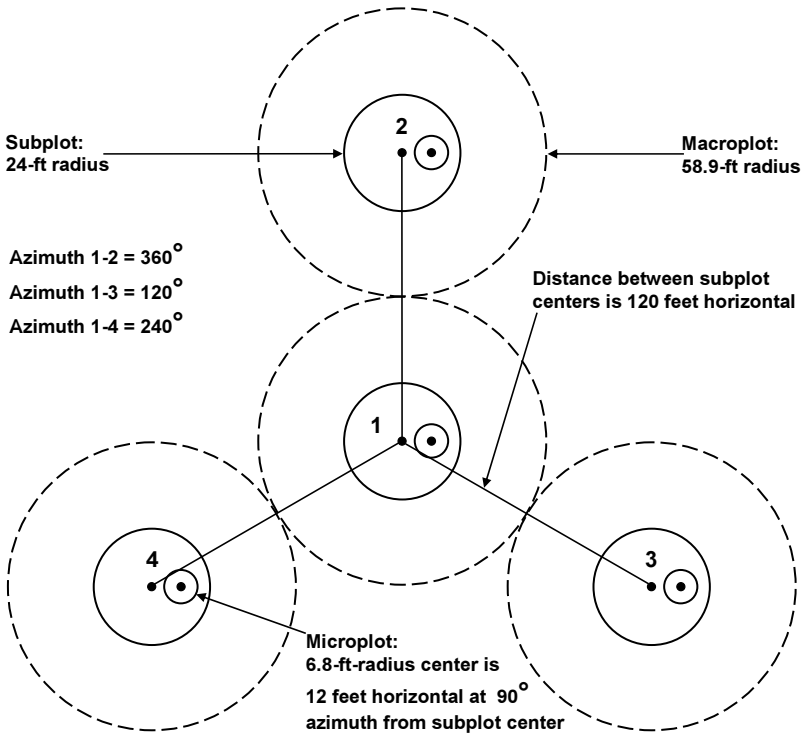

Figure 1.—National FIA plot design (adapted from Bechtold and Patterson 2005).

Sample Design

On the basis of historical sampling errors, a sampling intensity of about one plot per 6,000 acres is necessary to satisfy national FIA precision guidelines. Therefore, FIA divided the area of the United States into nonoverlapping, 5,937-acre hexagons and, for North Dakota, established a plot at a random location in the hexagon. This array of field plots is designated the Federal base sample and is considered an equal probability sample; measurement of the Federal base sample is funded by the Federal Government.

The Federal base sample is divided into five interpenetrating, nonoverlapping panels or subsamples, each of which provides complete, systematic coverage of a state. Each year, plots in a single panel are measured; panels are selected on a 5-year, rotating basis (McRoberts 1999). For estimation purposes, the measurement of each panel of plots is considered an independent, equal probability sample of all lands in a state.

Three-Phase Inventory

FIA conducts inventories in three phases. Remotely sensed data are used in Phase 1 to classify the area in the population of interest, for latter use in the post-stratification process, to increase the precision of estimates. In Phase 2, field crews visit the physical locations of permanent field plots to measure traditional inventory variables such as tree species, diameter, and height. In Phase 3, field crews visit a subset of Phase 2 plots to obtain measurements for an additional suite of variables associated with

forest and ecosystem health. The three phases of the enhanced FIA program as implemented in this inventory are discussed in detail in the sections that follow.

Phase 1

Aerial photographs, digital orthoquads (DOQs: digitally scanned aerial photograph), and satellite imagery are used for initial plot measurement via remotely sensed data and stratification. Phase 1 plot measurement consists of observations of conditions at the plot locations using aerial photographs or DOQs. Analysts determine a digitized geographic location for each field plot and a human interpreter assigns to the plot a land cover/use with primary focus on identifying forest land.[1] All plot locations that could contain forest land are selected for further measurement via field-crew visits in Phase 2.

The combination of natural variability among plots and budgetary constraints prohibits measurement of a sufficient number of plots to satisfy national precision standards for most inventory variables unless the estimation process is enhanced using ancillary data. Thus, the land area is stratified using remotely sensed and other map-based data.

A stratification scheme based on satellite imagery as proposed by Hansen and Wendt (2000) is applied to the National Land Cover Data (NLCD) as suggested by McRoberts et al. (2002). The NLCD is a digital land-cover map of the conterminous United States in which 30- by 30-m pixels are assigned to 21 land-cover classes. This classification was produced by the U.S. Geological Survey and was based on nominal 1992 Landsat 5 Thematic Mapper (TM) satellite imagery and ancillary data (Vogelmann et al. 2001). Four strata are created using a three-step process: 1) aggregate NLCD classes with trees into a forest stratum with the remaining classes into a nonforest stratum; 2) reclassify isolated groups of three or fewer pixels into their surrounding forest or nonforest class to comply with the FIA criterion that forest land must be at least 1 acre; and 3) create two additional classes (forest edge and nonforest edge) that includes all pixels within two pixels of the forest/nonforest boundary.

In addition to classifying every pixel into one of the four strata, every pixel is assigned to an ownership stratum based on the Protected Areas Database (PAD) described by DellaSala et al. (2001). In North Dakota, PAD was used to classify pixels into two ownership classes.

Stratified estimation requires that two tasks be accomplished. First, each plot must be assigned to a single stratum. Next, the proportion of each detailed stratum must be calculated (TM land-cover classification and ownership-group delineation). The first task is accomplished by assigning each plot to the stratum assigned for the pixel containing the center of the center subplot. The second task is accomplished by calculating the proportion of pixels in each stratum. The population estimate for a variable is calculated as the sum across all strata of the product of each stratum's observed proportion (from Phase 1) and the variable's estimated mean per unit area for the stratum (from Phase 2). The stratum assignments used in North Dakota are discussed in the estimation section of this report.

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[1] Lands satisfying FIA's definition of forest land include commercial timberland, some pastured land with trees, forest plantations, unproductive forested land, and reserved, noncommercial forested land. Forest land requires minimum stocking levels, a 1-acre minimum area, and a minimum bole-to-bole width of 120 ft with continuous canopy. Forest land excludes wooded strips and windbreaks less than 120 ft wide and idle farmland or other previously nonforest land that currently is below minimum stocking levels.

Phase 2

In Phase 2, field crews record a variety of data for plot locations determined in Phase 1 to include accessible forest land. Before visiting plot locations, field crews consult county land records to determine the ownership of plots and then seek permission from private landowners to measure plots on their lands. At the plot, field crews determine the location of the geographic center of the center subplot using (GPS) receivers. They record condition-level observations that include land cover, forest type, stand origin, stand age, stand-size class, site-productivity class, history of forest disturbance, and land use for every condition (major land use or forest stand at least 1 acre in size) that occurs on the plot. They also record information on condition boundaries on plots with multiple conditions. For each tree, field crews record a variety of observations and measurements, including condition, species, live/dead status, lean, diameter, height, crown ratio (percentage of tree height represented by crown), crown class (dominant, codominant, suppressed), damage, and decay status. Office staff use statistical models based on field-crew measurements to calculate values for additional variables, including individual-tree volume, per-unit-area estimates of number of trees, volume, and biomass by plot, condition, species group, and live/dead status. Additional information on data collection procedures used in Phase 2 is available at http://www.nrs.fs.fed.us/fia/data-collection/.

Phase 3

The third phase of the enhanced FIA program focuses on forest health. Phase 3 is administered by the FIA program with consultation from other Forest Service programs, other Federal agencies, state natural resource agencies, universities, and the FHM program. The FHM program consists of four interrelated and complementary activities: detection, evaluation, intensive site-ecosystem monitoring, and research on monitoring techniques. Detection monitoring consists of systematic aerial and ground surveys designed to collect baseline information on the current condition of forest ecosystems and to detect changes from those baselines over time. Evaluation studies examine the extent, severity, and probable causes of changes in forest health identified through the detection monitoring surveys. Intensive site-ecosystem monitoring examines regionally specific ecological processes at a network of sites in representative forested ecosystems. Research on monitoring techniques focuses on developing and refining indicator measurements to improve the efficiency and reliability of data collection and analysis at all levels of the program.

The ground-survey portion of the detection-monitoring program was integrated into the FIA program as Phase 3 in 1999. The Phase 3 sample consists of a 1:16 subset of the Phase 2 plots with one Phase 3 plot for about every 95,000 acres. Phase 3 measurements are obtained by field crews during the growing season and include an extended suite of ecological data: lichen diversity and abundance, soil quality (erosion, compaction, and chemistry), vegetation diversity and structure, and down woody material. The incidence and severity of ozone injury for selected bioindicator species also are monitored as part of an associated sampling scheme. All Phase 2 measurements are collected on each Phase 3 plot at the same time as the Phase 3 measurements. Additional information on data-collection procedures used in Phase 3 is available at http://www.nrs.fs.fed.us/fia/topics/.

Phase 3 variables are selected to address specific criteria outlined by the Montreal Process Working Group for the conservation and sustainable management of temperate and boreal forests (Montreal Process 1995) and are based on the concept of indicator variables. Observations of an indicator variable

represent an index of ecosystem functions that can be monitored over time to assess trends. Indicator variables are used in conjunction with each other, Phase 2 data, data from FHM evaluation monitoring studies, and ancillary data to address ecological issues such as vegetation diversity, fuel loading, regional air-quality gradients, and carbon storage. The Phase 2 and 3 data of the enhanced FIA program are a primary source of reporting data for the Montreal Process Criteria.

Estimation

Most of the estimates and analysis of forest resources in this report, including the estimates in Tables 1-20, 31-32, 54-59a, and 65 are based on data collected on the 7,622 Phase 2 plots across North Dakota (Fig. 2). The analysis of forest health issues that relate to down woody materials, soils, ozone damage, and crown condition are based on data collected on the 472 Phase 3 plots (Fig 3).

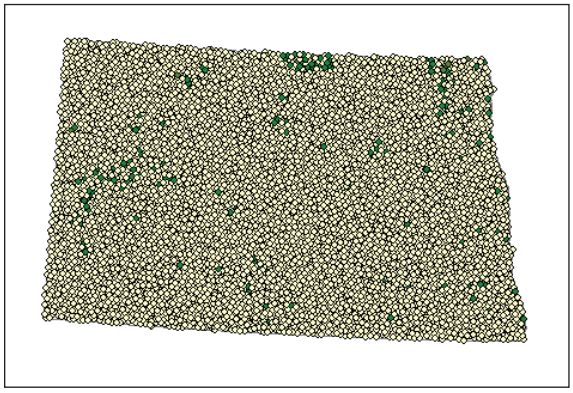

Figure 2.—Approximate location of forest land (green dots) and nonforest land (yellow dots) Phase 2 plots, North Dakota, 2005.

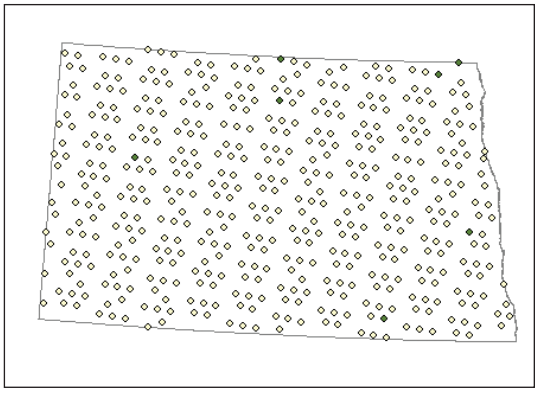

Figure 3.—Approximate location of forest land (green dots) Phase 3 plots and nonforest land (yellow dots) Phase 3, North Dakota, 2005.

About 20 percent of the Phase 2 observations were acquired each year from October 1, 2000 to September 30, 2005. These observations, collectively called the 2005 inventory, are within 20 estimation strata (Table A) defined by combinations of the four Phase 1 classes (nonforest, nonforest edge, forest edge, and forest), a land-ownership classification created from the PAD and county groups. Procedures described in Bechtold and Patterson (2005) for stratified estimation with observed stratum areas were used in conjunction with the strata in Table A to produce all estimates. The total area and number of plots within each stratum is shown in Table A.

Integration with Previous Inventories

In 2005, FIA completed measurement of the fifth panel of inventory plots in North Dakota. The 2005 panel along with those surveyed in 2001, 2002, 2003, and 2004 completed data collection for the fourth inventory of North Dakota's forests (Haugen et al. 2009). Previous inventories of North Dakota's forest resources were completed in 1956, 1980, and 1994 (Warner 1956, Jakes and Smith 1982, and Haugen et al. 1999).

Data from new inventories often are compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the efficiency and reliability

of the inventory, there have been several changes in procedures and definitions since the 1994 North Dakota inventory. These changes will have little impact on statewide estimates of forest area, timber volume, and tree biomass but they may significantly affect plot-classification variables such as forest type and stand-size class.

For consistency, a new, national plot design was implemented by all five regional FIA units in 1999 in which fixed-radius subplots are used exclusively. Prior to the new plot design, (during the 1980 and 1994 inventories) fixed and variable-radius subplots were used. Both designs have strong points but they often produce different classifications for condition characteristics. Procedures for assigning condition attributes such as forest type, stand age, and stocking changed significantly with the introduction of the new annual plot design. However, FIA research (unpublished) comparing these plot designs, showed no noticeable difference in volume and tree-count estimates.

For additional information on the sample protocols and estimation procedures for the first two phases of the FIA program, see Bechtold and Patterson (2005). For additional information on Phase 3 indicator sampling protocols, see USDA Forest Service (2003) and Woodall and Monleon (2008).

Quality of the Estimates

Two general types of error – random variability (precision) and estimation bias (accuracy) – are of interest to users. Random variability refers to the precision of the estimate, which would occur if the entire sampling and estimation process were repeated many times. Estimation bias refers to the difference between the estimate and the "true value" in the absence of this random variability, and to the overestimation or underestimation inherent in the entire estimation process.

Errors in the estimates in this report (both random variability and estimation bias) are affected by various sources. The four primary sources of error common to all sample-based estimates are sampling, measurement, prediction, and nonresponse error. The following sections provide a definition for each source of error in the context of the FIA inventory as well as a discussion of methods used to quantify and/or reduce that source of error. Measures of sampling, measurement, and prediction errors associated with various attributes are presented. Issues of possible bias related to nonresponse also are addressed.

Sampling Error

The process of sampling (selecting a random subset of a population and calculating estimates from this subset) causes estimates to contain error they would not have if every member of the population (e.g., every tree in North Dakota) had been observed and included in the sample. The 2005 State inventory is based on a sample of 7,622 plots located randomly across North Dakota (total area of 45.2 million acres), or a sampling rate of about one plot for every 5,936 acres.

The procedures for statistical estimation outlined in the previous section and described in detail in Bechtold and Patterson (2005) provide the estimates of the population totals and means in this report. Along with every estimate is an associated sampling error that is typically expressed as a percentage of the estimated value (the estimated value plus or minus the sampling error). This sampling error is the primary measure of the reliability of an estimate. We use a sampling error based on one standard error,

that is, the chances are two in three that the results would have been within the limits indicated had a 100-percent inventory been conducted using these methods.

Sampling errors for State-level estimates of the major attributes presented in this report are in Table B. Table 65 presents includes errors for these estimates at the county-group level (counties assigned to each group are listed in the footnote).

Estimates for classifications smaller than the State totals in Table B have larger sampling errors. For example, Table 65 shows that the sampling error for timberland area in any county is higher than that for total timberland area in North Dakota. To compute an approximate sampling error for an estimate that is smaller than a State total, use the following formula:
where:

$$E = \frac{(SE)\sqrt{(\text{State total estimate})}}{\sqrt{(\text{Smaller estimate})}} \qquad (1)$$

E = approximate sampling error for smaller estimate
SE = sampling error for State total estimate (percent)

For example, to compute the error on the area of forest land in the oak/hickory forest-type group for the State, proceed as follows:
The total area of the oak/hickory group in the State (from Table 3) is 156,200 acres.
The total area of all forest land in the State (from Table 3) is 724,200 acres.
The State total error for forest-land area (from Table B) is 7.34 percent.
Using formula (1):

$$\text{Sampling error} = E = (7.34)\sqrt{724200}\,/\sqrt{156200} = 15.8 \text{ percent.}$$

This approximation works well for estimates of area, volume, number of trees, and biomass. Individuals seeking more accurate sampling errors should use the estimation tools available at http://fia.fs.fed.us/tools-data/.

The estimators used by FIA are unbiased under the assumptions that the sample plots are a random sample of the total population, and that the observed value for any plot is the true value for that plot. Deviations from these basic assumptions are not reflected in the computation of sampling errors. The following sections on measurement, prediction, and nonresponse error address possible departures from these basic assumptions.

Measurement Error

Errors associated with the methods and instruments used to observe and record the sample attributes are called measurement errors. On FIA plots, attributes such as the diameter and height of a tree are measured with different instruments; other attributes such as species and crown class are observed without the aid of an instrument. On a typical FIA plot, 15 to 50 trees are observed with 15 to 20 attributes recorded on each tree. Also, many attributes that describe the plot and conditions on the plot

are observed. Errors in any of these observations affect the quality of the estimates. If a measurement is biased (such as tree diameter consistently taken at an incorrect place on the tree) the estimates that use this observation (such as volume) will reflect this bias.

To ensure that all FIA observations are made to the highest standards possible, a regular program of quality control and quality assurance is an integral part of all FIA data-collection efforts. This program begins with the documentation of protocols and procedures used in the inventory followed by extensive crew training. To assess the quality of the data collected by these trained crews, a random sample of at least 4 percent of all plots is measured independently by a different qualified crew. These independent measurements are called blind checks. A second measurement on blind check plots is made by a quality assurance (QA) crew. QA crews have as much or more experience and training in FIA field measurements as that of a standard FIA crew.

The quality of field measurements is assessed nationally through a set of measurement quality objectives (MQOs) that are set for every data item collected. Each MQO consists of two parts: a tolerance or acceptable level of measurement error and an objective in terms of the percentage of measurements within tolerance. Blind check measurements are used to observe how often individual field crews are meeting these objectives and to assess the overall compliance among all crews. Table C shows the compliance rates for various measurements used to compute the estimates included in this and in other FIA reports. The column labeled "North Dakota" is based on blind check measurements of plots used in this report. The column labeled "Plains States" includes all measurements by FIA crews within North Dakota, South Dakota, Nebraska, and Kansas. Data in the columns labeled "North Central States" were derived from measurements by FIA crews from 2000 through 2008 within an 11-state area (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin). Training and supervision of crews is a regional effort and crews often work in more than one state. Regional data-quality observations reflect the overall measurement quality of all data collected by FIA in the Northern States.

In North Dakota, variables such as diameter at breast height have a low tolerance (± 0.1 inch) and a high percentage of data within the tolerance (91.2 percent). Measurements for determining tree-size class are precise. By contrast, variables such as stand age have a larger tolerance (± 10 years) and fewer data within the tolerance (40.0 percent). The estimate of stand age is based on the composition of all age classes within a stand. Often, a stand is heterogeneous by age but a single value must be assigned to it. This can confound analysis of stand age over time.

Blind check observations also were used to test for relative bias in the field-crew measurements. Relative bias is defined here as a tendency for standard measurements by field-crews to be higher or lower than measurements by QA crews. The estimated relative bias and limits of 95-percent confidence intervals (based on parametric bootstrap estimates) for the relative bias are presented in Table D. Relative bias is reported only for variables that are measurements of continuous attributes (e.g., diameter and height) and several coded variables that are ordinal in nature (e.g., crown position). Relative bias is not appropriate for most coded variables.

Blind check measurements do not provide direct observations of true bias in field measurements (average difference between field measurements and true values) because they are paired observations of

two field measurements. The QA crew in these blind checks typically has more training and experience with FIA field measurements than the first crew, but both crews use the same methods and instruments to obtain measurements. These methods have been identified as the best available and selected for nationwide use by FIA, and are commonly used by similar natural-resource inventories. A basic assumption is that when applied correctly these methods provide unbiased observations of the attribute they are designed to measure. Under this assumption, relative bias observations in Table D provide observations of bias due to the difference in experience and training between the field and QA crews. In most cases, there is no significant bias.

Prediction Error

Errors associated with mathematical models (such as volume models) aimed at providing observations of the attributes of interest based on sample attributes are called prediction errors. Area, number of trees, volume, biomass, growth, removals, and mortality are the primary attributes of interest in this report. Estimates of area and number of trees are based on direct observation and do not rely on prediction models. Models are used to predict volume and biomass estimates for individual trees. Change estimates such as growth, mortality, and removals are based on these model-based predictions of volume from both the current plot measurements and the measurements taken in the previous inventory.

Estimates of prediction errors associated with volume models used in this report are presented by Hahn and Hansen (1991) along with the model forms, methods used in model development, and model-parameter estimates. The estimated prediction errors are based on observations of 10,453 trees measured in the 1989 Missouri inventory (Spencer et al. 1992). For gross cubic-foot volume in live trees, there was a 2.5 percent overprediction across all species, an underprediction of 4.3 percent in trees less than 10 inches in d.b.h., and an overprediction of 7.1 in trees 20 inches and larger in d.b.h. Prediction errors were similar for board foot estimates.

In comparing FIA estimates with those from other data sources, users should be aware of the prediction models used in both estimates. If both estimates are based on the same prediction models with matching fitted-parameter values, the prediction bias of one estimate should cancel out that of the other estimate. If the estimates are based on different prediction models, the prediction error of both models must be considered.

Nonresponse Error

Nonresponse error occurs when crews are unable to measure a plot (or a portion of a plot) at a selected location. Nonresponse falls into three classes:

- Denied access – Entire plots or portions of plots where the field crew is unable to obtain permission from the landowner to measure trees on the plot.
- Hazardous/inaccessible – Entire plots or portions of plots where conditions prevent a crew from safely accessing the plot or measuring trees on the plot.
- Other – Plots on which the field crew is unable to obtain a valid measurement for reasons other than those stated.

Nonresponse has two effects on the sample: it reduces the sample size, which is reflected in the sampling errors, and it can bias the estimates if the portion of the population not being sampled differs from the portion being sampled.

In FIA, nonresponse rates are relatively low. In the 2005 North Dakota inventory, 7,622 sample plots were selected for observation. All but 27 of these plots were included in the sample used to estimate current resources. On 26 plots, crews were unable to obtain owner permission to measure the plot or part of the plot; hazardous conditions on 1 plot prevented the crew from measuring all or part of the plot.

Even an overall nonresponse rate of 1 percent can cause considerable bias if not properly accounted for. The major source of nonresponse is denied access to plots, which occurs primarily on lands in private ownership. Also, observations for plots on nonforest land and water classes rarely require crews to physically enter the area. Nor is permission needed because the observation can be obtained from aerial photos or other sources of remotely sensed information.

The stratified estimation process used by FIA with strata defined by two ownership classes (private and public) and four Landsat TM forest cover classes (nonforest, nonforest edge, forest edge, and forest) reduces the possible effects of bias caused by nonresponse. Under the stratified estimation process used by FIA, nonresponses are removed from the sample, and stratum estimates (means, totals, and sampling errors) are obtained only from plots with valid observations. The net effect in the estimates of means and totals is that the average of the observed plots within the stratum (ownership-forest-cover class) becomes the estimate for all nonresponses within that stratum. The nonresponse rate in one stratum does not affect the estimate in other strata. The response rate within each stratum for the North Dakota 2005 inventory is presented in Table A.

In Table 1 of this report, we acknowledge denied access and hazardous as two land classes in North Dakota within which we are unable to provide estimates for variables such as forest area and timber volume. However, we do report the total estimated area in each of these classes. In all other tables of this report, we do not acknowledge either of these classes, and in the estimation process we treat the sample where we do have observations as a random sample of the entire State.

The nonresponse plots in this inventory were not permanently removed from the FIA system of plots. We will attempt to measure these plots in future inventories. At that time we may be able to obtain permission to access these plots, hazardous conditions may have changed, and/or other circumstances that caused us to drop plots from a specific inventory cycle may well change.

GLOSSARY

Average annual mortality: The average annual change in mortality of trees during the period between inventories. This estimate can be provided in cubic feet for live and growing-stock trees that died or in board feet for sawtimber trees that died.

Average annual net growth: The average annual change in the volume of trees during the period between inventories. Components include the change in volume of trees that have met the minimum size requirements over the inventory period, plus the volume of trees reaching the minimum size during the period (ingrowth), minus the volume of trees that died during the period, minus the volume of cull during the period. Mortality removals (trees killed in the harvesting process and left on site) and diversion removals (trees removed from the forest-land base due to a change from forest to nonforest land) are not included. This estimate can be provided in cubic feet for live and growing-stock trees or in board feet for sawtimber trees.

Average annual removals: The average annual change in removals of trees during the period between inventories. The estimate includes harvest removals, mortality removals (trees killed in the harvesting process and left on site), and diversion removals (trees removed from the forest-land base due to a change from forest to nonforest land). This estimate can be provided in cubic feet for live and growing-stock trees or in board feet for sawtimber trees.

Basal area: Tree area in square feet of the cross section at breast height of a single tree. When the basal areas of all trees in a stand are summed, the result usually is expressed as square feet of basal area per acre.

Bioindicator species: A tree, woody shrub, or herb species that responds to ambient levels of ozone pollution with distinct visible foliar symptoms that are easy to diagnose.

Biomass: The aboveground volume of live trees (including bark but excluding foliage) reported in dry tons (dry weight). Biomass has four components:

Bole: Biomass of a tree from 1 foot above the ground to a 4-inch top outside bark or to a point where the central stem breaks into limbs.

Tops and limbs: Total biomass of a tree from a 1-foot stump minus the bole.

1-to 5-inch trees: Total aboveground biomass of a tree from 1 to 5 inches in d.b.h.

Stump: Biomass of a tree 5 inches d.b.h. and larger from the ground to a height of 1 foot.

Bulk density: The mass of soil per unit volume. A measure of the ratio of pore space to solid materials in a given soil. It is expressed in units of grams per cubic centimeter of oven dry soil.

Coarse woody debris (CWD): Dead branches, twigs, and wood splinters 3.0 inches in diameter and larger measured at the smallest end.

Commercial species: Tree species suitable for industrial wood products.

Compacted live crown ratio: The percent of the total length of the tree that supports a full, live crown. To determine compacted live crown ratio for trees that have uneven length crowns, lower branches are visually transferred to fill holes in the upper portions of the crown, until a full, even crown is created.

Corporate: An ownership class of private lands owned by corporations.

County and municipal: An ownership class of public lands owned by counties or local public agencies, or lands leased by these governmental units for more than 50 years. Also known as local government.

Cropland: Land under cultivation within the last 24 months, including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, active Christmas tree plantations indicated by annual shearing, nurseries, and land in soil improvement crops but excluding land cultivated in developing improved pasture.

Crown: The part of a tree or woody plant bearing live branches or foliage.

Crown dieback: Recent mortality of branches with fine twigs, which begins at the terminal portion of a branch and proceeds toward the trunk. Dieback is considered only when it occurs in the upper and outer portions of the tree. When whole branches are dead in the upper crown, without obvious signs of damage such as breaks or animal injury, it is assumed the branches died from the terminal portion of the branch. Dead branches in the lower portion of the live crown are assumed to have died from competition and shading.

Cull tree: A live tree, 5.0 inches in d.b.h. or larger, that is unmerchantable for saw logs now or prospectively because of rot, roughness, or species (see definitions for rotten and rough trees).

Decay class: Qualitative assessment of stage of decay (5 classes) of coarse woody debris based on visual assessments of color of wood, presence/absence of twigs and branches, texture of rotten portions, and structural integrity.

Diameter class: A classification of trees based on diameter outside bark measured at breast height (4-1/2 feet above ground). D.b.h. is the common abbreviation for "diameter at breast height." With 2-inch diameter classes, the 6-inch class, for example, includes trees 5.0 through 6.9 inches d.b.h. A "diameter at root collar" or d.r.c. measurement is acquired for multi-stemmed woodland species (e.g., Rocky Mountain juniper).

Down woody material (DWM): Woody pieces of trees and shrubs that have been uprooted (no longer supporting growth) or severed from their root system, not self-supporting, and lying on the ground.

Duff: A soil layer dominated by organic material derived from the decomposition of plant and animal litter and deposited on either an organic or a mineral surface. This layer is distinguished from the litter layer in that the original organic material has undergone sufficient decomposition that the source of this material (e.g., individual plant parts) no longer can be identified.

Effective cation exchange capacity (ECEC): The sum of cations that a soil can adsorb in its natural pH. It is expressed in units of centimoles of positive charge per kilogram of soil.

Federal: An ownership class of public lands owned by the U.S. Government.

Fiber products: Products derived from wood and bark residues, such as pulp, composition board products, and wood chips.

Fine materials: Wood residues not suitable for chipping, such as planer shavings and sawdust.

Fine woody debris (FWD): Dead branches, twigs, and wood splinters 0.1 to 2.9 inches in diameter.

Forest land: Land at least 10-percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10-percent stocked with trees and forest areas adjacent to urban and builtup lands. Also included are pinyon-juniper and chaparral areas in the West and afforested areas. The minimum area for classification of forest land is 1 acre and 120 feet wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide.

Forest type: A classification of forest land based on the species presently forming a plurality of the live-tree stocking. If softwoods predominate (50 percent or more), then the forest type will be one of the softwood types and vice versa for hardwoods. For the Eastern United States, there are mixed hardwood-pine forest types when the pine and/or redcedar (either eastern or southern) component is between 25 and 49 percent of the stocking. If the pine/redcedar component is less than 25 percent of the stocking, then one of the hardwood forest types is assigned.

Forest-type group: Combinations of forest types that share closely associated species or site requirements and are generally combined for brevity of reporting.

Growing stock: A classification of timber inventory that includes live trees of commercial species meeting specified standards of quality or vigor. Rough and rotten cull trees are excluded. When associated with volume, this includes only trees 5.0 inches d.b.h. and larger.

Hardwood: A dicotyledonous tree, usually broad-leaved and deciduous.

Soft hardwoods: A category of hardwood species with wood generally of low specific gravity (less than 0.5). Notable examples include cottonwood, quaking aspen, and boxelder.

Hard hardwoods: A category of hardwood species with wood generally of high specific gravity (greater than 0.5). Notable examples include bur oak and green ash.

Industrial wood: All commercial roundwood products except fuelwood.

Land area: The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, estuaries, and canals less than 200 feet wide; and lakes, reservoirs, and ponds less than 4.5 acres in area.

Litter: Undecomposed or only partially decomposed organic material that can be readily identified (e.g., plant leaves, twigs).

Live cull: A classification that includes live, cull trees. When associated with volume, it is the net volume in live, cull trees that are 5.0 inches d.b.h. and larger.

Local government: An ownership class of public lands owned by counties or local public agencies, or lands leased by these governmental units for more than 50 years. Also known as county and municipal.

Logging residues: The unused portions of growing-stock and nongrowing-stock trees cut or killed by logging and left in the woods.

Merchantable: Refers to a pulpwood or saw log section that meets pulpwood or saw log specifications, respectively.

National Forest: An ownership class of Federal lands, designated by executive order or statute as National Forests or purchase units, and other lands under the administration of the Forest Service, including experimental areas.

Net volume in cubic feet: The gross volume in cubic feet less deductions for rot, roughness, and poor form. Volume is computed for the central stem from a 1-foot stump to a minimum 4.0-inch top diameter outside bark, or to the point where the central stem breaks into limbs.

Noncommercial species: Tree species of typically small size, poor form, or inferior quality, which normally do not develop into trees suitable for industrial wood products.

Noncorporate private: Nongovernmental conservation and natural resource organizations; unincorporated local partnerships, associations, and clubs; and Native American communities.

Nonforest land: Land that has never supported forests and lands formerly forested where use of timber management is precluded by development for other uses. (Note: Includes area used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 4.5-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., must be more than 1 acre in area to qualify as nonforest land.)

Nonstocked areas: Timberland less than 10-percent stocked with live trees.

Other red oaks: A group of species in the genus *Quercus* that includes scarlet oak, northern pin oak, southern red oak, bear oak, shingle oak, laurel oak, blackjack oak, water oak, pin oak, willow oak, and black oak.

Other white oaks: A group of species in the genus *Quercus* that includes overcup oak, chestnut oak, and post oak.

Ownership: The property owned by one ownership unit.

Ownership unit: A classification of ownership encompassing all types of legal entities having an ownership interest in land, regardless of the number of people involved. A unit may be an individual, a combination of persons; a legal entity such as a corporation, partnership, club, or trust, or a public agency. An ownership unit has control of a parcel or group of parcels of land.

Ozone: A regional, gaseous air pollutant produced primarily through sunlight-driven chemical reactions of nitrogen dioxide and hydrocarbons in the atmosphere and causing foliar injury to deciduous trees, conifers, shrubs, and herbaceous species.

Ozone bioindicator site: An open area used for ozone injury evaluations on ozone-sensitive species. The area must meet certain site selection guidelines on size, condition, and plant counts to be used for ozone injury evaluations in FIA.

Physiographic class: A measure of soil and water conditions that affect tree growth on a site. The physiographic classes are as follows:

Xeric: Very dry soils where excessive drainage seriously limits both growth and species occurrence. These sites are usually on upland and upper half slopes.

Xeromesic: Moderately dry soils where excessive drainage limits growth and species occurrence to some extent. These sites are usually on the lower half slopes.

Mesic: Deep, well-drained soils. Growth and species occurrence are limited only by climate. These include all cove sites (small sheltered bays) and bottomlands (low land) along intermittent streams.

Hydromesic: Moderately wet soils where insufficient drainage or infrequent flooding limits growth and species occurrence to some extent.

Hydric: Very wet sites where excess water seriously limits both growth and species occurrence.

Poletimber trees: Live trees at least 5.0 inches in d.b.h. but smaller than sawtimber trees.

Primary wood-using mill: A mill that converts roundwood products into other wood products. Common examples are sawmills that convert saw logs into lumber and pulpmills that convert pulpwood into wood pulp.

Productivity class: A classification of forest land in terms of potential annual cubic-foot volume growth per acre at culmination of mean annual increment in fully stocked natural stands.

Pulpwood: Roundwood, whole-tree chips, or wood residues used for the production of wood pulp.

Reserved forest land: Forest land withdrawn from timber utilization through statute, administrative regulation, or designation without regard to productive status.

Residues: Bark and woody materials that are generated in primary wood-using mills when roundwood products are converted to other products. Examples include slabs, edgings, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and pulp screenings. Includes bark residues and wood residues (both coarse and fine materials) but excludes logging residues.

Rotten tree: A live tree of commercial species that does not contain a saw log now or prospectively primarily because of rot (that is, when rot accounts for more than 50 percent of the total cull volume).

Rough tree: (a) A live tree of commercial species that does not contain a saw log now or prospectively primarily because of roughness (that is, when sound cull due to such factors as poor form, splits, or cracks accounts for more than 50 percent of the total cull volume) or (b) a live tree of noncommercial species.

Roundwood products: Logs, bolts, and other round timber generated from harvesting trees for industrial or consumer use.

Salvable dead tree: A downed or standing dead tree considered currently or potentially merchantable by regional standards.

Saplings: Live trees 1.0 inch through 4.9 inches d.b.h.

Saw log: A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, and with a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods, or meeting other combinations of size and defect specified by regional standards.

Sawtimber tree: A live tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume: Net volume of the saw log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise), from stump to a minimum 7.0 inches top d.o.b. for softwoods and a minimum 9.0 inches top d.o.b. for hardwoods.

Seedlings: Live trees less than 1.0 inch d.b.h. and at least 1 foot in height.

Select red oaks: A group of species in the genus *Quercus* that includes cherrybark oak, northern red oak, and Shumard oak.

Select white oaks: A group of species in the genus *Quercus* that includes white oak, swamp white oak, bur oak, swamp chestnut oak, and chinkapin oak.

Site index: An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Snag: A standing dead tree. In the current inventory, a snag must be 5.0 inches d.b.h./d.r.c. and 4.5 feet tall, and have a lean angle less than 45 degrees from vertical. A snag may be either self-supported by its roots, or supported by another tree or snag.

Softwood: A coniferous tree, usually evergreen, having needles or scale-like leaves.

Soil order: The broadest category or class of soil based largely on the processes that formed the soil as indicated by the presence or absence of diagnostic horizons or layers.

Sound dead: The net volume in salvable dead trees.

Stand: A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-size class: A classification of forest land based on the size class of live trees in the area. The classes are as follows:

Nonstocked: Forest land stocked with less than 10 percent of full stocking with live trees. Examples are recently cutover areas or recently reverted agricultural fields.

Seedling-sapling: Forest land stocked with at least 10 percent of full stocking with live trees with half or more of such stocking in seedlings or saplings or both.

Poletimber: Forest land stocked with at least 10 percent of full stocking with live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of poletimber exceeds that of sawtimber.

Sawtimber: Forest land stocked with at least 10 percent of full stocking with live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

State: An ownership class of public lands owned by states or lands leased by states for more than 50 years. Also a general reference to one of the political and geographic subdivisions of the United States.

Stocking: The degree of occupancy of land by trees, measured by basal area or number of trees by size and spacing, or both, compared to a stocking standard; that is, the basal area or number of trees, or both, required to fully utilize the growth potential of the land.

Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Timber products output: All timber products cut from roundwood and byproducts of wood manufacturing plants. Roundwood products include logs, bolts, or other round sections cut from growing-stock trees, cull trees, salvable dead trees, trees on nonforest land, noncommercial species, sapling-size trees, and limbwood. Byproducts from primary manufacturing plants include slabs,

edging, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and screenings of pulpmills that are used as pulpwood chips or other products.

Tree: A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 3.0 inches, a more or less definitely formed crown of foliage, and a height of at least 15 feet at maturity.

Tree size class: A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Tops: The wood of a tree above the merchantable height (or above the point on the stem 4.0 inches diameter outside bark (d.o.b.) or to the point where the central stem breaks into limbs). It includes the usable material in the uppermost stem.

Urban forest land: Land that would otherwise meet the criteria for timberland but is in an urban-suburban area surrounded by commercial, industrial, or residential development and not likely to be managed for the production of industrial wood products on a continuing basis. Wood removed would be for land clearing, fuelwood, or esthetic purposes. Such forest land may be associated with industrial, commercial, residential subdivision, industrial parks, golf course perimeters, airport buffer strips, and public urban parks that qualify as forest land.

Unreserved forest land: Forest land not withdrawn from harvest by statute or administrative regulation. This includes forest lands that are not capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands.

Veneer log: A roundwood product from which veneer is sliced or sawn and that usually meets certain standards of minimum diameter and length and maximum defect.

Weight: The weight of wood and bark, oven-dry basis (approximately 12 percent moisture content).

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Table A.—Area and number of plots in each stratum, North Dakota, 2005

County group[a]	Ownership layer[b]	Classified NLCD layer[c]	Area[d] (acres)	Selected[e]	Nonforest office plots[f]	Field check plots[g]	Field check plots measured[h]	Forest plots measured[i]	Denied access	Hazardous
Devils Lake & James River	Private	Forest and forest edge	73,888	11	7	4	4	4	0	0
Devils Lake & James River	Private	Nonforest	6,218,761	1,054	1,044	10	10	3	0	0
Devils Lake & James River	Private	Nonforest edge	169,722	25	23	2	2	2	0	0
Missouri River	Private	Forest	85,546	12	8	4	4	3	0	0
Missouri River	Private	Forest edge	879,177	150	137	13	11	9	2	0
Missouri River	Private	Nonforest	17,314,933	2,945	2,892	53	42	18	11	0
Missouri River	Private	Nonforest edge	1,746,841	285	264	21	18	12	4	0
Red River	Private	Forest and forest edge	172,771	33	9	24	21	19	3	0
Red River	Private	Nonforest	9,467,070	1,590	1,554	36	35	14	1	0
Red River	Private	Nonforest edge	291,476	46	25	21	19	14	2	0
Souris River	Private	Forest	88,829	9	1	8	7	6	1	0
Souris River	Private	Forest edge	193,358	33	21	12	12	11	0	0
Souris River	Private	Nonforest	6,305,023	1,058	1,045	13	12	6	1	0
Souris River	Private	Nonforest edge	269,651	52	38	14	13	8	1	0
Total private			43,277,046	7,303	7,068	235	210	129	26	0
Devils Lake & James River	Public	All	135,742	23	22	1	1	1	0	0
Missouri River	Public	Forest and forest edge	279,663	48	42	6	6	4	0	1
Missouri River	Public	Nonforest	725,375	105	98	7	7	5	0	0
Missouri River	Public	Nonforest edge	482,328	78	61	17	17	13	0	0
Red River	Public	All	161,941	32	28	4	4	3	0	0
Souris River	Public	All	184,787	33	23	10	10	9	0	0
Total public			1,969,836	319	274	45	45	35	0	1
State total			45,246,882	7,622	7,342	280	255	164	26	1

Continued

Table A.—continued

Table A—Footnote

[a] County group – The following table lists the counties in each group used to define the estimation strata.

Devils Lake	Missouri		River Red River		Souris River
Benson	Adams	McKenzie	Barnes	Traill	Bottineau
Dickey	Billings	McLean	Cass	Walsh	Burke
Foster	Bowman	Mercer	Cavalier		Divide
LaMoure	Burleigh	Morton	Eddy		McHenry
Ramsey	Dunn	Mountrail	Grand Forks		Pierce
Stutsman	Emmons	Oliver	Griggs		Renville
Towner	Golden Valley	Sheridan	Nelson		Rolette
Wells	Grant	Sioux	Pembina		Ward
	Hettinger	Slope	Ransom		
	Kidder	Stark	Richland		
	Logan	Williams	Sargent		
	McIntosh		Steele		

[b] Ownership layer – Classification based on Protected Areas Database.

[c] Classified NLCD layer – Classification based on the 1992 NLCD classification and 2-pixel edge zones.

[d] Area (Acres) – Total area defined by intersection of ownership and classified NLCD layers within group of counties specified.

[e] Selected – Total number of plots selected to be sampled.

[f] Nonforest office plots – Selected plots whose observed classification as nonforest based on examination of aerial photographs and/or digital orthoquads.

[g] Field check plots – Selected plots that required field measurement.

[h] Field check plots measured – Field check plots where measurement was completed successfully. Excludes plots that were denied access, hazardous, or lost and measurement was not possible.

[i] Forest plots measured – Field check plots where forest condition was present on plot and measurement was completed in 2004 inventory. These plots are used to estimate current conditions, e.g., area, volume, number of trees, and biomass.

Table B.—State-level estimates of major forest resource attributes and their sampling errors, North Dakota, 2005

Item	State total	Sampling error
Growing stock on timberland	*thousand cubic feet*	*percent*
Volume	366,873	15.91
Sawtimber on timberland	*thousand board feet*[a]	
Volume	1,122,234	1.07
Area:	acres	
Forest land	724,162	7.34
Timberland	533,668	8.67
Biomass (aboveground live trees)	*thousand dry tons*	
Forest land	18,477	9.55
Timberland	15,304	11.18

[a] International ¼-inch rule

Table C.—Measurement quality objective (MQO) tolerance compliance based on blind check plots, North Dakota, 2005

Variable	Tolerance	Objective	North Dakota		Plains States		North Central States	
			Data within tolerance	Records	Data within tolerance	Records	Data within tolerance	Records
Plot Level								
National Variables								
Distance to Road	No Tolerance	90.0%	100.0%	8	69.4%	85	82.0%	1,677
Water on Plot	No Tolerance	90.0%	100.0%	8	85.9%	85	87.8%	1,677
Regional Variables								
ELEVATION_GPS	±50 ft	99.0%	85.7%	7	72.2%	79	83.0%	1,528
LAT_DECIMAL_DEG	±0.0001 dg	99.0%	85.7%	7	93.8%	81	92.0%	1,538
LON_DECIMAL_DEG	±0.0001 dg	99.0%	100.0%	7	93.8%	81	90.6%	1,538
LAT_FEET	±140 ft		100.0%	7	98.8%	81	98.6%	1,538
LON_FEET	±140 ft		100.0%	7	97.5%	81	97.7%	1,538
	Results for			8 Plots		85 Plots		1,677 Plots
Condition Level								
National Variables								
Condition Status	No Tolerance	99.0%	97.1%	35	98.2%	217	99.0%	2,595
Reserve Status	No Tolerance	99.0%	97.1%	35	98.6%	217	99.4%	2,595
Owner Group	No Tolerance	99.0%	100.0%	5	92.0%	75	98.2%	1,810
Forest Type (Type)	No Tolerance	95.0%	100.0%	5	70.7%	75	82.7%	1,810
Forest Type (Group)	No Tolerance	99.0%	100.0%	5	82.7%	75	90.4%	1,810
Stand Size	No Tolerance	99.0%	40.0%	5	73.3%	75	87.0%	1,810
Regeneration Status	No Tolerance	99.0%	100.0%	5	98.7%	75	98.6%	1,810
Tree Density	No Tolerance	99.0%	100.0%	5	92.0%	75	96.9%	1,810
Owner Class	No Tolerance	99.0%	100.0%	5	88.0%	75	95.6%	1,810
Owner Status	No Tolerance	99.0%	100.0%	5	100.0%	75	98.0%	1,810
Regeneration Species	No Tolerance	99.0%	100.0%	5	98.7%	75	98.4%	1,810
Stand Age	±10 %	95.0%	40.0%	5	50.7%	75	68.1%	1,810
Disturbance 1	No Tolerance	99.0%	80.0%	5	76.7%	73	93.1%	1,796
Disturbance Year 1	±1 yr	99.0%	.	.	62.5%	16	74.2%	62
Disturbance 2	No Tolerance	99.0%	0.0%	1	82.1%	28	93.1%	175
Disturbance Year 2	±1 yr	99.0%	.	.	50.0%	2	33.3%	3
Disturbance 3	No Tolerance	99.0%	100.0%	1	100.0%	6	92.9%	14
Disturbance Year 3	±1 yr	99.0%	.	.	.	.	.	.
Treatment 1	No Tolerance	99.0%	100.0%	5	86.3%	73	95.2%	1,796

Continued

Table C.—continued

Variable	Tolerance	Objective	North Dakota		Plains States		North Central States	
			Data within tolerance	Records	Data within tolerance	Records	Data within tolerance	Records
Treatment Year 1	±1 yr	99.0%	.	.	100.0%	4	93.7%	111
Treatment 2	No Tolerance	99.0%	.	.	100.0%	14	90.8%	195
Treatment Year 2	±1 yr	99.0%	.	.	.	.	100.0%	12
Treatment 3	No Tolerance	99.0%	.	.	.	.	100.0%	29
Treatment Year 3	±1 yr	99.0%	.	.	.	.	100.0%	5
Physiographic Class	No Tolerance	80.0%	40.0%	5	61.3%	75	77.1%	1,810
Present Nonforest Use	No Tolerance	99.0%	100.0%	35	100.0%	177	99.0%	1,390
Regional Variables								
NC_LAND_USE	No Tolerance	99.0%	80.0%	35	77.0%	217	90.8%	2,595
	Results for			35 Conditions		217 Conditions		2,595 Conditions
Boundary Level								
National Variables								
Boundary Change	No Tolerance	99.0%	100.0%	1	100.0%	18	90.3%	421
Constrasting Condition	No Tolerance	99.0%	100.0%	1	77.8%	18	91.9%	421
Left Azimuth	±10 degrees	90.0%	100.0%	1	55.6%	18	84.1%	421
Corner Mapped	No Tolerance	90.0%	100.0%	1	94.4%	18	97.4%	421
Corner Azimuth	±10 degrees	90.0%	.	.	.	.	70.6%	17
Corner Distance	±1 ft	90.0%	.	.	.	.	70.6%	17
Right Azimuth	±10 degrees	90.0%	100.0%	1	44.4%	18	84.3%	421
	Results for			1 Boundaries		18 Boundaries		421 Boundaries
Subplot Level								
National Variables								
Subplot Center Cond	No Tolerance	99.0%	96.4%	28	94.2%	328	97.2%	6,535
Microplot Center Cond	No Tolerance	99.0%	96.4%	28	93.6%	328	96.8%	6,535
Slope	±10 %	90.0%	92.9%	28	88.7%	328	97.6%	6,535
Aspect	±10 º	90.0%	92.3%	26	77.4%	287	88.6%	6,021
Snow/Water Depth	±0.5 ft		100.0%	28	94.2%	328	66.8%	6,535
	Results for			28 Subplots		328 Subplots		6,535 Subplots

Continued

Table C.—continued

Variable	Tolerance	Objective	North Dakota		Plains States		North Central States	
			Data within tolerance	Records	Data within tolerance	Records	Data within tolerance	Records
Tree Level								
National Variables								
DBH	±0.1 /20 in.	95.0%	91.2%	34	79.5%	945	92.9%	27,896
DRC	±0.1 /20 in.	95.0%	92.9%	14	63.0%	27	63.0%	27
Azimuth	±10 º	90.0%	100.0%	48	97.5%	972	98.8%	27,923
Horizontal Distance	±0.2 /1.0 ft	90.0%	85.4%	48	95.1%	972	97.7%	27,923
Species	No Tolerance	95.0%	100.0%	48	96.0%	972	96.5%	27,923
Tree Genus	No Tolerance	99.0%	100.0%	48	98.1%	970	99.3%	27,904
Tree Status	No Tolerance	95.0%	100.0%	48	99.6%	972	99.0%	27,923
Rotten/Missing Cull	±10 %	90.0%	100.0%	35	96.9%	813	98.9%	18,782
Total Length	±10 %	90.0%	69.6%	23	69.3%	789	83.0%	17,997
Actual Length	±10 %	90.0%	100.0%	3	58.2%	79	81.3%	1,973
Compacted Crown Ratio	±10 %	80.0%	73.3%	45	82.5%	888	86.8%	24,377
Uncompacted Crown Ratio (P3)	±10 %	90.0%	.	.	53.3%	75	83.1%	1,061
Crown Class	No Tolerance	85.0%	88.9%	45	69.9%	888	83.0%	24,377
Decay Class	±1 class	90.0%	100.0%	3	76.7%	86	95.4%	2,860
Cause of Death	No Tolerance	80.0%	100.0%	3	95.3%	86	92.2%	2,860
Condition	No Tolerance	99.0%	100.0%	48	96.9%	972	97.5%	27,923
Mortality Year	±1 yr	70.0%	.	.	100.0%	3	97.2%	845
Crown position	No Tolerance		.	.	53.3%	75	83.4%	850
Crown light exposure	±1 class	85.0%	.	.	68.0%	75	92.6%	1,061
Sapling crown vigor class	No Tolerance	85.0%	.	.	.	.	73.0%	211
Crown density	±10 %	90.0%	.	.	40.0%	75	74.7%	850
Crown dieback	±10 %	90.0%	.	.	94.7%	75	97.2%	850
Transparency	±10 %	90.0%	.	.	54.7%	75	88.7%	850
Regional Variables								
NC Tree Class	No Tolerance	90.0%	93.8%	48	82.4%	971	92.0%	27,083
NC Damage Agent 1	No Tolerance	90.0%	86.7%	45	83.4%	888	92.5%	24,377
NC Damage Agent 2	No Tolerance	90.0%	76.9%	13	81.6%	234	87.5%	3,795
Missouri damage code	No Tolerance		.	.	.	.	65.3%	1,212
Utilization	No Tolerance	99.0%	.	.	100.0%	1	93.4%	499

Continued

Table C.—continued

Variable	Tolerance	Objective	North Dakota		Plains States		North Central States	
			Data within tolerance	Records	Data within tolerance	Records	Data within tolerance	Records
NC Tree Grade	No Tolerance	90.0%	66.7%	6	63.9%	241	68.8%	4,502
DBH-live & decay code 1-2 trees	±0.1 /20 in.	95.0%	90.3%	31	79.0%	892	92.9%	25,185
DBH-decay code 3-4-5 trees	±1 /20 in.	95.0%	100.0%	3	91.7%	36	98.9%	1,133
Total length trees 40 ft plus	±10 %	90.0%	62.5%	8	73.2%	459	84.2%	14,813
Total length trees less than 40 ft	±10 %	90.0%	73.3%	15	63.9%	330	77.2%	3,184
Total Length trees lt 5 inch	±10 %	90.0%	33.3%	12	60.0%	25	67.8%	230
	Results for			48 Trees		972 Trees		27,923 Trees
Seedling Level								
National Variables								
Species	No Tolerance	85.0%	100.0%	7	86.6%	127	91.2%	5,659
Genus	No Tolerance	90.0%	100.0%	7	92.1%	127	96.9%	5,659
Seedling Count	±20 %	90.0%	42.9%	7	44.1%	127	67.4%	5,659
Seedling Count coded	No Tolerance	90.0%	42.9%	7	55.1%	127	73.4%	5,659
	Results for			3 Microplots		80 Microplots		2,402 Microplots
Site Tree Level								
National Variables								
Condition list	No Tolerance	99.0%	100.0%	6	93.6%	94	92.9%	3,003
Diameter	±0.1 /20 in.	95.0%	83.3%	6	75.5%	94	89.4%	2,870
Species	No Tolerance	95.0%	100.0%	6	98.9%	94	97.0%	3,003
Genus	No Tolerance	99.0%	100.0%	6	100.0%	94	99.7%	3,003
Azimuth	±10 degrees	90.0%	83.3%	6	91.5%	94	98.1%	2,870
Distance	±5 feet	90.0%	100.0%	6	100.0%	94	99.4%	2,870
Total_length	±10 percent	90.0%	33.3%	6	79.8%	94	90.8%	2,870
Diameter_age	±5 years	95.0%	66.7%	6	58.5%	94	81.6%	2,870
Regional Variables								
Site_index_method	No Tolerance	99.0%	100.0%	6	100.0%	94	99.8%	3,003
Field_site_index	No Tolerance	99.0%	100.0%	6	100.0%	94	98.3%	3,003
	Results for			6 SI Trees		94 SI Trees		3,003 SI Trees

Table D.—Observed relative bias values (Average [field crew - QA crew]) for measurement variables on blind check plots, North Dakota, 2005.

Variable	Unit of measure	North Dakota Relative bias	North Dakota 95% CI limits Lower	North Dakota 95% CI limits Upper	North Dakota Number of observations	Plains States Relative bias	Plains States 95% CI limits Lower	Plains States 95% CI limits Upper	Plains States Number of observations	North Central States Relative bias	North Central States 95% CI limits Lower	North Central States 95% CI limits Upper	North Central States Number of observations
Plot Level													
National Variables													
Distance to Road	code	0.00	0.00	0.00	8	-0.15	-0.42	0.13	85	-0.02	-0.07	0.03	1,677
Regional Variables													
ELEVATION_GPS	feet	-10.00	-28.86	11.00	7	-27.20	-52.73	-8.78	79	-23.61	-51.95	-1.69	1,528
LAT_DECIMAL_DEG	degree	0.00	0.00	0.00	7	0.00	0.00	0.00	81	0.00	-0.01	0.00	1,538
LON_DECIMAL_DEG	degree	0.00	0.00	0.00	7	0.00	0.00	0.00	81	0.55	0.00	1.64	1,538
LAT_FEET	feet	-15.62	-27.34	-3.91	7	9.67	-4.27	32.40	81	-1,389.31	-3,933.65	-0.09	1,538
LON_FEET	feet	24.75	8.33	42.89	7	-43.51	-137.66	8.44	81	8,198.92	107.96	24,710.51	1,538
	Results for				8 Plots				85 Plots				1,677 Plots
Condition Level													
National Variables													
Stand Size	code	0.6	0.2	1	5	0.03	-0.13	0.17	75	0.01	-0.01	0.02	1,810
Stand Age	years	-0.20	-9.00	8.80	5	-1.39	-4.88	1.95	75	-0.72	-1.28	-0.24	1,810
	Results for				35 Conditions				217 Conditions				2,595 Conditions
Subplot Level													
National Variables													
Slope	percent	-0.75	-6.38	3.63	28	-0.23	-1.55	0.97	328	0.63	0.16	1.21	6,535
Aspect	degrees	-4.62	-13.19	0.00	26	-8.36	-18.23	-0.41	287	-0.57	-1.79	0.74	6,021
Snow/Water Depth	feet	0.00	0.00	0.00	28	-0.05	-0.46	0.27	328	-0.40	-0.55	-0.25	6,535
	Results for				28 Subplots				328 Subplots				6,535 Subplots
Tree Level													
National Variables													
DBH	inches	0.04	0.01	0.06	34	-0.09	-0.16	-0.04	945	-0.02	-0.03	-0.02	27,896
DRC	inches	-0.01	-0.05	0.04	14	0.11	-0.15	0.43	27	0.11	-0.15	0.43	27
Rotten/Missing Cull	percent	0.23	-0.86	1.17	35	-0.35	-0.76	0.09	813	0.02	-0.04	0.07	18,782
Total Length	feet	7.02	2.64	11.45	23	1.68	0.63	2.50	789	0.30	0.08	0.52	17,997
Actual Length	feet	3.00	1.15	5.56	3	-8.82	-25.30	1.11	79	-1.37	-2.32	-0.54	1,973

Continued

Table D.—continued

Variable	Unit of measure	North Dakota Relative bias	North Dakota 95% CI limits Lower	North Dakota 95% CI limits Upper	North Dakota Number of observations	Plains States Relative bias	Plains States 95% CI limits Lower	Plains States 95% CI limits Upper	Plains States Number of observations	North Central States Relative bias	North Central States 95% CI limits Lower	North Central States 95% CI limits Upper	North Central States Number of observations
Compacted Crown Ratio	percent	12.33	8.28	16.78	45	1.04	0.27	1.91	888	0.33	0.20	0.47	24,377
Uncompacted Crown Ratio (P3)	percent					-27.11	-34.00	-19.08	75	-3.32	-4.29	-2.26	1,061
Crown position	code					-0.97	-1.21	-0.73	75	-0.16	-0.20	-0.12	850
Crown light exposure	code					-0.83	-1.09	-0.57	75	-0.12	-0.17	-0.06	1,061
Sapling crown vigor class	code									-0.11	-0.19	-0.05	211
Crown density	percent					-26.40	-32.63	-20.07	75	-3.04	-4.29	-2.06	850
Crown dieback	percent					-1.27	-3.90	0.90	75	-0.34	-0.90	0.12	850
Transparency	percent					-15.00	-18.67	-11.43	75	-1.76	-2.61	-1.06	850
Regional Variables													
NC Tree Class	code	0.21	-0.42	0.83	48	0.12	-0.16	0.34	971	0.05	0.01	0.10	27,083
DBH-live & decay code 1-2 trees	inches	0.04	0.01	0.07	31	-0.09	-0.15	-0.03	892	-0.03	-0.04	-0.02	25,185
DBH-decay code 3-4-5 trees	inches	-0.03	-0.10	0.00	3	-0.31	-0.70	-0.04	36	-0.03	-0.06	-0.01	1,133
Total length trees 40 ft plus	feet	7.62	-0.01	15.87	8	2.42	1.52	3.43	459	0.75	0.60	0.87	14,813
Total length trees less than 40 ft	feet	6.70	1.52	11.60	15	0.65	-1.30	2.13	330	-1.79	-2.83	-0.84	3,184
Total Length trees lt 5 inch	feet	22.49	14.91	30.18	12	13.40	8.42	19.80	25	2.39	0.53	4.43	230
	Results for				48 Trees				972 Trees				27,923 Trees
Seedling Level													
National Variables													
Seedling Count	number	-160.48	-355.71	-28.57	7	-40.39	-64.46	-18.12	127	-12.04	-15.05	-9.61	5,659
Seedling Count coded	number	-1.14	-1.86	-0.36	7	-0.34	-0.56	-0.10	127	0.02	0.00	0.04	5,659
	Results for				3 Microplots				80 Microplots				2,402 Microplots
Site Tree Level													
National Variables													
Diameter	inches	0.02	-0.08	0.08	6	-0.15	-0.37	-0.04	94	-0.01	-0.02	0.01	2,870
Total_length	feet	8.35	0.65	15.82	6	0.80	-1.85	2.67	94	0.26	0.01	0.53	2,870
Diameter_age	years	4.67	-2.00	12.00	6	-1.45	-3.16	0.29	94	0.15	-0.05	0.34	2,870
Regional Variables													
Field_site_index	feet	0.00	0.00	0.00	6	0.00	0.00	0.00	94	0.09	0.01	0.19	3,003
	Results for				6 SI Trees				94 SI Trees				3,003 SI Trees

Table 1.—Percentage of area by land status, North Dakota, 2005

Land status	Percentage of area
Accessible forest land	
Unreserved forest land	
Timberland	1.1
Unproductive	0.4
Total unreserved forest land	1.5
Reserved forest land	
Productive	0.0
Unproductive	0.0
Total reserved forest land	0.1
All accessible forest land	1.6
Nonforest and other land	
Nonforest land	95.3
Water	
Census	2.0
Non-Census	0.8
All nonforest and other land	98.1
Nonsampled land	
Access denied	0.3
Hazardous conditions	0.0
Other	- -
All land	100.0
Total area (thousands of acres)	45,247

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the percentage rounds to less than 0.1 percent. Columns and rows may not add to their totals due to rounding.

Table 2.—Area of forest land, in thousand acres, by owner class and forest land status, North Dakota, 2005

Owner class	Unreserved forests			Reserved forests			All forest land
	Timberland	Unproductive	Total	Productive	Unproductive	Total	
Forest Service							
National grassland	23.1	49.2	72.3	- -	- -	- -	72.3
Other Federal							
National Park Service	- -	- -	- -	6.9	12.7	19.6	19.6
Bureau of Land Management	0.9	7.5	8.4	- -	- -	- -	8.4
Fish and Wildlife Service	27.7	- -	27.7	4.2	- -	4.2	31.9
Other Federal	21.5	3.1	24.6	- -	- -	- -	24.6
State and local government							
State	37.9	8.5	46.5	- -	- -	- -	46.5
Local (county, municipal, etc.)	11.2	- -	11.2	- -	- -	- -	11.2
Private							
Undifferentiated private	411.4	96.9	508.3	1.5	- -	1.5	509.8
All owners	533.7	165.2	698.9	12.6	12.7	25.3	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 3.—Area of forest land, in thousand acres, by forest-type group and productivity class, North Dakota, 2005

Forest type group	Site productivity class (cubic feet/acre/year)							All classes
	0-19	20-49	50-84	85-119	120-164	165-224	225+	
Pinyon / juniper group	42.6	- -	- -	- -	- -	- -	- -	42.6
Oak / hickory group	66.3	64.7	25.2	- -	- -	- -	- -	156.2
Elm / ash / cottonwood group	1.5	147.2	16.3	- -	- -	- -	- -	165.1
Maple / beech / birch group	54.5	151.7	11.7	- -	- -	- -	- -	217.9
Aspen / birch group	8.6	56.4	58.0	- -	- -	- -	- -	123.1
Exotic hardwoods group	- -	4.2	- -	- -	- -	- -	- -	4.2
Nonstocked	4.5	8.4	2.3	- -	- -	- -	- -	15.2
All forest type groups	177.9	432.7	113.6	- -	- -	- -	- -	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 4.—Area of forest land, in thousand acres, by forest-type group, ownership group, and land status, North Dakota, 2005

Forest type group	Forest Service		Other Federal		State and local government		Undifferentiated private		All forest land
	Timber-land	Other forest land	Timber-land	Other forest land	Timber-land	Other forest land	Timber-land	Other forest land	
Pinyon / juniper group	- -	29.1	- -	7.3	- -	5.9	- -	0.3	42.6
Oak / hickory group	5.1	1.6	5.9	9.0	- -	- -	79.0	55.7	156.2
Elm / ash / cottonwood group	- -	- -	22.0	11.1	23.1	- -	105.9	3.0	165.1
Maple / beech / birch group	18.0	18.6	10.0	6.9	12.9	- -	122.5	29.0	217.9
Aspen / birch group	- -	- -	12.3	- -	10.8	2.6	91.3	6.0	123.1
Exotic hardwoods group	- -	- -	- -	- -	- -	- -	4.2	- -	4.2
Nonstocked	- -	- -	- -	- -	2.3	- -	8.4	4.5	15.2
All forest type groups	23.1	49.2	50.1	34.3	49.1	8.5	411.4	98.4	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 5.—Area of forest land, in thousand acres, by forest-type group and stand-size class, North Dakota, 2005

Forest type group	Stand-size class					All size classes
	Large diameter	Medium diameter	Small diameter	Chaparral	Nonstocked	
Pinyon / juniper group	34.8	0.3	7.5	- -	- -	42.6
Oak / hickory group	29.3	84.4	42.5	- -	- -	156.2
Elm / ash / cottonwood group	96.1	24.9	44.1	- -	- -	165.1
Maple / beech / birch group	61.2	92.8	63.8	- -	- -	217.9
Aspen / birch group	22.2	64.1	36.7	- -	- -	123.1
Exotic hardwoods group	- -	1.2	3.0	- -	- -	4.2
Nonstocked	- -	- -	- -	- -	15.2	15.2
All forest type groups	243.6	267.7	197.6	- -	15.2	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 6.—Area of forest land, in thousand acres, by forest-type group and stand-age class, North Dakota, 2005

	Stand-age class (years)							
Forest type group	**Nonstocked**	**0-20**	**21-40**	**41-60**	**61-80**	**81-100**	**100+**	**All classes**
Pinyon / juniper group	-	-	1.8	21.4	1.6	17.9	-	42.6
Oak / hickory group	-	17.6	27.6	47.0	41.8	19.5	2.6	156.2
Elm / ash / cottonwood group	-	10.6	34.4	47.0	44.4	21.6	7.1	165.1
Maple / beech / birch group	-	4.4	24.4	96.4	62.8	29.8	-	217.9
Aspen / birch group	-	18.6	33.4	48.6	22.4	-	-	123.1
Exotic hardwoods group	-	-	-	3.0	1.2	-	-	4.2
Nonstocked	15.2		-	-	-	-	-	15.2
All forest type groups	15.2	51.3	121.5	263.3	174.3	88.8	9.8	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 7.—Area of forest land, in thousand acres, by forest-type group and stand origin, North Dakota, 2005

Forest type group	Stand origin		All forest land
	Natural stands	Artificial regeneration	
Pinyon / juniper group	42.6	- -	42.6
Oak / hickory group	156.2	- -	156.2
Elm / ash / cottonwood group	161.8	3.2	165.1
Maple / beech / birch group	214.5	3.3	217.9
Aspen / birch group	123.1	- -	123.1
Exotic hardwoods group	4.2	- -	4.2
Nonstocked	15.2	- -	15.2
All forest type groups	717.6	6.5	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 8.—Area of forest land, in thousand acres, by forest-type group and primary disturbance class, North Dakota, 2005

Forest type group	Disturbance class									All forest land
	None	Insects	Disease	Weather	Fire	Domestic animals	Wild animals	Human	Other	
Pinyon / juniper group	42.6	- -	- -	- -	- -	- -	- -	- -	- -	42.6
Oak / hickory group	129.9	- -	- -	14.1	- -	12.1	- -	- -	- -	156.2
Elm / ash / cottonwood group	129.2	- -	- -	11.6	6.2	9.2	8.8	- -	- -	165.1
Maple / beech / birch group	198.1	- -	- -	- -	1.4	9.7	6.0	- -	2.7	217.9
Aspen / birch group	117.3	- -	- -	- -	- -	1.3	4.4	- -	- -	123.1
Exotic hardwoods group	4.2	- -	- -	- -	- -	- -	- -	- -	- -	4.2
Nonstocked	12.9	- -	- -	2.3	- -	- -	- -	- -	- -	15.2
All forest type groups	634.3	- -	- -	28.0	7.6	32.4	19.2	- -	2.7	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 9.—Area of timberland, in thousand acres, by forest-type group and stand-size class, North Dakota, 2005

Forest type group	Stand-size class					All size classes
	Large diameter	Medium diameter	Small diameter	Chaparral	Nonstocked	
Oak / hickory group	27.1	43.9	18.9	- -	- -	89.9
Elm / ash / cottonwood group	94.6	19.2	37.2	- -	- -	151.0
Maple / beech / birch group	54.6	87.5	21.3	- -	- -	163.4
Aspen / birch group	22.2	62.4	29.8	- -	- -	114.5
Exotic hardwoods group	- -	1.2	3.0	- -	- -	4.2
Nonstocked	- -	- -	- -	- -	10.7	10.7
All forest type groups	198.5	214.3	110.2	- -	10.7	533.7

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 10.—Number of live trees, in thousands, on forest land by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)															All classes
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	
Softwood species groups																
Eastern softwood species groups																
Other eastern softwoods	15,438	4,556	2,544	2,583	1,534	632	374	160	118	37	37	- -	37	- -	- -	28,052
All softwoods	15,438	4,556	2,544	2,583	1,534	632	374	160	118	37	37	- -	37	- -	- -	28,052
Hardwood species groups																
Eastern hardwood species groups																
Select white oaks	12,594	20,200	12,574	6,341	3,220	1,170	741	310	381	282	134	35	- -	34	- -	58,017
Ash	34,061	18,994	11,821	6,580	3,374	1,633	929	535	36	75	36	- -	- -	- -	- -	78,072
Cottonwood and aspen	57,962	15,657	9,047	5,332	3,104	1,942	1,106	593	381	72	307	276	129	- -	108	96,015
Basswood	1,727	- -	273	173	- -	134	230	30	- -	- -	- -	35	- -	- -	- -	2,603
Other eastern soft hardwoods	13,608	9,191	5,143	2,659	2,247	987	690	113	109	258	34	35	- -	- -	- -	35,074
Eastern noncommercial hardwoods	46,784	863	333	147	40	40	115	- -	40	- -	- -	- -	- -	- -	- -	48,362
All hardwoods	166,736	64,905	39,190	21,231	11,985	5,906	3,812	1,581	947	687	511	380	129	34	108	318,143
All species groups	182,175	69,461	41,734	23,814	13,519	6,538	4,186	1,741	1,066	724	548	380	166	34	108	346,195

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the number of trees rounds to less than 1 thousand trees. Columns and rows may not add to their totals due to rounding.

Table 11.—Number of growing-stock trees, in thousands, on timberland by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)													All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	
Softwood species groups														
Eastern softwood species groups														
Other eastern softwoods	--	36	36	--	--	--	--	--	--	--	--	--	--	71
All softwoods	--	36	36	--	--	--	--	--	--	--	--	--	--	71
Hardwood species groups														
Eastern hardwood species groups														
Select white oaks	3,037	1,804	1,199	263	206	139	277	213	104	35	--	34	--	7,312
Ash	5,017	3,451	1,452	812	506	317	36	75	--	--	--	--	--	11,666
Cottonwood and aspen	6,942	3,896	2,433	1,316	688	317	315	72	233	240	129	--	--	16,580
Basswood	100	35	--	30	91	--	--	--	--	--	--	--	--	256
Other eastern soft hardwoods	1,780	852	733	180	182	--	--	40	--	35	--	--	--	3,801
All hardwoods	16,877	10,038	5,817	2,602	1,673	773	628	399	337	310	129	34	--	39,615
All species groups	16,877	10,073	5,853	2,602	1,673	773	628	399	337	310	129	34	--	39,686

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the number of trees rounds to less than 1 thousand trees. Columns and rows may not add to their totals due to rounding.

Table 12.—Net volume of all live trees, in million cubic feet, by owner class and forest land status, North Dakota, 2005

Owner class	Unreserved forests			Reserved forests			All forest land
	Timberland	Unproductive	Total	Productive	Unproductive	Total	
Forest Service							
National grassland	15.9	26.8	42.7	- -	- -	- -	42.7
Other Federal							
National Park Service	- -	- -	- -	0.8	12.9	13.7	13.7
Bureau of Land Management	- -	6.2	6.2	- -	- -	- -	6.2
Fish and Wildlife Service	23.3	- -	23.3	0.8	- -	0.8	24.0
Other Federal	12.9	2.7	15.6	- -	- -	- -	15.6
State and local government							
State	30.6	4.8	35.4	- -	- -	- -	35.4
Local (county, municipal, etc.)	26.2	- -	26.2	- -	- -	- -	26.2
Private							
Undifferentiated private	493.3	59.9	553.2	2.0	- -	2.0	555.2
All owners	602.3	100.5	702.8	3.5	12.9	16.5	719.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 13.—Net volume of all live trees, in million cubic feet, on forest land by forest-type group and stand-size class, North Dakota, 2005

Forest type group	Stand-size class					All size classes
	Large diameter	Medium diameter	Small diameter	Chaparral	Nonstocked	
Pinyon / juniper group	38.1	1.4	0.3	- -	- -	39.8
Oak / hickory group	61.8	86.1	9.8	- -	- -	157.8
Elm / ash / cottonwood group	221.9	27.3	7.6	- -	- -	256.8
Maple / beech / birch group	74.3	75.2	11.8	- -	- -	161.3
Aspen / birch group	27.9	68.2	4.7	- -	- -	100.8
Exotic hardwoods group	- -	2.0	- -	- -	- -	2.0
Nonstocked	- -	- -	- -	- -	0.8	0.8
All forest type groups	424.1	260.2	34.1	- -	0.8	719.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 13a.—Net volume of all live trees, in million cubic feet, on forest land by species and forest-type group, North Dakota, 2005

Species	Forest type group							
	Pinyon / juniper	Oak / hickory	Elm / ash / cottonwood	Maple / beech / birch	Aspen / birch	Exotic hardwoods	Nonstocked	All forest type groups
American basswood	-	-	-	12.0	-	-	-	12.0
American elm	-	4.3	9.8	13.9	0.5	0.8	-	29.3
American plum	-	-	-	-	-	-	-	-
balsam poplar	-	0.8	3.2	0.2	7.6	-	-	11.9
black ash	-	0.1	0.4	-	0.4	-	-	0.9
black willow	-	-	0.2	-	-	-	-	0.2
boxelder	-	7.3	31.0	8.9	0.5	0.6	-	48.3
bur oak	-	104.3	11.7	37.3	10.1	-	-	163.4
chokecherry	-	-	-	-	-	-	-	-
eastern cottonwood	-	-	161.2	-	-	-	-	161.2
eastern hophornbeam	-	-	-	0.0	-	-	-	0.0
eastern redcedar	-	-	-	1.0	-	-	-	1.0
green ash	1.9	23.7	30.9	71.3	2.9	0.6	-	131.3
hawthorn spp.	-	-	-	-	-	-	-	-
paper birch	-	0.1	-	-	0.5	-	-	0.6
peachleaf willow	-	-	0.9	0.1	0.1	-	-	1.0
pin cherry	-	-	-	-	-	-	-	-
quaking aspen	-	17.0	0.6	4.5	77.8	-	0.8	100.7
Rocky Mountain juniper	37.9	0.3	0.1	7.4	0.2	-	-	45.9
Russian-olive	-	-	0.3	0.1	-	-	-	0.4
serviceberry spp.	-	-	-	-	-	-	-	-
Siberian elm	-	-	-	4.3	-	-	-	4.3
slippery elm	-	-	0.1	0.5	-	-	-	0.5
white willow	-	-	2.6	-	-	-	-	2.6
willow spp.	-	-	3.9	-	-	-	-	3.9
All species	39.8	157.8	256.8	161.3	100.8	2.0	0.8	719.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 14.—Net volume of all live trees, in million cubic feet, on forest land by species group and ownership group, North Dakota, 2005

Species group	Ownership group				
	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Eastern softwood species groups					
Other eastern softwoods	26.6	13.5	3.6	3.2	46.9
All softwoods	26.6	13.5	3.6	3.2	46.9
Hardwood species groups					
Eastern hardwood species groups					
Select white oaks	6.7	15.6	5.8	135.3	163.4
Ash	4.7	15.7	10.7	101.2	132.2
Cottonwood and aspen	- -	9.0	34.9	229.7	273.7
Basswood	3.6	- -	- -	8.4	12.0
Other eastern soft hardwoods	1.2	5.8	2.6	76.1	85.7
Eastern noncommercial hardwoods	- -	- -	4.0	1.3	5.4
All hardwoods	16.1	46.1	58.1	552.0	672.3
All species groups	42.7	59.6	61.6	555.2	719.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 15.—Net volume of all live trees, in million cubic feet, on forest land by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)													All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	
Softwood species groups														
Eastern softwood species groups														
Other eastern softwoods	4	9	9	6	6	4	4	2	2	--	3	--	--	47
All softwoods	4	9	9	6	6	4	4	2	2	--	3	--	--	47
Hardwood species groups														
Eastern hardwood species groups														
Select white oaks	27	27	25	15	14	9	15	14	8	4	--	5	--	163
Ash	22	27	25	19	17	15	1	4	1	--	--	--	--	132
Cottonwood and aspen	21	27	28	28	24	16	17	4	25	30	22	--	32	274
Basswood	1	1	--	2	5	1	--	--	--	3	--	--	--	12
Other eastern soft hardwoods	9	11	16	12	13	3	3	13	2	4	--	--	--	86
Eastern noncommercial hardwoods	1	1	0	0	2	--	1	--	--	--	--	--	--	5
All hardwoods	80	92	95	77	75	45	38	35	37	40	22	5	32	672
All species groups	84	101	104	83	81	48	41	36	38	40	24	5	32	719

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the volume rounds to less than 1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 16.—Net volume of all live trees, in million cubic feet, on forest land by forest-type group and stand origin, North Dakota, 2005

Forest type group	Stand origin		All forest land
	Natural stands	Artificial regeneration	
Pinyon / juniper group	39.8	- -	39.8
Oak / hickory group	157.8	- -	157.8
Elm / ash / cottonwood group	255.4	1.3	256.8
Maple / beech / birch group	154.4	6.9	161.3
Aspen / birch group	100.8	- -	100.8
Exotic hardwoods group	2.0	- -	2.0
Nonstocked	0.8	- -	0.8
All forest type groups	711.0	8.2	719.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 17.—Net volume of growing-stock trees, in million cubic feet, on timberland by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)													All classes
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	
Softwood species groups														
Eastern softwood species groups														
Other eastern softwoods	--	0	0	--	--	--	--	--	--	--	--	--	--	0
All softwoods	--	0	0	--	--	--	--	--	--	--	--	--	--	0
Hardwood species groups														
Eastern hardwood species groups														
Select white oaks	7	8	10	4	4	4	11	11	6	4	--	5	--	73
Ash	11	15	12	11	11	9	1	4	--	--	--	--	--	74
Cottonwood and aspen	16	20	23	20	16	10	14	4	19	26	22	--	--	190
Basswood	0	0	--	0	2	--	--	--	--	--	--	--	--	3
Other eastern soft hardwoods	4	4	6	3	4	--	--	2	--	4	--	--	--	26
All hardwoods	38	48	51	38	36	23	27	21	26	33	22	5	--	366
All species groups	38	48	51	38	36	23	27	21	26	33	22	5	--	367

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the volume rounds to less than 1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 18.—Net volume of growing-stock trees, in million cubic feet, on timberland by species group and ownership group, North Dakota, 2005

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Eastern softwood species groups					
Other eastern softwoods	- -	- -	- -	0.4	0.4
All softwoods	- -	- -	- -	0.4	0.4
Hardwood species groups					
Eastern hardwood species groups					
Select white oaks	3.2	8.2	4.3	57.6	73.4
Ash	2.1	8.0	5.9	58.4	74.5
Cottonwood and aspen	- -	7.1	14.8	167.9	189.8
Basswood	2.7	- -	- -	0.3	3.0
Other eastern soft hardwoods	- -	0.7	- -	25.2	25.8
All hardwoods	8.0	24.0	25.0	309.5	366.4
All species groups	8.0	24.0	25.0	309.9	366.9

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 19.—Net volume of sawtimber trees, in million board feet, (International 1/4-inch rule) on timberland by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	
Softwood species groups												
Eastern softwood species groups												
Other eastern softwoods	2	--	--	--	--	--	--	--	--	--	--	2
All softwoods	2	--	--	--	--	--	--	--	--	--	--	2
Hardwood species groups												
Eastern hardwood species groups												
Select white oaks	--	17	18	19	54	53	32	18	--	28	--	240
Ash	--	45	47	43	6	18	--	--	--	--	--	159
Cottonwood and aspen	--	93	75	47	70	22	98	132	115	--	--	651
Basswood	--	2	11	--	--	--	--	--	--	--	--	13
Other eastern soft hardwoods	--	12	18	--	--	10	--	17	--	--	--	56
All hardwoods	--	169	170	108	131	104	130	167	115	28	--	1,121
All species groups	2	169	170	108	131	104	130	167	115	28	--	1,122

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the volume rounds to less than 1 million board feet. Columns and rows may not add to their totals due to rounding.

Table 19a.—Net volume of sawtimber trees, in million board feet, (Doyle rule) on timberland by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)											All classes
	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9	37.0+	
Softwood species groups												
Eastern softwood species groups												
Other eastern softwoods	1	--	--	--	--	--	--	--	--	--	--	1
All softwoods	1	--	--	--	--	--	--	--	--	--	--	1
Hardwood species groups												
Eastern hardwood species groups												
Select white oaks	--	7	9	11	36	38	25	17	--	32	--	176
Ash	--	19	24	25	4	13	--	--	--	--	--	85
Cottonwood and aspen	--	39	38	27	46	16	78	115	130	--	--	490
Basswood	--	1	6	--	--	--	--	--	--	--	--	7
Other eastern soft hardwoods	--	5	9	--	--	7	--	15	--	--	--	36
All hardwoods	--	71	87	64	86	74	103	147	130	32	--	793
All species groups	1	71	87	64	86	74	103	147	130	32	--	793

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the volume rounds to less than 1 million board feet. Columns and rows may not add to their totals due to rounding.

Table 20.—Net volume of sawtimber trees, in million cubic feet, on timberland by species group and ownership group, North Dakota, 2005

Species group	Ownership group				
	Forest Service	Other Federal	State and local government	Undifferentiated private	All owners
Softwood species groups					
Eastern softwood species groups					
Other eastern softwoods	--	--	--	0.2	0.2
All softwoods	--	--	--	0.2	0.2
Hardwood species groups					
Eastern hardwood species groups					
Select white oaks	1.3	5.9	0.9	35.3	43.4
Ash	0.2	4.2	1.3	23.2	28.9
Cottonwood and aspen	--	3.3	11.3	102.8	117.5
Basswood	2.1	--	--	--	2.1
Other eastern soft hardwoods	--	--	--	10.5	10.5
All hardwoods	3.6	13.5	13.5	171.8	202.4
All species groups	3.6	13.5	13.5	172.1	202.7

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 31.—Live-tree aboveground dry weight, in thousand dry tons, (CRM) by owner class and forest land status, North Dakota, 2005

Owner class	Unreserved forests			Reserved forests			All forest land
	Timberland	Unproductive	Total	Productive	Unproductive	Total	
Forest Service							
National grassland	452	621	1,073	- -	- -	- -	1,073
Other Federal							
National Park Service	- -	- -	- -	36	332	368	368
Bureau of Land Management	- -	212	212	- -	- -	- -	212
Fish and Wildlife Service	772	- -	772	26	- -	26	798
Other Federal	423	94	517	- -	- -	- -	517
State and local government							
State	839	144	983	- -	- -	- -	983
Local (county, municipal, etc.)	521	- -	521	- -	- -	- -	521
Private							
Undifferentiated private	13,270	2,068	15,338	48	- -	48	15,386
All owners	16,277	3,140	19,417	110	332	441	19,858

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 thousand dry tons. Columns and rows may not add to their totals due to rounding.

Table 32.—Live-tree aboveground dry weight, in thousand dry tons, (CRM) on forest land by species group and diameter class, North Dakota, 2005

Species group	Diameter class (inches)															All classes
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+	
Softwood species groups																
Eastern softwood species groups																
Other eastern softwoods	31	58	85	178	186	116	105	65	69	29	31	- -	- -	- -	66	1,019
All softwoods	31	58	85	178	186	116	105	65	69	29	31	- -	- -	- -	66	1,019
Hardwood species groups																
Eastern hardwood species groups																
Select white oaks	64	543	940	911	808	482	435	269	434	401	238	- -	- -	100	144	5,769
Ash	118	441	721	806	766	582	491	404	32	95	53	- -	- -	- -	- -	4,510
Cottonwood and aspen	189	319	457	559	583	571	472	335	312	79	324	135	454	91	973	5,851
Basswood	1	- -	12	15	- -	33	86	17	- -	- -	- -	- -	- -	68	- -	231
Other eastern soft hardwoods	35	162	243	277	402	289	302	67	85	279	46	- -	71	- -	- -	2,259
Eastern noncommercial hardwoods	82	8	15	15	7	12	48	- -	32	- -	- -	- -	- -	- -	- -	219
All hardwoods	490	1,474	2,388	2,582	2,565	1,968	1,835	1,092	896	854	660	135	525	258	1,116	18,839
All species groups	521	1,531	2,473	2,760	2,752	2,084	1,940	1,157	965	883	691	135	525	258	1,183	19,858

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 thousand dry tons. Columns and rows may not add to their totals due to rounding.

Table 54.—Area of accessible forest land, in thousand acres, by Forest Survey Unit, county, and forest land status, North Dakota, 2005

Forest Survey Unit and county	Unreserved forests			Reserved forests			All forest land
	Timberland	Unproductive	Total	Productive	Unproductive	Total	
Eastern							
Red River	159.4	47.6	207.0	1.5	- -	1.5	208.5
Devils Lake & James River	34.9	9.0	43.8	- -	- -	- -	43.8
Souris River	176.1	16.0	192.1	4.2	- -	4.2	196.3
Missouri River	163.3	92.6	256.0	6.9	12.7	19.6	275.5
Total	533.7	165.2	698.9	12.6	12.7	25.3	724.2
All counties	533.7	165.2	698.9	12.6	12.7	25.3	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties

Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties

Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties

Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Table 55.—Area of accessible forest land, in thousand acres, by Forest Survey Unit, county, ownership group and forest land status, North Dakota, 2005

Forest Survey Unit and county	Forest Service		Other Federal		State and local government		Undifferentiated private		All forest land
	Timber-land	Other forest land	Timber-land	Other forest land	Timber-land	Other forest land	Timber-land	Other forest land	
Eastern									
Red River	10.0	- -	- -	- -	15.8	- -	133.6	49.1	208.5
Devils Lake & James River	- -	- -	6.7	3.1	5.9	- -	22.3	5.9	43.8
Souris River	- -	- -	23.1	4.2	7.9	2.6	145.1	13.3	196.3
Missouri River	13.1	49.2	20.3	27.0	19.5	5.9	110.4	30.1	275.5
Total	23.1	49.2	50.1	34.3	49.1	8.5	411.4	98.4	724.2
All counties	23.1	49.2	50.1	34.3	49.1	8.5	411.4	98.4	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties

Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties

Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties

Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Table 56.—Area of forest land, in thousand acres, by Forest Survey Unit, county, and forest-type group, North Dakota, 2005

County	Forest type group							
	Pinyon / juniper	Oak / hickory	Elm / ash / cottonwood	Maple / beech / birch	Aspen / birch	Exotic hardwoods	Nonstocked	All forest type groups
Barnes	-	-	1.6	-	-	-	-	1.6
Benson	-	3.1	5.0	5.4	6.7	-	-	20.2
Billings	34.6	-	-	18.4	-	-	-	52.9
Bottineau	-	11.1	1.7	11.1	19.4	-	2.3	45.6
Burke	-	-	-	-	3.5	-	-	3.5
Burleigh	-	-	5.9	-	-	-	-	5.9
Cass	-	-	1.4	3.3	-	1.2	-	6.0
Cavalier	-	22.4	-	5.8	8.4	-	-	36.5
Dickey	-	-	-	1.7	-	-	-	1.7
Dunn	1.6	10.2	9.8	23.3	3.0	-	-	47.8
Emmons	-	1.6	6.2	4.7	-	-	-	12.4
Golden Valley	-	-	-	4.2	-	-	-	4.2
Grand Forks	-	-	7.3	11.0	-	-	-	18.3
Grant	-	-	10.5	-	-	-	-	10.5
Griggs	-	-	-	6.0	-	-	-	6.0
LaMoure	-	-	-	6.5	-	-	-	6.5
McHenry	-	-	4.6	5.6	19.3	-	1.5	31.0
McKenzie	6.5	10.7	13.8	42.7	-	-	-	73.7
McLean	-	-	5.9	-	-	-	-	5.9
Mercer	-	-	4.8	4.4	-	-	-	9.2
Morton	-	5.9	13.1	7.1	-	-	-	26.1
Mountrail	-	4.4	-	1.4	-	-	-	5.8
Nelson	-	5.8	-	-	-	-	-	5.8
Oliver	-	-	5.9	-	-	-	-	5.9
Pembina	-	22.7	16.0	17.2	10.8	-	-	66.7
Ramsey	-	-	-	5.9	-	-	-	5.9
Ransom	-	5.1	11.9	-	-	-	-	16.9
Renville	-	-	9.8	-	-	-	-	9.8
Richland	-	-	11.9	6.6	-	-	1.7	20.1
Rolette	-	31.7	-	-	52.0	-	5.3	89.0
Sioux	-	1.7	-	-	-	-	-	1.7
Stark	-	-	-	1.5	-	-	-	1.5
Traill	-	2.6	1.5	-	-	-	-	4.1
Walsh	-	11.5	10.5	-	-	-	4.5	26.5
Ward	-	-	-	14.5	-	3.0	-	17.4
Wells	-	5.9	-	3.7	-	-	-	9.6
Williams	-	-	5.9	6.0	-	-	-	12.0
All counties	42.6	156.2	165.1	217.9	123.1	4.2	15.2	724.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table 57.—Area of timberland, in thousand acres, by Forest Survey Unit, county, and stand-size class, North Dakota, 2005

Forest Survey Unit and county	Stand-size class					All size classes
	Large diameter	Medium diameter	Small diameter	Chaparral	Nonstocked	
Eastern						
Red River	89.3	35.1	33.4	- -	1.7	159.4
Devils Lake & James River	18.0	16.9	- -	- -	- -	34.9
Souris River	43.6	89.8	33.6	- -	9.1	176.1
Missouri River	47.6	72.6	43.2	- -	- -	163.3
Total	198.5	214.3	110.2	- -	10.7	533.7
All counties	198.5	214.3	110.2	- -	10.7	533.7

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.
Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties
Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties
Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties
Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Table 58.—Area of timberland, in thousand acres, by Forest Survey Unit, county, and stocking class, North Dakota, 2005

Forest Survey Unit and county	Stocking class of growing-stock trees					All classes
	Nonstocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked	
Eastern						
Red River	31.3	47.9	48.3	15.0	16.8	159.4
Devils Lake & James River	1.7	13.8	11.3	3.1	5.0	34.9
Souris River	27.8	38.0	67.1	40.7	2.6	176.1
Missouri River	37.1	74.4	32.8	19.0	- -	163.3
Total	97.9	174.0	159.5	77.7	24.5	533.7
All counties	97.9	174.0	159.5	77.7	24.5	533.7

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties

Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties

Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties

Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Table 59.—Net volume of growing stock and sawtimber (International 1/4-inch rule) on timberland by Forest Survey Unit, county, and major species group, North Dakota, 2005

Forest Survey Unit and county	Growing stock					Sawtimber				
	Major species group					Major species group				
	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species
	(In million cubic feet)					(In million board feet)[1]				
Eastern										
Red River	- -	- -	40.6	75.0	115.6	- -	- -	123.9	275.0	399.0
Devils Lake & James River	- -	0.4	35.9	11.5	47.9	- -	1.6	146.7	17.9	166.2
Souris River	- -	- -	67.0	39.3	106.2	- -	- -	129.6	82.2	211.8
Missouri River	- -	- -	75.5	21.7	97.2	- -	- -	320.9	24.4	345.3
Total	- -	0.4	219.0	147.4	366.9	- -	1.6	721.1	399.6	1,122.2
All counties	- -	0.4	219.0	147.4	366.9	- -	1.6	721.1	399.6	1,122.2

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic or board feet. Columns and rows may not add to their totals due to rounding.

[1] International 1/4-inch rule.

Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties

Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties

Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties

Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Table 59a.—Net volume of growing stock and sawtimber (Doyle rule) on timberland by Forest Survey Unit, county, and major species group, North Dakota, 2005

Forest Survey Unit and county	Growing stock					Sawtimber				
	Major species group					Major species group				
	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species
	(In million cubic feet)					(In million board feet) [1]				
Eastern										
Red River	- -	- -	40.6	75.0	115.6	- -	- -	82.5	181.5	264.0
Devils Lake & James River	- -	0.4	35.9	11.5	47.9	- -	0.6	116.3	9.2	126.1
Souris River	- -	- -	67.0	39.3	106.2	- -	- -	60.9	58.2	119.1
Missouri River	- -	- -	75.5	21.7	97.2	- -	- -	272.4	11.9	284.3
Total	- -	0.4	219.0	147.4	366.9	- -	0.6	532.1	260.8	793.5
All counties	- -	0.4	219.0	147.4	366.9	- -	0.6	532.1	260.8	793.5

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic or board feet. Columns and rows may not add to their totals due to rounding.

[1] Doyle rule.

Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties

Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties

Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties

Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Table 65.—Sampling errors by Forest Survey Unit/County group for area of forest land, area of timberland, growing-stock volume on timberland, and sawtimber volume on timberland, North Dakota, 2005

Forest Survey Unit/County group	Area of forestland (acres)	Sampling error	Area of timberland (acres)	Sampling error	Growing-stock volume on timberland (cubic feet)	Sampling error	Sawtimber volume on timberland (board feet)	Sampling error
1 Devils Lake & James River	43,849	30.65	34,891	34.72	47,858,622	58.51	166,177,834	81.57
1 Missouri River	275,547	13.18	163,334	17.42	97,193,867	39.38	345,286,425	52.96
1 Red River	208,499	12.56	159,365	15.24	115,594,313	21.91	398,978,900	26.53
1 Souris River	196,266	12.92	176,078	13.83	106,226,661	21.36	211,790,844	31.63
All county groups	724,161	7.34	533,668	8.67	366,873,463	15.91	1,122,234,003	23.15

This report utilizes a sampling error based on one standard error which means the chances are two in three that had a 100-percent inventory been taken using these methods, the results would have been within the limits indicated.

Multiple county county groups:

Devils Lake & James River = Benson, Dickey, Foster, LaMoure, Ramsey, Stutsman, Towner, and Wells counties

Missouri River = Adams, Billings, Bowman, Burleigh, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, Logan, McIntosh, McLean, McKenzie, Mercer, Morton, Mountrail, Oliver, Sheridan, Sioux, Slope, Stark, and Williams counties

Red River = Barnes, Cass, Cavalier, Eddy, Grand Forks, Griggs, Nelson, Pembina, Ransom, Richland, Sargent, Steele, Traill, and Walsh counties

Souris River = Bottineau, Burke, Divide, McHenry, Pierce, Renville, Rolette, and Ward counties

Miles, Patrick D.; Haugen, David E.; Barnett, Charles J. 2011. **North Dakota's forests, 2005: statistics, methods, and quality assurance.** Resour. Bull. NRS-57. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 65 p.

The first full annual inventory of North Dakota's forests was completed in 2005 after 7,622 plots were selected and 164 forested plots were visited and measured. This report includes detailed information on forest inventory methods and data quality estimates. Important resource statistics are included in the tables. A detailed analysis of the North Dakota inventory is presented in Resource Bulletin NRS-31 (www.nrs.fs.fed.us/pubs/rb/rb_nrs31.pdf).

KEY WORDS: inventory, timberland, forest land, sampling error, sample design, volume, biomass

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