South Dakota's Forest Resources in 2004

Ronald J. Piva, Douglas Haugan, Gregory J. Josten, and
Gary J. Brand

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The North Central Research Station's Forest Inventory and Analysis program (NCFIA) began fieldwork for the fifth forest inventory of South Dakota's forest resources in 2001. This inventory initiated the new annual inventory system in which one-fifth of the field plots (considered one panel) in the State are measured each year. A complete inventory consists of measuring and compiling the data for all plots in all five panels. Once all panels have been measured, each will be remeasured approximately every 5 years. For example, in South Dakota, the field plots measured in 2004 will be remeasured in 2009.

In 2004, NCFIA continued the annual inventory effort with the fourth panel of the fifth forest inventory. This fifth inventory of South Dakota's forest resources will be completed in 2005. However, because each year's sample is a systematic sample of the State's forest and because timely information is needed about South Dakota's forest resources, estimates have been prepared from data gathered during the first 4 years of the inventory. Data presented in this report represent 80 percent of the field plots (or four panels) for a complete inventory and are a combination of the first year's panel from 2001, the second year's panel from 2002, the third year's panel from 2003, and the fourth year's panel from 2004. Earlier reports for the 2001 panel (Leatherberry and Haugan 2003), the 2002 panel (Piva et al. 2003), and the 2003 panel (Piva et al. 2005) have also been published. Results presented are estimates based on sampling techniques; estimates were compiled assuming the 2001, 2002, 2003, and 2004 data represent one sample. When the final

panel is completed in 2005, the precision of the estimates will increase and additional data will be released.

Reports of previous inventories of South Dakota are dated 1935, 1962, 1984, and 1996. As a result of our ongoing efforts to improve the efficiency and reliability of the inventory, several procedures and definitions have changed since the last South Dakota inventory in 1996 (Leatherberry et al. 2000). The most important change is the border-to-border inventory of forest resources in South Dakota. Before 1996, both the NCFIA and the Interior West FIA (IWFIA) (formerly the Intermountain FIA program) in Ogden, UT, inventoried South Dakota's forest resources. NCFIA inventoried that portion of the State east of the 103rd meridian. IWFIA inventoried western South Dakota (west of the 103rd meridian), including the Black Hills National Forest (BHNF). In 1996, NCFIA inventoried all of South Dakota except for the BHNF, which was inventoried by IWFIA in 1999 (DeBlander 2002). The portion of the Custer National Forest that is in South Dakota was inventoried again by IWFIA in 1997 (DeBlander 2001).

Because different designs and methods have been employed in various South Dakota inventories, a comparison of the 2004 data with data from earlier inventories should be interpreted with caution. Where comparisons are made with data from past inventories, they are done only to suggest the direction of change. For this report, the information for South Dakota's 1996 inventory is a combination of the 1996 inventory by NCFIA of all

About the Authors:

Ronald J. Piva is a Forester with the North Central Research Station, St. Paul, MN.

Douglas Haugan is Senior Forester/GIS Specialist with the South Dakota Department of Agriculture, Resource Conservation and Forestry Division, Pierre, SD.

Gregory J. Josten is Senior Forester/Stewardship Programs with the South Dakota Department of Agriculture, Resource Conservation and Forestry Division, Rapid City, SD.

Gary J. Brand is a Research Forester with the North Central Research Station, St. Paul, MN.

lands outside the BHNF and the 1999 inventory by IWFIA of the BHNF. The combined information was obtained from the Forest Inventory Mapmaker Web site located at: http://www.ncrs2.fs.fed.us/4801/FIADB/index.htm.

RESULTS

Area

In 2004, there were an estimated 1.6 million acres of forest land in South Dakota, accounting for almost 4 percent of the State's total land area. Forest land is land that is at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Seventy-one percent, or almost 1.2 million acres, of the forest land in the State was publicly owned (table 1). Most of the public land in the State is west of the Missouri River.

There are three major areas of natural forests in South Dakota (Ball and Erickson 1998). The Black Hills forest is the largest area of forest land in the State. This forested area is composed primarily of ponderosa pine, but also includes quaking aspen, Black Hills spruce (a variety of white spruce), paper birch, and bur oak. The second largest area of forest land is the flood plain forests along the Missouri River. American elm and green ash are the major species found in these forests. Bur oak forests along the upper terraces and draws of rivers, and in the northern Black Hills, account for the third largest area of forest land in the State. Other forested areas in South
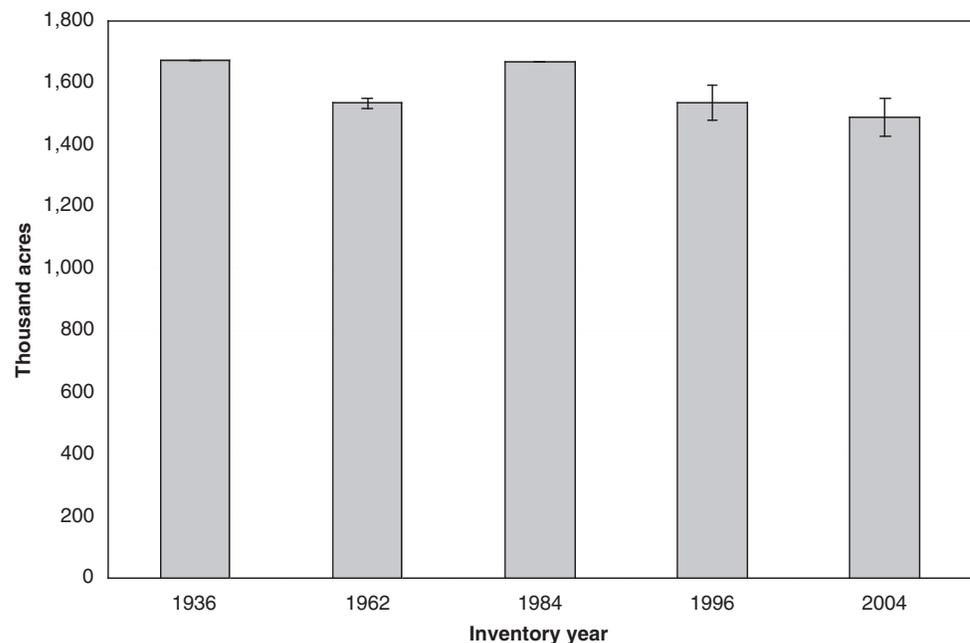
Figure 1.—Area of timberland, South Dakota, 1936-2004. (Note: The 1936 area may contain some area of forest land that is not timberland. Sample errors are not provided for the 1936 and 1984 inventories because no single statewide sample error is available for those inventories. The 1962 and 2004 estimates are for total timberland area; the sample error associated with the 1996 estimate is calculated for timber area outside of the BHNF. Sample error is represented by the vertical line at the top of each bar.)

Dakota are the cottonwood forests scattered along the rivers and streams throughout the State and the maple and basswood forests of the upland forests on the eastern side of the State.

Timberland accounted for 91 percent, or 1.5 million acres, of the forest land in South Dakota in 2004. Timberland is forest land that is producing, or is capable of producing, 20 cubic feet of wood per acre per year under natural conditions and is not restricted from harvest. Throughout most of the 20th century, the area of timberland in South Dakota remained relatively stable, rising and falling between 1.5 and 1.7 million acres (fig. 1). The 2004 timberland area estimate is based on a partial inventory (four panels of five), and the estimate is likely to change as more data are collected during the last panel of South Dakota's fifth survey of the forest resources in 2005.

Seventy-two percent of the timberland in the State is publicly owned (table 2). The USDA Forest Service, through the Black Hills and Custer National Forests, holds the majority of public timberland. Owners of less than 100 acres of timberland hold most of the private timberland in the State (Leatherberry et al. 2000). Those holdings are generally associated with farms or ranches. Native American tribal groups own an estimated 93 thousand acres of timberland held as tribal trust land within the boundaries of reservations in South Dakota (Haugen and Hansen 2002).

The ponderosa pine forest type accounted for over three-fourths of the total timberland area in South Dakota in 2004 (fig. 2). Overall, the softwood forest types combined accounted for 80 percent of the total timberland area in the State. The elm/ash/cottonwood forest type group occupied the second largest area of timberland, but accounted for only 7 percent of the total.

Although virtually all of the timberland area in South Dakota is of natural origin, South Dakota residents have a long history of planting trees. Most of these plantings are associated with windbreaks, shelterbelts, or farmstead plantings and do not meet the area and/or width requirements to be classified as timberland. Many of the earlier efforts to establish tree plantations failed or were later abandoned.
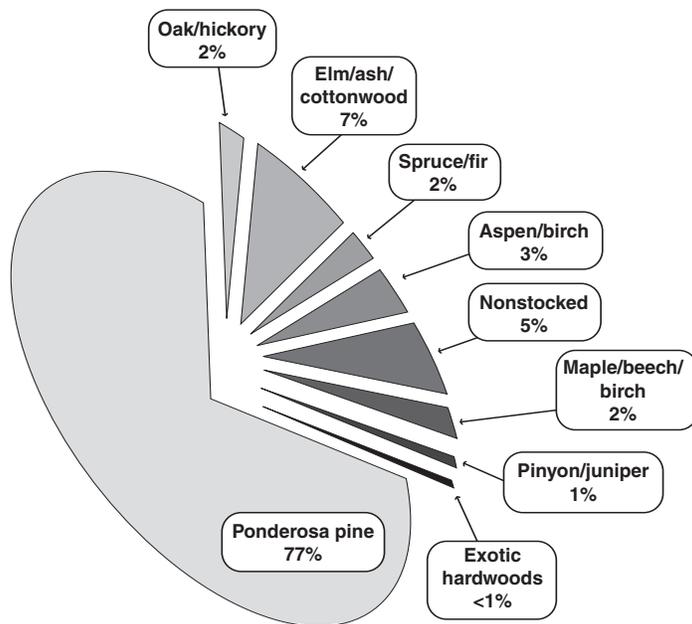

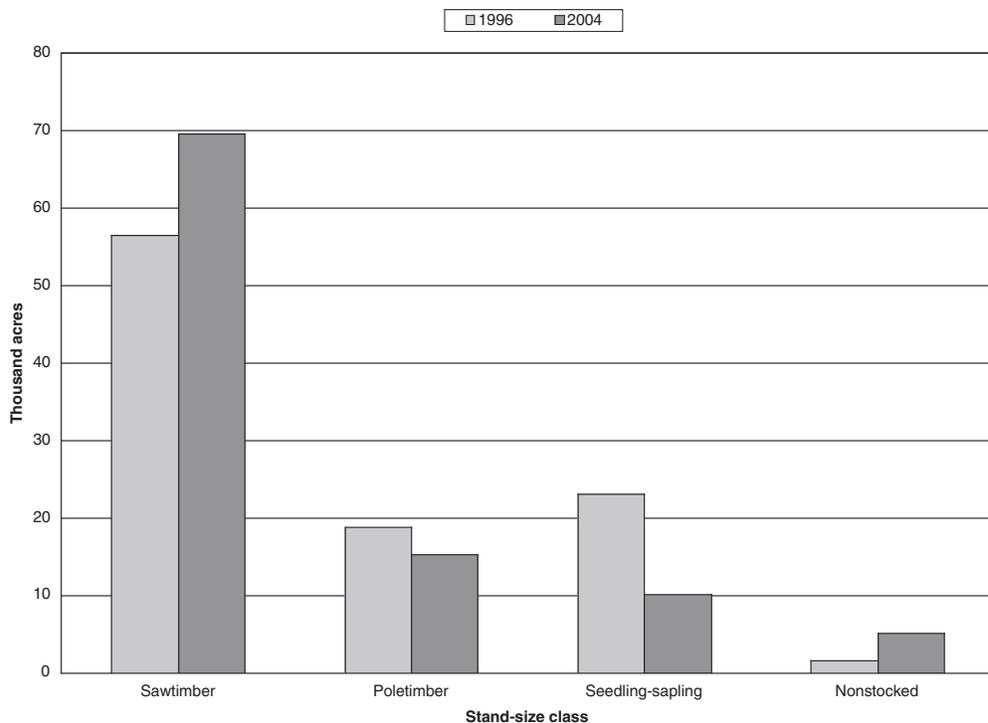Figure 2.—*Area of timberland by forest type group, South Dakota, 2004.*

Figure 3.—Area of timberland by stand-size class, South Dakota, 1996 and 2004.

As South Dakota's forests mature and are affected by natural and human-caused events, they take on certain stand-size characteristics. Stand-size class is a measure of the average diameter of the dominant trees in a stand. There are four stand-size classes: 1) sawtimber—large trees, softwoods at least 9 inches in diameter at breast height (d.b.h.) and hardwoods at least 11 inches d.b.h.; 2) poletimber—medium trees 5 inches in d.b.h. to sawtimber size; 3) sapling-seedling—small trees, softwoods at least 6 inches tall and hardwoods at least 1 foot tall, to poletimber size; 4) and nonstocked stands—timberland less than 10 percent stocked in all live trees. In 2004, sawtimber stands occupied 1 million acres of timberland, or 70 percent of the timberland area (table 3). Poletimber-size stands accounted for 15 percent of the timberland area, followed by sapling/seedling stands on 10 percent of timberland area. Nonstocked timberland occupied 5 percent of the total timberland area, mainly in the Black Hills area of the State. The predominance of

sawtimber-size stands reflects the presence of larger diameter ponderosa pine in the Black Hills National Forest and older, large-diameter bottomland hardwood stands.

Since South Dakota's forest inventory in 1996 and the BHNF inventory in 1999, the area of sawtimber-size stands has increased by almost 170 thousand acres. The area of poletimber-size stands and seedling-sapling-size stands has decreased by 61 thousand acres and 204 thousand acres, respectively (fig. 3). The ensuing fifth panel of the fifth South Dakota inventory will provide information for more definitive conclusions about forces driving the changes in stand-size class.

Volume

South Dakota's net volume of all live trees on forest land totaled 1.7 billion cubic feet (table 4). Almost 80 percent of this volume is from one species–ponderosa pine. All the hardwoods species combined accounted for only 18 percent of the total volume of all live trees

on forest land. Net cubic and board foot volumes are based on tree measurements (d.b.h., tree class, and site index) and volume models presented by Hahn and Hansen (1991). The models were regionally adjusted by applying cull factors computed from trees measured in the 1996 inventories of the Plains States.

Growing-stock trees on timberland accounted for over 95 percent (1.5 billion cubic feet) of the live tree volume on forest land. A growing-stock tree is a 5.0-inch d.b.h. or larger, live tree of commercial species that meets specified standards of size, quality, and merchantability. Besides growing-stock volume, there were an additional 68 million cubic feet in live cull trees (trees that were 5.0 inches d.b.h. or larger and unmerchantable for saw logs now or prospectively because of rot, roughness, or species) and 6 million cubic feet of salvable dead trees (trees downed or standing dead that were 5.0 inches d.b.h. or larger and contained at least one 8-foot section that was at least 50 percent sound) on timberland in South Dakota in 2004 (table 5). Over three-fourths of the live cull volume on timberland came from hardwood species. All of the salvable dead volume on timberland came from softwood species.

Almost 88 percent of the growing-stock volume on timberland came from the softwood forest type groups (table 6). Twelve percent of the volume was in the hardwood forest type groups. A minor amount of growing-stock volume came from nonstocked timberland.

Eighty-two percent (1.2 billion cubic feet) of the growing-stock volume on timberland came from ponderosa pine (fig. 4 and table 7). Cottonwood and aspen combined contained the second largest volume of growing stock, but still accounted for only 6 percent of the total volume. Between 1996 and 2004, ponderosa pine and spruce growing-stock volumes decreased in South Dakota, because of disturbances such as insect infestations, wildfires, and severe weather. As eastern redcedar becomes established on former rangeland and abandoned farmland, the volume of growing stock appears to be increasing.

There were 5.7 billion board feet of sawtimber in South Dakota (table 8). Sawtimber volume is the volume of wood in the saw log portion of sawtimber-size trees. More than half of the sawtimber volume came from the small-diameter, sawtimber-size trees less than 15 inches d.b.h.
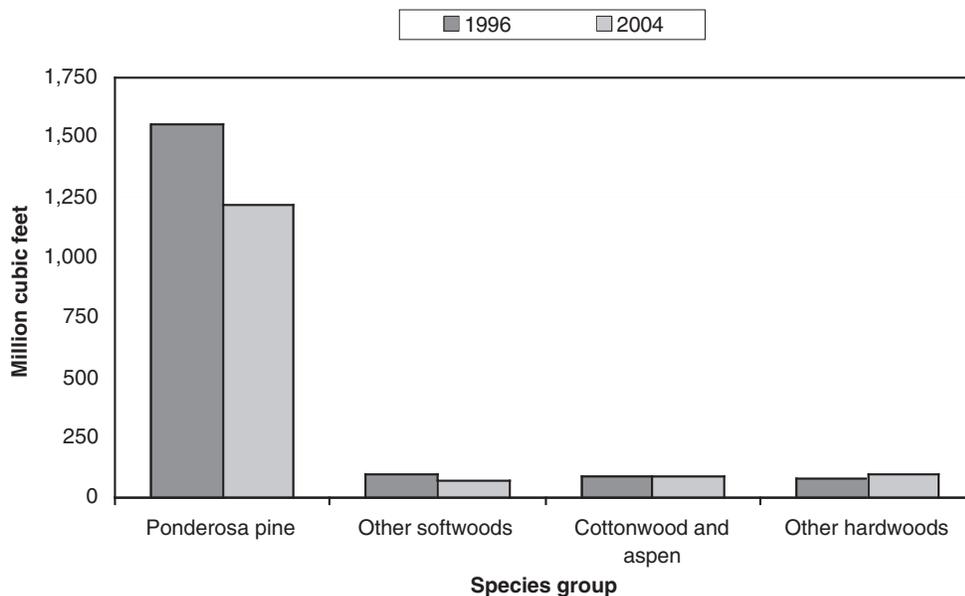

Figure 4.—Growing-stock volume on timberland by species group in South Dakota, 1996 and 2004.

Biomass

All live aboveground tree biomass on timberland in South Dakota was estimated at 28.9 million dry tons in 2004 (table 9). This averages out to almost 20 dry tons of biomass per acre of timberland. Biomass is the amount of total wood and bark (excluding foliage) of trees 1.0 inch in d.b.h or larger, including all tops and limbs. The dry tons estimate of biomass is an important measure because it provides information that can be used for analyses related to carbon sequestration, wood fiber availability for fuel, and other uses. In 2004, 89 percent of the total biomass was in growing-stock trees, 6 percent came from saplings between 1.0 and 5.0 inches d.b.h, and 5 percent came from non-growing-stock trees (cull trees and noncommercial species). Softwood species accounted for 77 percent of all live aboveground tree biomass on timberland. Eighty-four percent of the softwood biomass in the State is found on public lands. Hardwood biomass, on the other hand, is mostly privately owned with 82 percent of the total live hardwood biomass in private ownership.

Forest Health

Although South Dakota is mostly prairie and cropland, forests are an important component of the landscape. Currently, the primary concerns for South Dakota's forests are drought, the mountain pine beetle, and the pine engraver beetle (Harris 2005).

Drought conditions, which began in the western portions of South Dakota in 2001, were felt statewide in 2003. The drought has ended in the eastern part of the State, but much of the western half of the State is still experiencing a moisture deficit. This increased environmental stress resulted in tree mortality attributed in part to colonization of borers such as ash bark beetles, cottonwood borer, and Zimmerman pine moth.

Extensive ponderosa pine mortality has occurred throughout the Black Hills because of the mountain pine beetle, a bark beetle, during the past 6 years. Infestations in the Beaver Park and Deerfield areas of the Black Hills have been expanding. Pine mortality was widespread in the Northern Hills and Central Hills where a number of areas with very large concentrated beetle pockets have fused. Estimates from the 2004 survey set the number of trees killed by mountain pine beetle at almost 150 thousand trees, with 58 thousand acres affected.

Another bark beetle killing many ponderosa pines in the Black Hills and the Pine Ridge Indian Reservation is the pine engraver beetle. The activity of this beetle was concentrated in the southern Black Hills, in burned areas and around the perimeter of the forest. The population has been increasing in recent years because of the increase in suitable hosts: trees that have been injured or killed by fire, mountain pine beetle, severe snow, or hail storms. About half of the mapped mortality in the Black Hills National Forest is within and adjacent to areas that burned from 1 to 5 years ago. Since 2000, approximately 180 thousand acres have burned in the Black Hills. Many of the areas hardest hit by the pine engraver beetle were in the wildland-urban interface. More than 70 thousand ponderosa were killed and 45 thousand acres affected in 2004 by pine engraver beetles.

A more complete discussion of forest health issues that have affected South Dakota forests since the last complete forest inventory and of current events is available at: http://fhm.fs.fed.us/

SUMMARY

In summary, estimates of South Dakota's forest resources indicate timberland area has remained relatively stable at about 3 percent of the total land area. Ponderosa pine, found mostly in the Black Hills region, is the predominant forest type group. Eastern redcedar appears to be expanding in the State, but it is

still a minor portion of the total area and volume. As additional data become available from ensuing annual inventories, a clearer picture of the direction of South Dakota's forests will emerge. Additional data related to the two most recent inventories of South Dakota (1980 and 1996) are available at: www.ncrs.fs.fed.us/4801/fiadb/index.htm.

APPENDIX

Inventory Methods

Since the 1996 inventory of South Dakota's forest outside the BHNF, several changes have been made in NCFIA inventory methods to improve the quality of the inventory as well as meet increasing demands for timely forest resource information. The most significant difference between inventories is the change from periodic inventories to annual inventories. Historically, NCFIA periodically inventoried each State on a cycle that averaged about 12 years. However, the need for timely and consistent data across large regions, combined with national legislative mandates, resulted in NCFIA's implementation of an annual inventory system. The annual inventory system began in South Dakota in 2001. At that time, the NCFIA program assumed responsibility for inventorying all forest lands in South Dakota.

With the NCFIA annual inventory system, approximately one-fifth of all field plots are measured each year. After 5 years, the entire inventory cycle will be completed. After the initial 5-year cycle, NCFIA will report and analyze results as a moving 5-year average. For example, NCFIA will be able to generate a report based on inventory results for 2001 through 2005 or for 2002 through 2006. While there are great advantages for an annual inventory, one difficulty is reporting on results for fewer than 5 years. With the 2001-2004 panels, only 80 percent of all field plots have been measured. Sampling error estimates for the 2004 inventory results are area of forest land, 3.69 percent; area of timberland, 4.06

percent; volume of growing stock on timberland, 5.74 percent; and volume of sawtimber on timberland, 6.41 percent. These sampling error estimates are higher than those for the last periodic inventory completed in 1996 (e.g., 3.8 percent for timberland area outside the BHNF and 4.2 percent for growing-stock volume outside the BHNF) because of the smaller sample sizes. Thus, caution should be used when drawing conclusions based on this limited data set. As we complete ensuing measurements, we will have additional confidence in our results due to the increased number of field plots measured. As each measurement year is completed, the precision of estimates will improve.

Other significant changes between inventories include new remote sensing technology, use of a new sampling design, new field plot configuration, and additional remotely sensed and field data. The advent of remote sensing technology since the previous inventory in 1996 has allowed NCFIA to use Multi-Resolution Land Characterization (MRLC) data and other available remote sensing products to stratify the total area of the State and to improve the precision of estimates. Previous inventories used manual interpretation of aerial photos to stratify the sample.

New algorithms were used in 2004 to assign forest type and stand-size class to each condition observed on a plot (Bechtold and Patterson 2005). FIA is using these algorithms nationwide to increase consistency among States. The list of recognized forest types, grouping of these forest types for reporting purposes, models used to assign stocking values to individual trees, definition of non-stocked, and names given to the forest types changed with the new algorithms. As a result, comparisons between the 1996 inventory results and those published for the 2004 inventory may not be valid. For additional details about algorithms used in both inventories, please contact NCFIA.

Sampling Phases

The 2004 South Dakota survey was conducted in three phases. The first phase used classified satellite imagery to stratify the State and aerial photographs to select plots for field measurement. The second phase measured the traditional FIA suite of mensurational variables, and the third phase focused on a suite of variables related to the health of the forest.

The only land that could not be sampled was (1) private land where field personnel could not obtain permission from the owner to measure the field plot and (2) plots that could not be accessed because of a hazard or danger to field personnel. The methods used in the preparation of this report make the necessary adjustments to account for sites where access was denied. There was one denied access plot in 2001 and in 2004, four denied access plots in 2002, and none in 2003. There were no plots that were too hazardous to establish in 2001, 2002, and 2004, and two plots in 2003.

Phase 1

The 2004 South Dakota inventory used a classification of 30-m Landsat Thematic Mapper satellite imagery. FIA used the imagery to form two initial strata—forest and nonforest. Pixels within 60 m (2 pixel widths) of a forest/nonforest edge formed two additional strata--forest edge and nonforest edge. Forest pixels within 60 m on the forest side of a forest-nonforest boundary were classified into a forest edge stratum. Pixels within 60 m of the boundary on the nonforest side were classified into a nonforest edge stratum. The estimated population total for a variable is the sum across all strata of the product of each stratum's estimated area and the variable's estimated mean per unit area for the stratum. Stratification and estimation were conducted at the NCFIA Forest Survey Unit level. All private land and the BHNF were stratified into one of the four strata: (1) nonforest, (2) nonforest edge, (3) forest, or (4) forest edge. The Custer National Forest was stratified into one of two strata: (1) nonforest and nonforest edge combined, or (2) forest and forest edge combined. All the other public land in South Dakota was stratified into one of three strata: (1) nonforest, (2) nonforest edge, or (3) forest and forest edge combined.

In the 1996 South Dakota inventory outside the BHNF, photointerpreters at NCFIA assembled aerial photographs into township mosaics, and a systematic grid of 121 one-acre photo plots (each dot representing approximately 190.4 acres on the ground) was overlaid on each township mosaic. Each of these photo plots was stereoscopically examined and classified based on land use, forest type, and stand-size density. From these photo plots, a systematic sample of plots (without regard to their aerial photo classification) was selected as ground plots and further examined by survey crews to verify the classification and to take further measurements. Additional information related to the procedures for the 1996 South Dakota inventory can be found in Leatherberry et al. (2000), and procedures for the 1999 BHNF inventory by IWFIA can be found in DeBlander (2002) and USDA Forest Service (1999).

The move to satellite imagery changed NCFIA's phase 1 sample from being based on one photo plot for every 190.4 acres to a sample based on a classified pixel every 0.22 acres. The increased intensity of the phase 1 sample greatly improved estimates of the area within each stratum, particularly at the county level. Additionally, because the classification was conducted across the entire State, biases in the photo plot sampling method that resulted from differences in photo quality, age of photography, and experience of the photointerpreter were minimized and classification was consistent across the entire State.

Phase 2

Phase two of the inventory consisted of the measurement of the first annual sample of field plots in South Dakota and the re-measurement of inventory plots from the 1999 BHNF inventory (DeBlander 2002). Current FIA precision standards for annual inventories

require a sampling intensity of one plot for approximately every 6,000 acres. FIA has established a plot array that divides the entire area of the United States into nonoverlapping hexagons, each of which contains approximately 5,937 acres (McRoberts 1999). An array of field plots was established by selecting one plot from each hexagon based on the following rules: (1) if an IWFIA plot from the 1999 inventory of the BHNF fell within a hexagon, it was selected; (2) if more than one IWFIA plot from the 1999 inventory of the BHNF fell within a hexagon, the plot nearest the hexagon center was selected; and (3) if no existing IWFIA plots fell within the hexagon, and for all area outside the BHNF, a new NCFIA plot was established in the hexagon (McRoberts 1999). This array of plots is designated the Federal base sample and is considered an equal probability sample; its measurement in South Dakota is funded by the Federal government.

The total Federal base sample was systematically divided into five interpenetrating, nonoverlapping subsamples or panels. Each year the plots in a single panel are measured, and panels are selected on a 5-year, rotating basis (McRoberts 1999). For estimation purposes, the measurement of each panel of plots may be considered an independent systematic sample of all land in a State. Field crews measure vegetation on plots forested at the time of the last inventory and on plots currently classified as forested or straddler (nonforest/forest and forest/nonforest) by trained photointerpreters using aerial photos or digital orthophotoquads. A sample of plots classified as nonforest was checked to ensure correct classification.

Phase 3

NCFIA has two categories of field plot measurements—phase 2 plots (standard FIA plots) and phase 3 plots (forest health plots). Both types of plot are systematically distributed both geographically and temporally. Phase 3 plots are measured with the full array of FHM

vegetative and health variables (Mangold 1998) collected as well as the full suite of measures associated with phase 2 plots. Phase 3 plots must be measured between June 1 and August 30 to accommodate the additional measurement of nonwoody understory vegetation, ground cover, soils, and other variables. We anticipate that in South Dakota the complete 5-year annual inventory will include the classification of approximately 520 phase 3 plots, of which approximately 26 will have field measurements. On the remaining plots, referred to as phase 2 plots, only variables that can be measured throughout the entire year are collected. In South Dakota, the complete 5-year annual inventory is expected to include the classification of about 8,302 phase 2 plots. The 2001-2004 annual panel results represent field measures on 227 timberland plots, 26 other forest land plots, 8 denied access and hazardous plots, and 6,382 non-forest land plots.

The new national FIA plot configuration with four subplots (fig. 5) was first used for data collection in South Dakota in the BHNF in 1999 and for the rest of the State during the 2001 panel. This design was also used in the 2002, 2003, and 2004 panels and will be used in subsequent years. On forest land outside the BHNF, all plots in the annualized inventory are newly established; therefore, some remeasurement data will not be available until the sixth year of the annual inventory. These measurements form the basis for change estimates between the first five-panel cycle and the second five-panel cycle for characteristics such as average annual net growth, mortality, and removals. The national plot design requires mapping forest conditions on each plot. Due to the small sample size (20 percent) each year, precision associated with change factors such as mortality will be relatively low. Consequently, change estimates outside the BHNF may not be reported until at least the third annual panel of the second five-panel cycle of inventory has been implemented, and even then we anticipate that estimates of change will be limited in detail. When the

complete second five-panel annual inventory has been completed in 2010, the full range of change variables will be available for the entire State.

Subplot: 24.0 ft radius

Annular Plot: 58.9 ft radius

Azimuth 1-2 = 360°
Azimuth 1-3 = 120°
Azimuth 1-4 = 240°

Distance between subplot centers is 120 ft horizontal

N
MAGNETIC

Microplot: 6.8 ft radius center is 12 ft horizontal @ 90° azimuth from the subplot center
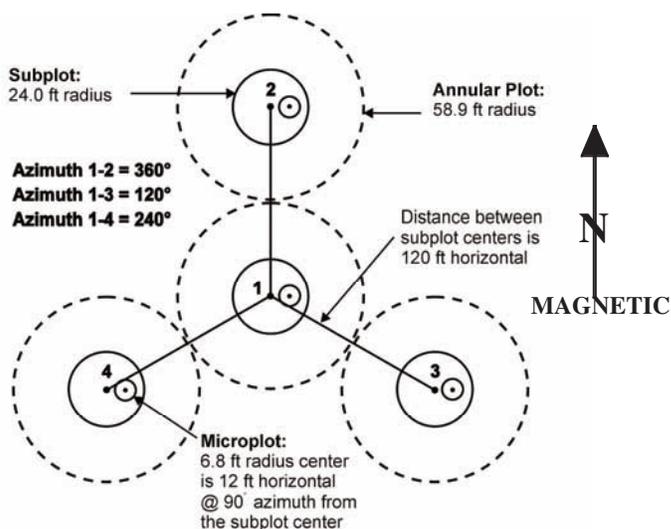
Figure 5.—Current NCFIA field plot design.

The overall plot layout for the new design consists of four subplots. The centers of subplots 2, 3, and 4 are located 120 feet from the center of subplot 1. The azimuths to subplots 2, 3, and 4 are 0, 120, and 240 degrees, respectively. For remeasurement plots from the 1999 inventory of the BHNF, the center of the plot is located at the same point as the center of the previous plot. Trees with diameter at breast height (diameter at 4.5 feet above ground level, commonly referred to as d.b.h.) or diameter at the root collar (for woodland species such as Rocky Mountain juniper, commonly referred to as d.r.c.) 5

inches and larger are measured on a 24-foot-radius (1/24 acre) circular subplot. All trees less than 5 inches d.b.h/d.r.c. are measured on a 6.8-foot-radius (1/300 acre) circular microplot located 12.0 feet due east of the center of each of the four subplots. Forest conditions that occur on any of the four subplots are recorded. Factors that differentiate forest conditions are changes in forest type, stand-size class, land use, ownership, and density. Each condition that occurs anywhere on any of the subplots is identified, described, and mapped if the area of the condition meets or exceeds 1 acre in size.

Field plot measurements are combined with phase 1 estimates in the compilation process and table production. The number of tables generated from less than five panels of data is limited. However, at http://ncrs2.fs.fed.us/4801/fiadb/fim17/wcfim 17.asp other tabular data can be generated. For additional information, contact:
Program Manager
Forest Inventory and Analysis
North Central Research Station
1992 Folwell Ave.
St. Paul, MN 55108-1034

or

State Forester
South Dakota Department of Agriculture
Resurce Conservation and Forestry Division
523 East Capitol Avenue
Pierre, SD 57501-3182

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TABLE TITLES

Table 1.—*Area of forest land by forest type group, forest type, and owner category, South Dakota, 2001–2004*

Table 2.—*Area of timberland by major forest type group, stand origin, and owner category, South Dakota, 2001–2004*

Table 3.—*Area of timberland by forest type group, forest type, and stand-size class, South Dakota, 2001–2004*

Table 4.—*Net volume of all live trees on forest land by species group, species, and owner category, South Dakota, 2001–2004*

Table 5.—*Net volume of all live trees and salvable dead trees on timberland by class of timber and softwood/hardwood species category, South Dakota, 2001–2004*

Table 6.—*Net volume of growing stock on timberland by forest type group, forest type, and softwood/hardwood species category, South Dakota, 2001–2004*

Table 7.—*Net volume of growing stock on timberland by species group, species, and diameter class, South Dakota, 2001–2004*

Table 8.—*Net volume of sawtimber on timberland by species group, species, and diameter class, South Dakota, 2001–2004*

Table 9.—*All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree component, South Dakota, 2001–2004*

TABLES

Table 1. -- Area of forest land by forest type group, forest type, and owner category, South Dakota, 2001-2004

(In thousand acres)

Forest type group/ forest type	Owner category			
	All owners	Public	Private	Unidentified owner
Softwood type groups				
Spruce / fir group				
White spruce	32.3	32.3	- -	- -
All forest types	32.3	32.3	- -	- -
Pinyon / juniper group				
Eastern redcedar	19.6	- -	19.6	- -
Rocky Mountain juniper	8.3	8.3	- -	- -
All forest types	27.9	8.3	19.6	- -
Ponderosa pine group				
Ponderosa pine	1,197.0	977.3	219.8	- -
All forest types	1,197.0	977.3	219.8	- -
All softwood groups	1,257.3	1,017.9	239.4	- -
Hardwood type groups				
Oak / hickory group				
Bur oak	37.9	12.3	25.5	- -
Mixed upland hardwoods	19.4	- -	19.4	- -
All forest types	57.3	12.3	45.0	- -
Elm / ash / cottonwood group				
Black ash / American elm / red maple	0.9	- -	0.9	- -
Cottonwood	42.4	- -	42.4	- -
Sugarberry / hackberry / elm / green ash	62.9	6.6	56.3	- -
Cottonwood / willow	4.9	- -	4.9	- -
All forest types	111.1	6.6	104.5	- -
Maple / beech / birch group				
Elm / ash / locust	51.4	4.7	46.8	- -
All forest types	51.4	4.7	46.8	- -
Aspen / birch group				
Aspen	54.9	45.1	9.8	- -
All forest types	54.9	45.1	9.8	- -
Exotic hardwoods group				
Other exotic hardwoods	5.6	- -	5.6	- -
All forest types	5.6	- -	5.6	- -
All hardwood groups	280.3	68.7	211.6	- -
Nonstocked	101.2	71.5	29.7	- -
All forest groups	1,638.8	1,158.1	480.7	- -

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.

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Table 2. -- Area of timberland by major forest type group,
stand origin, and owner category, South Dakota, 2001 - 2004

(In thousand acres)

Major forest type group and stand origin	Owner category			
	All owners	Public	Private	Unidentified owner
Softwood type groups				
Natural	1,192.1	959.3	232.8	- -
All softwood types	1,192.1	959.3	232.8	- -
Hardwood type groups				
Natural	222.8	45.4	177.4	- -
All hardwood types	222.8	45.4	177.4	- -
Nonstocked	75.4	65.2	10.2	- -
All groups	1,490.4	1,070.0	420.4	- -

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 timberland by forest type group, forest type, and
stand-size class, South Dakota, 2001-2004

(In thousand acres)

Forest type group/ forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling-seedling	Non-stocked
Softwood type groups					
Spruce / fir group					
White spruce	32.3	25.0	7.3	- -	- -
All forest types	32.3	25.0	7.3	- -	- -
Pinyon / juniper group					
Eastern redcedar	13.0	13.0	- -	- -	- -
Rocky Mountain juniper	8.3	- -	- -	8.3	- -
All forest types	21.4	13.0	- -	8.3	- -
Ponderosa pine group					
Ponderosa pine	1,138.5	901.5	135.8	101.2	- -
All forest types	1,138.5	901.5	135.8	101.2	- -
All softwood groups	1,192.1	939.6	143.0	109.5	- -
Hardwood type groups					
Oak / hickory group					
Bur oak	11.4	- -	11.4	- -	- -
Mixed upland hardwoods	19.4	6.0	6.4	7.0	- -
All forest types	30.8	6.0	17.8	7.0	- -
Elm / ash / cottonwood group					
Cottonwood	40.5	33.0	7.5	- -	- -
Sugarberry / hackberry / elm / green ash	62.9	41.7	5.8	15.4	- -
Cottonwood / willow	4.9	4.9	- -	- -	- -
All forest types	108.3	79.7	13.3	15.4	- -
Maple / beech / birch group					
Elm / ash / locust	29.5	4.6	18.5	6.4	- -
All forest types	29.5	4.6	18.5	6.4	- -
Aspen / birch group					
Aspen	48.6	7.6	28.8	12.2	- -
All forest types	48.6	7.6	28.8	12.2	- -
Exotic hardwoods group					
Other exotic hardwoods	5.6	- -	5.6	- -	- -
All forest types	5.6	- -	5.6	- -	- -
All hardwood groups	222.8	97.9	84.0	40.9	- -
Nonstocked	75.4	- -	- -	- -	75.4
All forest groups	1,490.4	1,037.5	227.1	150.5	75.4

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. -- Net volume of all live trees on forest land by species group, species,
and owner category, South Dakota, 2001-2004

(In thousand cubic feet)

Species group/ species	All owners	Owner category Public	Private	Unidentified owner
Softwoods				
Spruce and balsam fir				
White spruce	59,524	57,059	2,465	- -
All species	59,524	57,059	2,465	- -
Other eastern softwoods				
Rocky Mountain juniper	10,792	5,376	5,416	- -
Eastern redcedar	6,531	- -	6,531	- -
Ponderosa pine	1,301,636	1,101,715	199,921	- -
All species	1,318,959	1,107,091	211,868	- -
Total softwoods	1,378,483	1,164,150	214,333	- -
Hardwoods				
Select white oaks				
Bur oak	90,422	15,008	75,415	- -
All species	90,422	15,008	75,415	- -
Hard maple				
Sugar maple	1,074	- -	1,074	- -
All species	1,074	- -	1,074	- -
Ash				
Green ash	49,751	1,374	48,377	- -
All species	49,751	1,374	48,377	- -
Cottonwood and aspen				
Eastern cottonwood	70,972	- -	70,972	- -
Quaking aspen	28,554	25,754	2,800	- -
All species	99,526	25,754	73,772	- -
Basswood				
American basswood	771	- -	771	- -
All species	771	- -	771	- -
Other eastern soft hardwoods				
Boxelder	16,843	- -	16,843	- -
Paper birch	2,781	2,555	225	- -
Hackberry	3,944	- -	3,944	- -
American elm	28,797	593	28,203	- -
Siberian elm	3,175	- -	3,175	- -
All species	55,539	3,148	52,391	- -
Eastern noncommercial hardwoods				
Eastern hophornbeam	1,871	368	1,503	- -
Chokecherry	50	- -	50	- -
Willow spp.	1,012	- -	1,012	- -
All species	2,933	368	2,564	- -
Total hardwoods	300,016	45,652	254,364	- -
All species groups	1,678,499	1,209,802	468,697	- -

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

Table 5. -- Net volume of all live trees and salvable dead trees on timberland
by class of timber and softwood/hardwood species category, South Dakota, 2001-2004

(In thousand cubic feet)

Class of timber	All species	Softwood species	Hardwood species
Live trees			
Growing-stock trees			
Sawtimber			
Saw log portion	1,030,151	931,148	99,003
Upper stem portion	145,166	133,315	11,851
Total	1,175,317	1,064,463	110,855
Poletimber	301,243	222,149	79,094
All growing-stock trees	1,476,561	1,286,612	189,949
Cull trees			
Rough trees[1]			
Sawtimber size	52,416	12,253	40,163
Poletimber size	13,194	2,279	10,914
Total	65,609	14,532	51,077
Rotten trees[1]			
Sawtimber size	1,259	638	621
Poletimber size	1,257	- -	1,257
Total	2,516	638	1,878
All live cull trees	68,125	15,170	52,955
All live trees	1,544,686	1,301,782	242,904
Salvable dead trees			
Sawtimber size	3,464	3,464	- -
Poletimber size	2,861	2,861	- -
All salvable dead trees	6,325	6,325	- -
All classes	1,551,010	1,308,107	242,904

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

Table 6. -- Net volume of growing stock on timberland by forest type group,
forest type, and softwood/hardwood species category, South Dakota, 2001-2004

(In thousand cubic feet)

Forest type group/ forest type	All species	Softwood species	Hardwood species
Softwood type groups			
Spruce / fir group			
White spruce	46,987	43,338	3,650
All forest types	46,987	43,338	3,650
Pinyon / juniper group			
Eastern redcedar	4,791	4,791	- -
Rocky Mountain juniper	300	300	- -
All forest types	5,091	5,091	- -
Ponderosa pine group			
Ponderosa pine	1,243,062	1,222,113	20,949
All forest types	1,243,062	1,222,113	20,949
All softwood groups	1,295,140	1,270,542	24,599
Hardwood type groups			
Oak / hickory group			
Bur oak	12,445	615	11,830
Mixed upland hardwoods	19,404	3,514	15,890
All forest types	31,849	4,129	27,719
Elm / ash / cottonwood group			
Cottonwood	62,904	- -	62,904
Sugarberry / hackberry / elm / green ash	32,319	- -	32,319
Cottonwood / willow	12,156	- -	12,156
All forest types	107,379	- -	107,379
Maple / beech / birch group			
Elm / ash / locust	15,525	1,384	14,141
All forest types	15,525	1,384	14,141
Aspen / birch group			
Aspen	22,666	9,730	12,935
All forest types	22,666	9,730	12,935
Exotic hardwoods group			
Other exotic hardwoods	3,175	- -	3,175
All forest types	3,175	- -	3,175
All hardwood groups	180,594	15,244	165,350
Nonstocked	826	826	- -
All forest groups	1,476,561	1,286,612	189,949

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

Table 7. -- Net volume of growing stock on timberland by species group, species, and diameter class, South Dakota, 2001-2004

(In thousand cubic feet)

Species group/species	All classes	Diameter class (inches at breast height)									
		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	21.0-28.9	29.0+
Softwoods											
Spruce and balsam fir											
White spruce	58,539	3,323	7,678	9,086	8,017	12,602	10,434	3,237	4,163	- -	- -
All species	58,539	3,323	7,678	9,086	8,017	12,602	10,434	3,237	4,163	- -	- -
Other eastern softwoods											
Rocky Mountain juniper	4,627	1,079	2,073	1,049	427	- -	- -	- -	- -	- -	- -
Eastern redcedar	6,060	634	715	2,214	1,334	1,164	- -	- -	- -	- -	- -
Ponderosa pine	1,217,386	58,769	147,879	205,257	202,054	191,271	145,636	112,426	74,002	71,172	8,920
All species	1,228,074	60,482	150,667	208,520	203,814	192,435	145,636	112,426	74,002	71,172	8,920
Total softwoods	1,286,612	63,805	158,345	217,606	211,831	205,037	156,070	115,662	78,164	71,172	8,920
Hardwoods											
Select white oaks											
Bur oak	43,442	8,758	10,604	5,869	6,443	3,743	1,230	4,049	- -	2,747	- -
All species	43,442	8,758	10,604	5,869	6,443	3,743	1,230	4,049	- -	2,747	- -
Hard maple											
Sugar maple	1,074	- -	- -	407	667	- -	- -	- -	- -	- -	- -
All species	1,074	- -	- -	407	667	- -	- -	- -	- -	- -	- -
Ash											
Green ash	30,062	3,359	5,612	6,971	3,870	3,993	1,940	- -	- -	4,317	- -
All species	30,062	3,359	5,612	6,971	3,870	3,993	1,940	- -	- -	4,317	- -
Cottonwood and aspen											
Eastern cottonwood	69,126	369	950	1,694	1,468	4,508	4,714	6,408	3,026	18,207	27,783
Quaking aspen	23,460	7,271	8,881	4,848	1,653	806	- -	- -	- -	- -	- -
All species	92,586	7,639	9,831	6,542	3,121	5,314	4,714	6,408	3,026	18,207	27,783
Basswood											
American basswood	771	322	163	286	- -	- -	- -	- -	- -	- -	- -
All species	771	322	163	286	- -	- -	- -	- -	- -	- -	- -
Other eastern soft hardwoods											
Boxelder	5,024	- -	- -	- -	- -	- -	1,101	1,571	2,352	- -	- -
Paper birch	2,506	1,522	983	- -	- -	- -	- -	- -	- -	- -	- -
Hackberry	327	- -	- -	327	- -	- -	- -	- -	- -	- -	- -
American elm	10,982	1,661	2,832	2,231	2,268	738	1,252	- -	- -	- -	- -
Siberian elm	3,175	476	1,618	1,081	- -	- -	- -	- -	- -	- -	- -
All species	22,014	3,660	5,433	3,639	2,268	738	2,352	1,571	2,352	- -	- -
Total hardwoods	189,949	23,739	31,642	23,713	16,370	13,788	10,236	12,028	5,379	25,271	27,783
All species groups	1,476,561	87,544	189,987	241,319	228,201	218,825	166,306	127,691	83,543	96,444	36,703

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

Table 8. -- Net volume of sawtimber on timberland by species group, species, and diameter class, South Dakota, 2001-2004

(In thousand board feet)[1]

Species group/ species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Spruce and balsam fir									
White spruce	200,367	38,315	34,018	52,626	43,876	13,739	17,793	- -	- -
All species	200,367	38,315	34,018	52,626	43,876	13,739	17,793	- -	- -
Other eastern softwoods									
Rocky Mountain juniper	7,193	5,046	2,148	- -	- -	- -	- -	- -	- -
Eastern redcedar	24,767	12,076	6,879	5,812	- -	- -	- -	- -	- -
Ponderosa pine	4,979,740	953,169	967,740	940,443	733,123	579,364	385,659	372,910	47,332
All species	5,011,701	970,291	976,767	946,255	733,123	579,364	385,659	372,910	47,332
Total softwoods	5,212,068	1,008,606	1,010,785	998,881	776,998	593,103	403,453	372,910	47,332
Hardwoods									
Select white oaks									
Bur oak	87,465	- -	30,423	17,749	5,909	19,680	- -	13,705	- -
All species	87,465	- -	30,423	17,749	5,909	19,680	- -	13,705	- -
Hard maple									
Sugar maple	3,174	- -	3,174	- -	- -	- -	- -	- -	- -
All species	3,174	- -	3,174	- -	- -	- -	- -	- -	- -
Ash									
Green ash	64,358	- -	16,104	17,462	8,733	- -	- -	22,060	- -
All species	64,358	- -	16,104	17,462	8,733	- -	- -	22,060	- -
Cottonwood and aspen									
Eastern cottonwood	315,293	- -	6,017	19,735	21,109	30,167	14,338	91,702	132,225
Quaking aspen	11,395	- -	7,506	3,889	- -	- -	- -	- -	- -
All species	326,688	- -	13,523	23,624	21,109	30,167	14,338	91,702	132,225
Other eastern soft hardwoods									
Boxelder	22,956	- -	- -	- -	4,873	7,123	10,961	- -	- -
American elm	18,782	- -	9,856	3,310	5,615	- -	- -	- -	- -
All species	41,738	- -	9,856	3,310	10,488	7,123	10,961	- -	- -
Total hardwoods	523,423	- -	73,079	62,145	46,239	56,969	25,298	127,467	132,225
All species groups	5,735,490	1,008,606	1,083,864	1,061,026	823,237	650,073	428,751	500,377	179,556

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the volume rounds to less than 1 thousand board feet. Columns and rows may not add to their totals due to rounding.
[1] International 1/4-inch rule.

Table 9. -- All live aboveground tree biomass on timberland by owner category,
softwood/hardwood species category, and tree biomass component, South Dakota, 2001-2004

(In dry tons)

Owner category and softwood/hardwood category	All components	All live 1-5 inch trees	Growing-stock trees			Non-growing-stock trees		
			Total	Boles	Stumps, tops, and limbs	Total	Boles	Stumps, tops, and limbs
Public								
Softwoods	18,608,721	687,795	17,778,510	14,704,877	3,073,633	142,416	117,419	24,997
Hardwoods	1,206,413	399,190	741,780	515,655	226,126	65,443	46,528	18,915
Total	19,815,134	1,086,984	18,520,291	15,220,532	3,299,758	207,859	163,947	43,912
Private								
Softwoods	3,671,799	133,334	3,415,907	2,838,571	577,335	122,558	94,263	28,295
Hardwoods	5,368,304	398,908	3,726,261	2,683,391	1,042,870	1,243,135	905,386	337,749
Total	9,040,103	532,242	7,142,168	5,521,963	1,620,205	1,365,693	999,649	366,044
All ownerships								
Softwoods	22,280,520	821,129	21,194,417	17,543,449	3,650,968	264,974	211,683	53,292
Hardwoods	6,574,717	798,098	4,468,041	3,199,046	1,268,995	1,308,578	951,914	356,664
Total	28,855,237	1,619,227	25,662,458	20,742,495	4,919,963	1,573,552	1,163,596	409,956

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 dry ton. Columns and rows may not add to their totals due to rounding.

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Piva, Ronald J.; Haugan, Douglas; Josten, Gregory J.; Brand, Gary J.
  2005. **South Dakota's forest resources in 2004.** Resour. Bull. NC-254. St. Paul,
    MN: U.S. Department of Agriculture, Forest Service, North Central Research
    Station. 22 p.

    Reports the initial results of the first four annual panels (2001-2004) of the fifth
    forest inventory of South Dakota. Includes information on forest area; volume; bio-
    mass; and forest health.

    KEY WORDS: Annual inventory, forest land, timberland, forest type, volume, bio-
    mass, forest health, South Dakota.

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