



SouthPro

A Computer Program for Managing Uneven-Aged Loblolly Pine Stands

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Abstract

SouthPro is a Microsoft Excel add-in program that simulates the management, growth, and yield of uneven-aged loblolly pine stands in the Southern United States. The built-in growth model of this program was calibrated from 991 uneven-aged plots in seven states, covering most growing conditions and sites. Stands are described by the number of trees in 13 size classes for softwood, soft hardwood, and hard hardwood species. SouthPro allows managers to predict stand development, by year and for many decades, from a specific initial diameter distribution. Cutting regimes are specified by the timing and intensity of harvest. Cutting intensity can be set by a free target distribution or a basal area–maximum diameter– q -ratio (BDq) target distribution, or as a diameter-limit cut. Diameter distribution, basal area, volume, income, net present value, and stand diversity by species group and size class are shown in tabulated and graphic form.

This manual provides suggestions for working with Excel, describes program installation and activation of SouthPro, and gives background information on the SouthPro growth model. The manual includes a comprehensive tutorial that explains how to start the program; enter simulation data; generate BDq distributions; add, delete, and retrieve setup files; execute single and multiple simulations; plot summary statistics; and produce stock-and-cut tables and marking guides. Limitations of the model and appropriate interpretations of its predictions are discussed.

Keywords: Loblolly pine, *Pinus taeda*, uneven-aged, selection, management, economics, ecology, SouthPro, south, simulation, software, growth model, diversity.

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Chapter 1. Overview

Manual

This chapter provides an overview of the SouthPro program, offers suggestions for users who are new to Microsoft Excel,¹ and describes options for getting help with SouthPro. Chapter 2 describes program installation and activation, and Chapter 3 gives a more thorough introduction to the program and provides a simple tutorial to help you get started. You are strongly encouraged to read these first three chapters before beginning to work with SouthPro. Finally, Chapter 4 describes the limitations of SouthPro and appropriate uses of its predictions. In addition, this chapter briefly describes other growth and yield models for uneven-aged stands of loblolly and loblolly–shortleaf pine.

This manual is not a book on how to manage uneven-aged loblolly pine stands. For information on silviculture of uneven-aged southern pines, see the following publications:

Baker, James B. and others. 1996. Uneven-aged silviculture for the loblolly and shortleaf pine forest cover types. Gen. Tech. Rep. SO–118. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 65 p. Available from the Communications Office, Southern Forest Research Station, 200 Weaver Blvd., P.O. Box 2680, Asheville, NC 28802. Phone: (704) 257–4392; Fax: (704) 257–4840.

Farrar, R. M. 1996. Fundamentals of uneven-aged management in southern pine. Moser, W. K., and Brennan, L. A., eds. Tall Timbers Research Station Miscellaneous Publication No. 9. Tallahassee, FL. 68 p. Available from the Library, Tall Timbers Research Station, Route 1, Box 678, Tallahassee, FL 32312–9712. Phone: (904) 893–4153 ext. 234 or 235; Fax: (904) 688–7781.

SouthPro Program

Program Functionality

SouthPro is a Microsoft Excel add-in program that simulates the growth of uneven-aged loblolly pine stands in the Southern United States. SouthPro tracks the number of trees in 13 diameter classes and 3 species groups: pines and other softwoods (SW), soft hardwoods (SH), and hard hardwoods (HH). This program also produces summary statistics of the ecological and economic consequences of user-defined management regimes. The ecological statistics include the Shannon index (Hunter 1990, Magurran 1988, Pielou 1977) of species group diversity, the Shannon index of size class diversity (hereafter referred to as size diversity), and the total basal area of each species group. These statistics are computed at 1-year intervals and after harvests. Harvests are assumed to occur at the beginning of the year.

The economic statistics computed for each harvest include the basal area cut, volume of pulpwood and sawtimber removed by species group, gross income generated by the harvest, and net present value of the harvest. The total net present value of the harvest and the mean annual production of the stand, in terms of basal area cut and volume harvested, are reported as well. SouthPro also provides a number of options for plotting these summary statistics over time. Finally, SouthPro can produce stock-and-cut tables, generate marking guides, and calculate basal area–maximum diameter– q -ratio (BD q) distributions.

To gain a better understanding of how SouthPro generates its predictions, you are encouraged to read *Growth Model for Uneven-Aged Loblolly Pine Stands: Simulations and Management Implications* by Lin and others (1998). This work provides a complete discussion of both the growth model and the equations used to calculate tree volumes and values. It also describes the equations used to calculate species group and size diversity.

Growth Model

SouthPro is based on a site- and density-dependent, multispecies matrix growth model, calibrated from 991 permanent plots of the Southern Forest Inventory and Analysis (SO–FIA) data base (Lin and others 1998). Of these plots, 238 (24%) are either owned or leased by the forest industry, 631 (64%) are under private control, 111 (11%) are on Federal land, and the remaining 11 (1%) are owned by State or local governments. The number of plots by State is shown in Table 1. The trees on all these plots were measured twice between 1978 and 1994 at intervals of 6 to 11 years. They were classified as “mixed age” and of the loblolly pine forest type in the initial inventory, and they contain naturally regenerated stands.

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Table 1—Distribution of sample plots by State

State	Survey year		Number of plots
	Current	Previous	
Alabama	1990	1982	292
Arkansas	1988	1978	53
Louisiana	1991	1984	243
Mississippi	1994	1987	270
Oklahoma	1993	1986	4
Tennessee	1989	1980	2
Texas	1992	1986	127
Total			991

In the model, regeneration, growth, and mortality are affected by stand density, site productivity, and interactions between trees of different species and sizes. Stand density and site productivity also affect tree form and thus the standing volume of sawlogs and pulpwood. In validation studies, out-of-sample forecasts of the model agreed with observations and long-term predictions were consistent with ecological studies of climax forests of this type (Lin and others 1998).

Conjunction of SouthPro and Excel

SouthPro works in conjunction with Excel. When SouthPro is running, all Excel commands and functions continue to be available. The more you know about Excel, the easier it will be to enter stand data, run SouthPro simulations, and work with SouthPro output. In addition, anything that can be done in Excel when SouthPro is closed can also be done when SouthPro is open. Consequently, it is not necessary to exit SouthPro before doing other work in Excel.

If you are new to Excel, take some time to look through the *Microsoft Excel User's Guide*. Pay particular attention to sections that discuss how to choose commands, select cells, enter data, edit or format worksheets or charts, work with chart types, change chart data, manage workbook files, or print worksheets and charts. The time spent learning these skills is likely to more than pay for itself in time saved as you work with SouthPro and Excel.

In addition, because SouthPro protects the contents of its output worksheets and hides the Setup Files worksheet, you may want to read those sections of the *Microsoft Excel User's Guide* that describe how to protect and unprotect sheets, as well as those that describe how to hide and unhide sheets.

Aids for Using SouthPro

SouthPro will be easier to use if you do the following:

- Complete the tutorial offered in Chapter 3, which introduces most of SouthPro's features.
- Read this manual and keep it accessible as you learn SouthPro.
- Pay close attention to the status bar at the bottom of the Excel window. This status bar will prompt you for needed information and inform you of SouthPro's progress as the program responds to your requests.
- Consult the Excel documentation, including the on-line help available through the Help menu, for questions concerning Excel's features.

Chapter 2. Installing SouthPro

Obtaining SouthPro

SouthPro can be downloaded free of charge from the SouthPro Web site (<http://forest.wisc.edu/research/SouthPro>). Four versions are currently available, one for each version of Microsoft Excel with which it can be run:

- Excel 5.0 for IBM-compatible computers
- Excel 5.0 for Macintosh
- Excel 97 for IBM-compatibles
- Excel 98 for Macintosh

All four versions have the same functionality but differ slightly in formatting to accommodate differences in how each version of Excel displays dialog boxes.

System Requirements

To run SouthPro with Microsoft Excel version 5.0 for Windows 3.1 or 3.11, or with Microsoft Excel 97 for Windows 95 and Windows NT (version 3.51 Service Pack 5 or later), you need the following hardware and software:

- IBM-compatible computer with an 80486 or higher processor
- Minimum of 8 megabytes (MB) of RAM for Windows 3.1 or 3.11, 12 MB for Windows 95, or 16 MB for Windows NT; SouthPro has not yet been tested with Windows 98, although it should be upward compatible
- Microsoft Excel 5.0 or 97

To run SouthPro with Microsoft Excel 5.0 or 98 for the Macintosh, you need the following hardware and software:

- A PowerPC processor-based, MacOS-compatible system
- Apple System 6.0.2 or later for Excel 5.0 or Apple System 7.5 or later for Excel 98
- Minimum of 8 MB of RAM for Excel 5.0 or 16 MB for Excel 98
- Microsoft Excel 5.0 or 98 for Macintosh

Installing and Activating SouthPro

Follow these steps to install SouthPro as a Microsoft Excel add-in program:

1. Download SouthPro free of charge from the SouthPro Web site (<http://forest.wisc.edu/research/SouthPro>), following the instructions on the Download page.
2. Open Microsoft Excel.
3. Select Add-Ins... from the Excel Tools menu and click Browse (in Excel 98, click Select).
4. Browse to the directory or folder on your hard drive where you stored SOUTHPRO.xla. Click on SOUTHPRO.xla and then select Open or press the Enter (Return) key. In most cases, a new check box named SOUTHPRO will be added to the list in alphabetical order. In Excel 5.0 for Windows 3.1, the new check box will sometimes be added at the top of the list, followed by a blank space. In either case, the new check box should contain either the letter *x* or a check mark (✓), which indicates that the SOUTHPRO check box has been selected.
5. To activate SouthPro, make sure the SOUTHPRO check box is selected and then click OK or press Enter.

Once SouthPro is activated, go to the Excel Tools menu. Notice that SouthPro... now appears as the last item on this menu (Fig. 1). Selecting this item starts SouthPro.

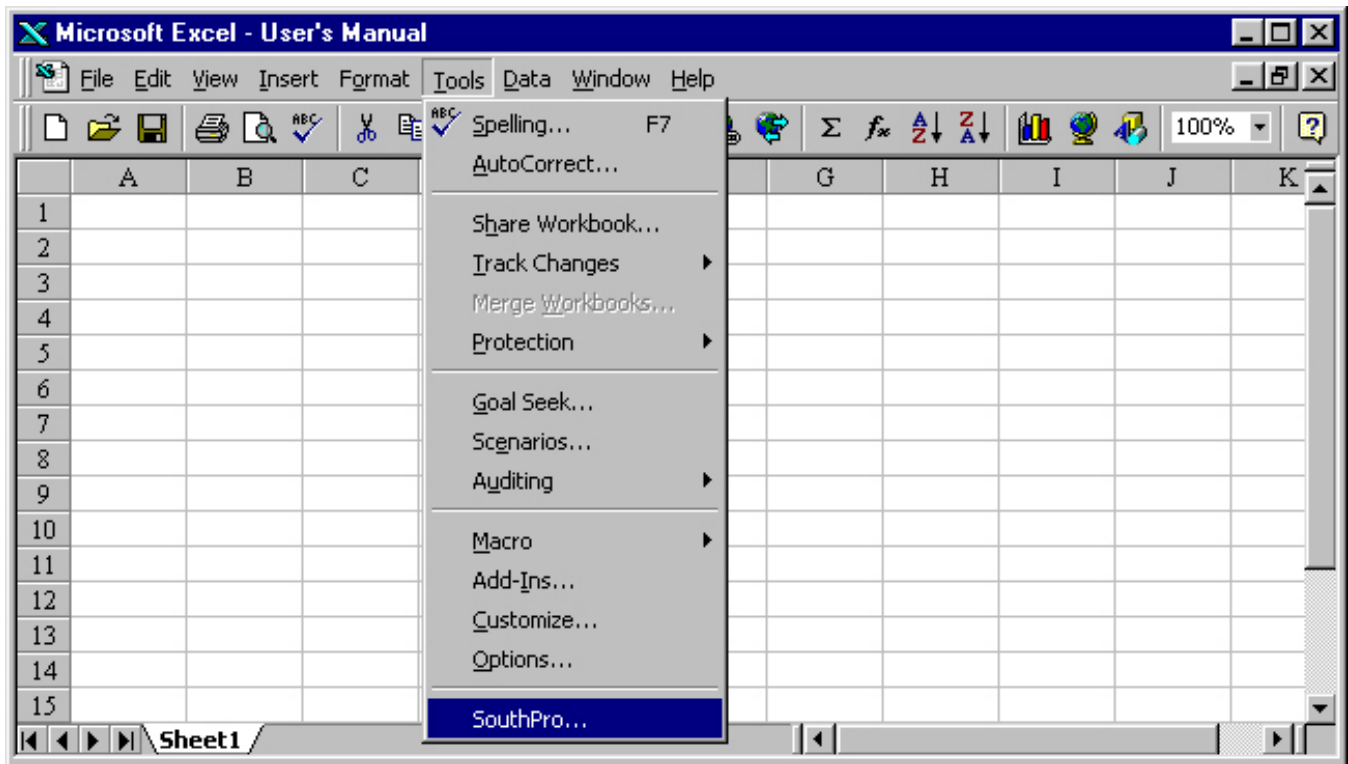


Figure 1—SouthPro functions as a tool within Excel.

Deactivating and Reactivating SouthPro

Once you have installed and activated SouthPro, it will open automatically every time you run Excel. This may be undesirable if you use SouthPro only occasionally, because it increases the time needed to open and close Excel and it uses memory. Consequently, you may wish to reactivate SouthPro before each use and to deactivate it afterwards.

To deactivate SouthPro, select Add-Ins... from the Excel Tools menu (Fig. 1). Click the SOUTHPRO check box to de-select the item. Next, click OK or press Enter. This will cause Excel to close the SouthPro add-in. In addition, SouthPro will no longer open automatically every time you run Excel.

Deactivating SouthPro does not immediately remove the SouthPro option from the Excel Tools menu. It remains available until Excel is closed. Thus, even if SouthPro is deactivated during a particular Excel session, it is still possible to run SouthPro during that session without reactivating it.

Chapter 3. Running SouthPro

This chapter explains how to do the following:

- Start SouthPro
- Enter simulation parameters
- Add and delete setup files
- Execute single and multiple simulations
- Generate charts of changes in a variety of stand characteristics over time
- Produce stock-and-cut tables and marking guides

Before you begin this tutorial, read the overview in Chapter 1 and install SouthPro as described in Chapter 2.

Starting SouthPro

SouthPro can be opened and run from within any Excel workbook by selecting the SouthPro... option from the Excel Tools menu. SouthPro begins by adding a menu entitled SOUTHPRO to the Excel worksheet menu bar (Fig. 2). The SOUTHPRO menu lists the types of actions that SouthPro can perform: updating setup files; loading input data from setup files; running single or multiple simulations; and producing summary charts, stock-and-cut tables, and marking guides. These options remain available as long as both SouthPro and Excel are running, even if you switch from one workbook to another or open a new workbook. This feature greatly facilitates the organization of input and output data from individual stands or groups of related stands into separate workbooks.

Next, SouthPro searches for a copy of the Input Data worksheet in the active workbook. Although it is possible to run SouthPro from within any Excel workbook, most SouthPro options require the presence of one or more specific worksheets. The most frequently required one is the Input Data worksheet (Fig. 3), which contains the data needed to run a SouthPro simulation. If SouthPro fails to find this worksheet, it will ask you if one should be inserted.

Caution: When searching for a copy of the Input Data worksheet, SouthPro merely searches for a worksheet with that name.

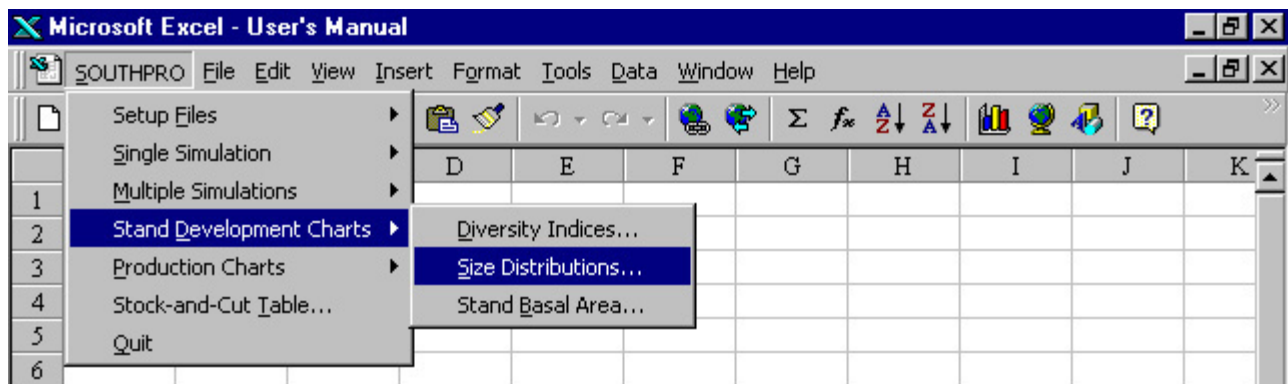


Figure 2—The SOUTHPRO menu.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	Softwoods													
4	DBH class (mches)	2	4	6	8	10	12	14	16	18	20	22	24	26+
5	Initial distribution (trees/acre)	128.57	62.28	27.17	19.43	12.98	8.90	5.93	3.46	1.91	1.02	0.46	0.18	0.10
6	First target (trees/acre)	1000.00	1000.00	22.62	16.15	11.54	8.24	5.89	4.21	3.00	2.15	0.00	0.00	0.00
7	Second target (trees/acre)	1000.00	1000.00	22.62	16.15	11.54	8.24	5.89	4.21	3.00	2.15	0.00	0.00	0.00
8	Sawtimber stumpage prices	NA	NA	NA	NA	237.00	237.00	237.00	237.00	237.00	237.00	237.00	237.00	237.00
9	Pulpwood price (\$/cord)	23.73												
10														
11	Sott Hardwoods													
12	DBH class (mches)	2	4	6	8	10	12	14	16	18	20	22	24	26+
13	Initial distribution (trees/acre)	137.92	28.33	13.01	4.38	2.20	0.98	0.55	0.23	0.11	0.05	0.03	0.00	0.02
14	First target (trees/acre)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Second target (trees/acre)	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
16	Sawtimber stumpage prices	NA	NA	NA	NA	NA	124.00	124.00	124.00	124.00	124.00	124.00	124.00	124.00
17	Pulpwood price (\$/cord)	13.73												
18														
19	Hard Hardwoods													
20	DBH class (mches)	2	4	6	8	10	12	14	16	18	20	22	24	26+
21	Initial distribution (trees/acre)	148.08	32.34	12.91	6.65	3.98	1.82	1.24	0.68	0.32	0.20	0.13	0.06	0.07
22	First target (trees/acre)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Second target (trees/acre)	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
24	Sawtimber stumpage prices	NA	NA	NA	NA	NA	198.00	198.00	198.00	198.00	198.00	198.00	198.00	198.00
25	Pulpwood price (\$/cord)	13.73												
26														
27	Management Schedule													
28	First year of simulation	1998												
29	Year of first harvest	2000												
30	Number of harvests	10												
31	Management cycle (years)	10												
32	1 st target-to-2 nd target (years)	5												
33	Length of simulation (years)	52												
34			First	Second										
35	Fixed Costs		Target	Target										
36	Administration (\$/acre)	25.00	25.00											
37	Hardwood control (\$/acre)	55.00	0.00											
38														
39	Interest rate (%/year)	3												
40														
41	Loblolly site index (age 50)	85												
42														
43	Sawtimber price units	\$/Mbf	(\$/Mbf or \$/Ccf)											

Figure 3—Sample Input Data worksheet.

Consequently, if you have renamed the Input Data worksheet, SouthPro will inform you that it is unable to find the worksheet. Similarly, if you call a different worksheet “Input Data,” SouthPro will treat this worksheet as a SouthPro-generated Input Data worksheet and will attempt to read input data from it. These cautions also apply to SouthPro’s Setup Files and Batch Files worksheets. For SouthPro to function properly, do not use apostrophes in the name of the workbook in which you are working.

Tutorial: Starting SouthPro

Start SouthPro by selecting SouthPro... from the Excel Tools menu (Fig. 1). If SouthPro... is not listed as an option, make sure that SouthPro has been installed and activated (see Chapter 2) and that the active sheet is either a worksheet or a dialog sheet, not a chart sheet or a Visual Basic module. When SouthPro asks whether it should insert a copy of the Input Data worksheet into the active workbook, either select YES or press Enter. Notice that the SOUTHPRO menu has been added to the Excel worksheet menu bar (far left) and that an Input Data worksheet has been inserted at the front of the active workbook.

Entering Input Data

The Input Data worksheet (Fig. 3) is used to enter the data needed to run a simulation. The required data include the initial stand distribution, target stand distributions (that is, the desired stand distribution after harvest), various management schedule parameters, site index, stumpage prices, interest rate, and fixed costs associated with administration and hardwood control.

Table 2—Metric conversion factors

inch/pound unit	Metric unit
acre	0.405 hectare (ha)
1 inch	2.54 centimeter (cm)
1 foot (ft)	0.305 meter (m)
1 square foot (ft ²)	0.093 square meter (m ²)
1 ft ² /acre	0.229 m ² /ha
1 cubic foot (ft ³)	0.028 cubic meter (m ³)

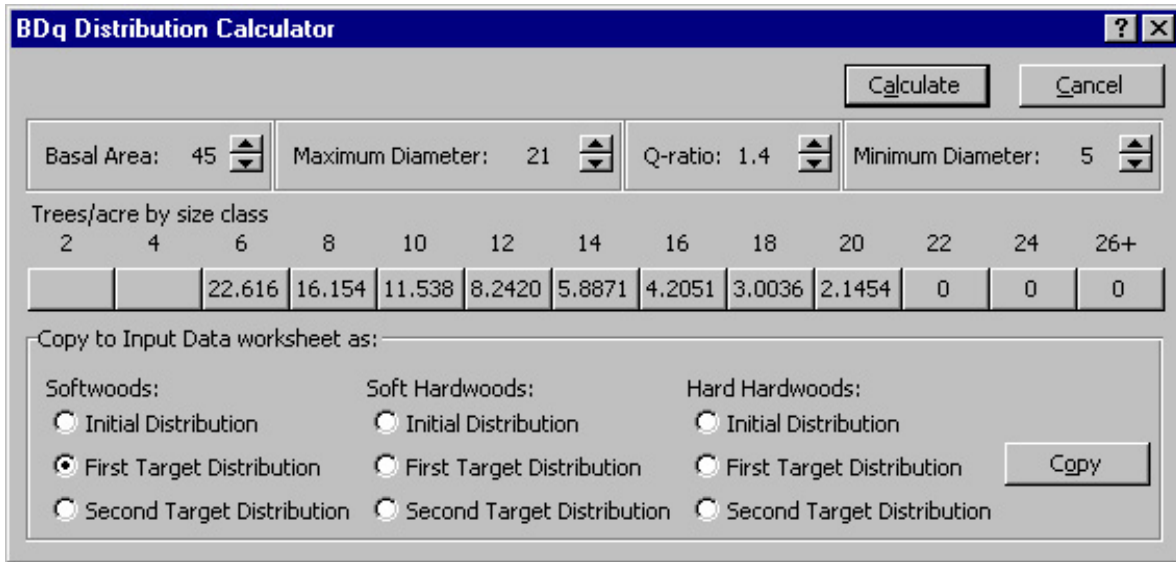


Figure 4—SouthPro BDq Distribution Calculator.

Initial Distribution

The initial distribution is the number of trees per acre by species group and size class at the start of the simulation. Size classes are defined at 2-in. diameter-at-breast-height (DBH) intervals, from size 2 (1 to < 3 in.) to size 26+ (≥25 in.). (See Table 2 for metric conversion factors.) On the Input Data worksheet, enter initial distribution data for softwoods in cells B5 through N5, for soft hardwoods in cells B13 through N13, and for hard hardwoods in cells B21 through N21 (Fig. 3).

Alternatively, a BDq distribution (a distribution defined by a basal area (B), a maximum diameter (D), and a *q*-ratio) may be calculated for any of the three species groups and copied to the appropriate cells of the Input Data worksheet using the SouthPro BDq Distribution Calculator (Fig. 4). To do this, select Setup Files from the SOUTHPRO menu and then select BDq Distributions. The BDq Distribution Calculator provides controls to enter the basal area, maximum diameter, and *q*-ratio you wish to use. If the basal area entered is the total basal area, enter a minimum diameter of 1 in. DBH. If the basal area entered is the merchantable basal area, enter a minimum diameter of 5 in. DBH. In either case, the basal area should be for a given species group, not the entire stand.

Target Distributions

A target distribution is the desired number of live trees per acre in each size class and species group after a harvest or similar intervention. Target distributions should reflect the effects of both the desired harvest and hardwood control, if any. For example, if hardwood control calls for the complete removal of all hardwoods, assign zero trees/acre to each size class of the target distributions for both soft and hard hardwood species. Conversely, if no cut is to be performed in a particular size class, assign 1,000 trees/acre to that size class in the target distribution.

To allow for the simulation of hardwood control that occurs either more or less frequently than the cutting cycle, as well as simply to allow greater flexibility in simulating management options, SouthPro accepts two target distributions. The first target distribution is required and should be entered into cells B6 to N6, B14 to N14, and B22 to N22 for softwoods, soft hardwoods, and hard hardwoods, respectively (Fig. 3). The second target distribution is optional and may be entered into cells B7 to N7, B15 to N15, and B23 to N23, for softwoods, soft hardwoods, and hard hardwoods, respectively. Like initial distributions, target distributions can either be entered manually or by using the SouthPro BDq Distribution Calculator.

For simulations in which hardwood control occurs more frequently than the cutting cycle, one target distribution should be the desired distribution after hardwood control and the other target distribution should be the desired distribution after both hardwood control and harvesting. Similarly, for simulations in which hardwood control occurs less frequently than the cutting cycle, one target distribution should be the desired distribution after harvesting and the other should be the desired distribution after harvesting and hardwood control.

By accepting two target distributions, SouthPro also enables you to perform limited simulations of shelterwood systems. In this case, the first target distribution should be the desired distribution after the establishment cut and the second target distribution should be the desired distribution after the removal cut. Although the shelterwood method is used to regenerate even-aged stands, SouthPro can be used to simulate stand growth while a partial shelterwood overstory is in place or to simulate the initial conversion of uneven-aged to even-aged stands using the shelterwood method, provided the shelterwood overstory is sufficiently dense to approximate uneven-aged, or at least multi-aged, conditions.

As previously noted, the plots used to calibrate the SouthPro growth model were all classified as “mixed aged” at their first measurement, meaning they contained at least two distinct age classes. In other words, stands with a shelterwood overstory in place were not excluded from the data set. Nevertheless, it would be inappropriate to use SouthPro to simulate stand growth after a shelterwood overstory has been removed completely because the resulting stand would be strictly even-aged. In contrast, SouthPro may be used to simulate irregular shelterwood systems that retain a sufficiently dense overstory throughout the rotation. However, the results of such simulations should be interpreted more cautiously than those from simulations of uneven-aged management regimes.

For simulations in which the same management activities are performed each time the stand data are entered (for example, those in which no interventions take place between selection harvests), only the first target distribution is needed. Thus, for many, if not most, simulations, you will only need to enter a first target distribution. The methods used to define the timing of management activities are described in the next section.

Management Schedule

The timing of management activities over the course of a simulation is determined by the management schedule parameters entered into cells B28 through B33 of the Input Data worksheet (Fig. 3). These parameters are the

- year in which the simulation is to begin,
- year of first harvest,
- total number of harvests to be performed,
- length of management cycle,
- length of interval from a harvest that uses the first target distribution as the cutting guide to a harvest that uses the second target distribution (hereafter referred to as the first target-to-second target interval), and
- overall length of simulation.

As defined here, the management cycle is the number of years needed to complete one repetition of a cyclical management regime (Fig. 5). For simulations using a single target distribution, the management cycle is simply the cutting cycle. For simulations using two distinct target distributions, the management cycle can be treated as either the number of years between successive harvests using the first target distribution as the cutting guide or as the number of years between successive harvests using the second target distribution.

For simulations using a single target distribution, enter a zero for the first target-to-second target interval. The simulated stands are then cut at intervals equal to the management cycle, and the first target distribution is used as the sole cutting guide. If a second target distribution has been entered into the Input Data worksheet, SouthPro deletes this distribution for you.

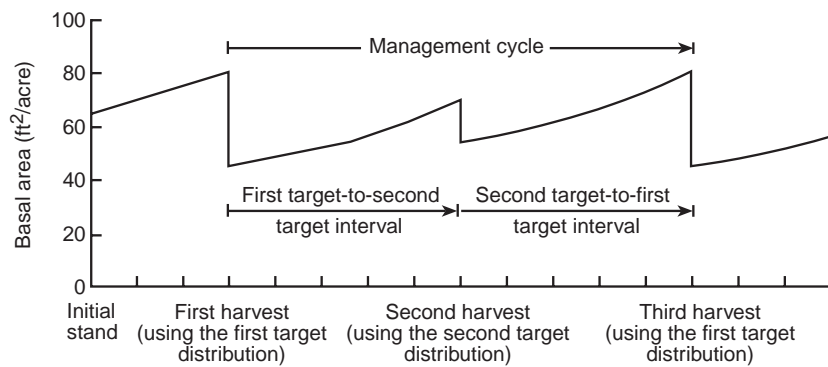


Figure 5—Illustration of SouthPro management schedule parameters.

If the year of the first harvest equals the first year of the simulation, SouthPro simulates the harvest before it simulates the growth of the stand. Otherwise, it simulates stand growth to the beginning of the year designated as the year of the first harvest and then harvests the stand using the first target distribution as the cutting guide. In so doing, all trees in excess of the target for each size and species group are removed. Next, SouthPro grows the stand for the number of years in the management cycle and once again uses the first target distribution to harvest the stand. This pattern is repeated until either the requested number of harvests have been conducted or the end of the simulation has been reached.

For simulations involving two distinct target distributions, instruct SouthPro to use both distributions by entering a positive integer for the length of the first target-to-second target interval. SouthPro will then determine the length of the second target-to-first target interval automatically by subtracting the first target-to-second target interval from the management cycle. SouthPro assumes that these intervals remain constant throughout the simulation. As is the case for single-target simulations, SouthPro grows the stand to the beginning of the year designated as the year of the first harvest and then harvests the stand using the first target distribution as the cutting guide. In the case of two-target simulations, however, SouthPro then grows the stand for the number of years assigned for the first target-to-second target interval and harvests it using the second target distribution. A third growth period, equal to the second target-to-first target interval, is then followed by a third harvest, again using the first target distribution (Fig. 5). This pattern is repeated until either the requested number of harvests have been conducted or the end of the simulation has been reached.

The easiest way to develop an intuitive feel for how the management schedule parameters interact to control the timing of management activities is to study a few examples and experiment with others on your own. The management schedule parameters shown in Figure 3, for instance, would result in 10 harvests. The first target distribution would be used as the cutting guide for harvests in the years 2000, 2010, 2020, 2030, and 2040, and the second target distribution would be used as the cutting guide for harvests in 2005, 2015, 2025, 2035, and 2045. Thus, the cutting cycle would be 5 years and all hardwoods would be controlled every 10 years. Note also that even though the last harvest would occur in 2045, the stand would be grown until the end of the simulation in 2050. On the other hand, if the length of the first target-to-second target interval in Figure 3 were set to zero, a maximum of six harvests could be conducted without increasing the length of the simulation. These harvests would now occur in 2000, 2010, 2020, 2030, 2040, and 2050, and they would all be guided by the first target distribution. In this case, the cutting cycle would be 10 years and all hardwoods would be controlled simultaneously.

For each year in which trees are removed, the stand distributions before and after the harvest are recorded in the Stand Development output worksheet (see Setting Up and Running Single Simulations, Figs. 11 to 14). In these worksheets, the type of post-harvest distribution for a given year is indicated by an ordinal number. For example, 2000-1st indicates that the first target distribution was used as the cutting guide for the harvest in 2000; similarly, 2005-2nd indicates that the second target distribution was used as the cutting guide for the harvest in 2005. This convention is also used in the Production output worksheets (Fig. 15).

Site Index

Enter the stand's loblolly pine site index (base age 50 years) into cell B41 of the Input Data worksheet (Fig. 3). To ensure that the site index falls within the range of site productivity classes used to calibrate the model, SouthPro requires that the site index be a number between 51 and 130, inclusive. SouthPro converts the site index into a site productivity class according to Table 3 (Anon. 1994–1995). Table 3 can also be used to estimate base age 50 site indices for stands with dominant and co-dominant trees of other ages. Although SouthPro accepts site indices between 51 and 59, or between 125 and 130, it will caution you that the model's calibration data set had few plots in those ranges (Table 3).

Table 3—Loblolly pine site productivity classes for total heights of average dominant and co-dominant trees

Age of dominant trees (years)	Tree heights (ft) for various site productivity classes					
	6	5	4	3	2	1
20	33–37	38–50	51–60	61–70	> 70	NA
30	42–47	48–65	66–77	78–90	> 90	NA
40	47–53	54–73	74–87	88–101	> 101	NA
50	51–59	60–79	80–94	95–109	110–124	125–130
60	54–62	63–83	84–99	100–115	>115	NA
70	56–63	64–86	87–103	104–120	>120	NA
80	57–65	66–89	90–105	106–123	>123	NA
Number of plots	6	122	343	383	135	2

Economic Data

The economic data required to perform a SouthPro simulation include the sawtimber and pulpwood stumpage prices, the fixed costs associated with administration and hardwood control, and the interest rate. Enter the stumpage prices for softwood, soft hardwood, and hard hardwood pulpwood (\$/cord) into cells B9, B17, and B25 of the Input Data worksheet, respectively (Fig. 3). Sawtimber stumpage prices can be expressed in either \$/Ccf (dollars per hundred cubic feet) or \$/Mbf (dollars per thousand board feet; \$/Mbf–Scribner for softwoods and \$/Mbf–Doyle for hardwoods) units. Indicate the unit by entering \$/Ccf or \$/Mbf in cell B43 (Fig. 3). In addition, for each species group a different stumpage price may be entered for each sawtimber size class. Enter the softwood sawtimber stumpage prices into cells F8 through N8, the soft hardwood sawtimber stumpage prices into cells G16 through N16, and the hard hardwood sawtimber stumpage prices into cells G24 through N24 (Fig. 3).

The fixed costs (\$/acre) associated with administration belong in cell B36 of the Input Data worksheet for harvests using the first target distribution as the cutting guide and in cell C36 for harvests using the second target distribution. Similarly, the fixed costs associated with hardwood control belong in cell B37 for harvests using the first target distribution as the cutting guide and in cell C37 for harvests using the second target distribution. SouthPro assumes that all costs associated with harvesting and transporting merchantable trees are reflected in the stumpage prices.

Finally, enter the annual interest rate (%/year) in cell B39. The interest rate entered should be a real interest rate (that is, the nominal interest rate, net of inflation). For instance, if the nominal interest rate is 7%/year and the rate of inflation is 4%/year, the real interest rate would be 3%/year and you would enter 3 in cell B39, not 0.03. If SouthPro encounters an interest rate between -0.25% and 0.25%/year, it will ask you if you do, in fact, wish to use such a low interest rate.

To account for steady changes in real stumpage prices over time, simply increase or decrease the interest rate by an amount equal to the expected rate of decrease or increase, respectively. For example, if the real interest rate is 3%/year but stumpage prices are expected to increase in real terms by 1%/year, you would enter 2 in cell B39.

The fixed costs and the interest rate are used only to calculate the net present value of harvests. These numbers can be modified after a simulation has been completed without having to repeat the simulation, as explained in the discussion of output worksheets in the section on Setting Up and Running Single Simulations.

Worksheet Protection

When an Input Data worksheet is first inserted into a workbook, the cells into which data must be entered all contain question marks. All other non-empty cells are locked to prevent accidental changes of format. It is generally best to keep this protection in place. Should the need arise, however, the worksheet may be unprotected (see the *Microsoft Excel User's Guide* for a discussion of how to protect and unprotect worksheets). The password to unprotect this and all other SouthPro-generated worksheets is Pinus taeda. Passwords in Excel are case sensitive. If the format of an Input Data worksheet is altered unintentionally, you can replace the altered worksheet with a new copy by deleting the old worksheet and attempting to run a SouthPro simulation (from the SOUTHPRO menu). SouthPro will detect that there is no longer a worksheet named "Input Data" in the active workbook and will ask if you would like to have one inserted.

Error Check

Before SouthPro performs a simulation, it first verifies that the Input Data worksheet contains valid data. The initial and target distribution parameters must all be non-negative, as must the values entered for the stumpage prices and the fixed costs. As noted previously, the site index must be a number between 51 and 130, inclusive. The management schedule parameters must all be integers. Furthermore, the number of harvests, the length of the management cycle, and the length of the simulation cannot be negative. The interest rate, on the other hand, may be any numerical value. Finally, the length of a simulation is limited to 2,000 years and the number of harvests is limited to 255. If SouthPro detects a violation, it will prompt you to enter a new value.

SouthPro also checks the logic of the management schedule parameters. For example, if the simulation length is too short for all the harvests to be completed, SouthPro will warn you of this situation but it will proceed with the simulation if instructed to do so.

Insertions and Deletions

Unlike Excel, SouthPro does not track the insertion or deletion of cells, rows, or columns. For example, SouthPro will always take the value located in cell B28 of the Input Data worksheet to be the first year of a simulation. Thus, if you were to insert a new row at row 26 of the Input data worksheet, SouthPro would send an error message when it tried to read cell B28 and found it empty. However, SouthPro may also fail to detect the insertion or deletion of a cell, row, or column. This would result in erroneous predictions, the cause of which can be quite difficult to identify. Consequently, avoid inserting or deleting cells, rows, or columns into SouthPro-generated worksheets.

Tutorial: Entering data into the Input Data worksheet

Practice how to input data by entering the data in Figure 3 into the appropriate cells of the Input Data worksheet. To enter a value into a given cell, click on the cell or go to it using the arrow keys. Type in the desired value and then press Enter or select another cell. Notice that, in this example, the soft hardwoods and the hard hardwoods have the same Target Distributions. To save time, enter the soft hardwood target distribution data first, copy these data to the clipboard, and then use the Paste command on the Excel Edit menu to paste these data into the hard hardwood target distribution cells. To copy the data to the clipboard, first select the data by clicking on cell B6. Then, press and hold the Shift key and click on cell N6. Next, select the Copy command from the Edit menu. Now, click on cell B7 and select the Paste command from the Edit menu.

The target distributions you just entered are actually BDq distributions that could have been entered more easily with the BDq Distribution Calculator. To do this, select the Setup Files command from the SOUTHPRO menu and then select the BDq Distributions command. In the BDq Distribution Calculator dialog box (Fig. 4), set the basal area to 40, leave the maximum diameter set at 21, set the Q-ratio to 1.4, increase the minimum diameter to 5, and click the Calculate button. The distribution that is now displayed in the dialog box should match the first target distribution for softwoods you entered into the Input Data worksheet, except that the first two size-classes should be blank since the minimum DBH was set at 5 in. Copy this distribution to cells B6 through N6 of the Input Data worksheet by selecting the First Target Distribution option for softwoods and then clicking the Copy button. Now, close the BDq Distribution Calculator dialog box by clicking the Cancel button. Notice that cells B6 and B7 of the Input Data worksheet now contain question marks to indicate that valid targets still need to be entered for these size classes before a simulation can be performed successfully. Enter a value of 1000 into each of these cells to indicate that none of the trees in these two size-classes should be harvested.

Working With Setup Files

You will often use certain sets of input data for more than one simulation. For example, the economic data may be the same for different simulations. Likewise, you may want to compare the effects of different management schedule parameters on a given initial distribution, or you may wish to apply the same target distribution to more than one stand. To avoid having to

reenter frequently used sets of data, SouthPro allows you to save the data sets in setup files. You can create setup files for

- initial distributions,
- target distributions,
- management schedules,
- stumpage prices, and
- fixed costs.

The setup files are stored in a worksheet named Setup Files. If the active workbook does not contain a copy of the Setup Files worksheet when an action requires that worksheet, SouthPro will ask whether it should insert a Setup Files worksheet. SouthPro adds the Setup Files worksheet to the end of the workbook and hides it. The Setup Files worksheet is hidden because you will rarely need to access it directly.

Adding Setup Files

SouthPro provides a series of dialog boxes for adding setup files to and deleting them from the Setup Files worksheet. Before a setup file can be created, the parameters must be in the appropriate cells of the Input Data worksheet. To access the Add Setup Files dialog box (Fig. 6), select the Setup Files command from the SOUTHPRO menu on the Excel workbar and click Add. The Add Setup Files dialog box helps you select the sets of parameters that SouthPro will save as setup files and to enter the names that will be assigned to the newly created files.

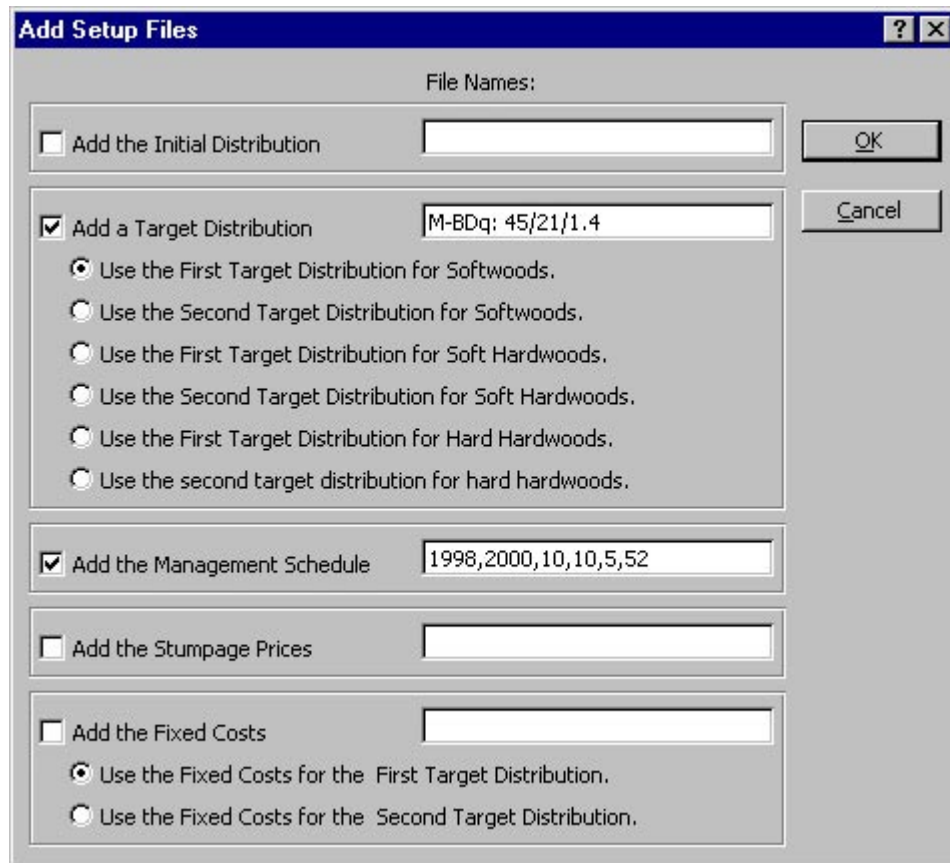


Figure 6—Add Setup Files dialog box.

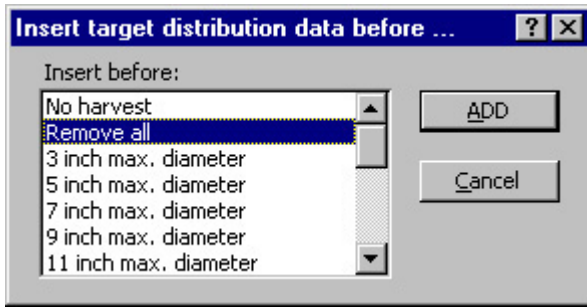


Figure 7—Insert Target Distribution dialog box.

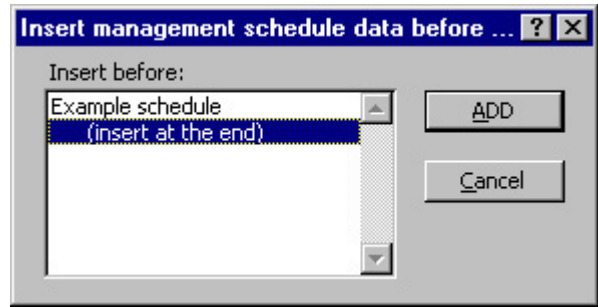


Figure 8—Insert Management Schedule dialog box.

Before it creates a setup file, SouthPro verifies that the name entered is not already in use. SouthPro also verifies that the appropriate cells of the Input Data worksheet contain valid data. If both conditions are satisfied, SouthPro displays dialog boxes (Figs. 7 and 8) that ask you to select where the new setup file will be added to the Setup Files worksheet relative to existing setup files of the same type. It is good procedure to keep your setup files organized, either alphabetically, by stand location, or by some other method. Careful organization will allow you to access these files more easily. In addition, be sure to save the active workbook if you want to save any changes you’ve made to the Setup Files worksheet.

When SouthPro creates an initial distribution setup file, it saves the initial distributions of all three species groups in a single file. In contrast, when it creates a target distribution setup file, it saves only the parameters of the chosen species group. Once created, however, a target distribution setup file can be used for all three species groups, not just the one from which it was created. To save the target distribution parameters of more than one species group, use the Add Setup Files dialog box a second or third time as needed. Likewise, when SouthPro creates a fixed costs setup file, only the fixed costs associated with the chosen target distribution are saved in the file, but they can be used to enter the fixed costs for harvests using either the first or second target distributions.

Deleting Setup Files

To access the Delete Setup Files dialog box (Fig. 9), select the Setup Files command from the SOUTHPRO menu and click Delete. Select the type of setup file you wish to delete and the dialog box will display the names of the files of this type. To delete a file, click on the name of the file; then click Delete or press Enter.

Viewing and Editing Setup Files Worksheet

We recommend that you use the Setup Files dialog boxes to add and delete setup files. It should never be necessary to edit the Setup Files worksheet directly. As mentioned previously, when SouthPro adds a Setup Files worksheet to a workbook, it protects and hides the worksheet to prevent it from being corrupted accidentally. However, sometimes it is useful to see the Setup Files worksheet, such as when moving or copying it to another workbook. To reveal (“unhide”) the Setup Files worksheet, select the Sheet command from the Excel Format menu and click Unhide. To re-hide the Setup Files worksheet, again select the Sheet command from the Format menu and click Hide. (See the *Microsoft Excel User’s Guide* for further details.)

It is unlikely that you will ever need to unlock the protected Setup Files worksheet. Should you need to do so, select Protection from the Excel Tools menu and click on Unprotect Sheet. When prompted for the password, enter *Pinus taeda* (passwords are case sensitive in Excel). To protect the worksheet again, repeat the *Pinus taeda* password. If you forget to re-protect the worksheet, SouthPro will do this for you the next time it uses the worksheet.

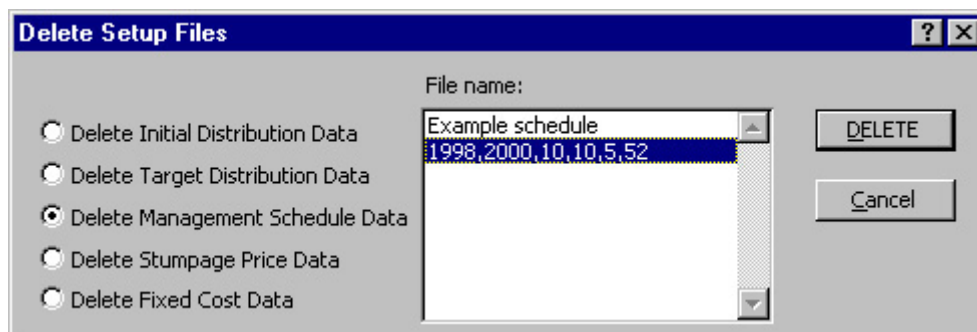


Figure 9—Delete Setup Files dialog box.

Sharing Setup Files

SouthPro saves a setup file only to the Setup Files worksheet in the active workbook. You can save a single setup file in another workbook by

1. copying the setup file data from the Input Data worksheet of the active workbook to the clipboard,
2. opening the second workbook,
3. pasting the desired data into the Input Data worksheet of the second workbook, and
4. saving the data through the Add Setup Files dialog box.

To make all the setup files of one workbook available in a second workbook, first “unhide” the Setup Files worksheet, as described in the previous section, Viewing and Editing Setup Files Worksheet. Then, select Move or Copy Sheet from the Edit menu to copy the worksheet into the desired workbook. Be sure to click the Create A Copy check box. Otherwise, the worksheet will be moved from the active workbook to the destination workbook, rather than simply copied there. See the *Microsoft Excel User’s Guide* for further details.

Tutorial: Adding and deleting setup files

For practice, this tutorial will show you how to create and delete setup files from the First Target Distribution for softwoods and management schedule parameters that you entered into the Input Data worksheet in the previous tutorial.

Creating a setup file

First, select the Setup Files command from the SOUTHPRO menu and click Add. In the Add Setup Files dialog box (Fig. 6), click the Add a Target Distribution and the Add the Management Schedule check boxes. Under Add a Target Distribution, select the Use the First Target Distribution for Softwoods option.

Next, name each setup file. Choose names that will help you remember the data in your setup files. For example, you could use the name “M-BDq: 45/21/1.4” to designate a BDq distribution with a merchantable basal area of 45 square feet per acre, maximum diameter of 21 in., and q -ratio of 1.4. Likewise, though somewhat unwieldy, the name “1998,2000,10,10,5,52” could be used to designate the following management schedule parameters: the first year of the simulation (1998), year of first harvest (2000), desired number of harvests (10), management cycle (10 years), first target-to-second target interval (5 years), and total length of simulation (52 years). Once you have entered the names of your setup files, either click OK or press Enter.

When the Insert Target Distribution Data dialog box appears (Fig. 7), select “Remove all.” This tells SouthPro to insert the new target distribution setup file before the “Remove all” setup file. Now, click Add or press Enter. When the Insert Management Schedule dialog box appears (Fig. 8), tell SouthPro to insert the management schedule parameters at the end of the list. Then, click Add or press enter.

Next, copy the setup file to a new workbook. First, select Sheet from the Excel Format menu and click Unhide. When the Unhide dialog box appears, select Setup Files and either click OK or press Enter. The Setup Files worksheet should now be visible. To copy this worksheet to a new workbook, select Move or Copy Sheet from the Edit menu. In the “To Book:” drop-down list in the Move or Copy dialog box, select “(new book)”. Next, click on the Create A Copy check box. Then, click OK or press Enter. You have created a new workbook and have copied the Setup Files worksheet into it. You may close the new workbook without saving it by selecting Close from the File menu and answering NO when asked if you want to save your changes.

Finally, hide the Setup Files worksheet in the original workbook. To do this, activate this worksheet by clicking on the Setup Files tab at the bottom of the Excel window. Then, select Sheet from the Format menu, and select Hide.

Deleting a setup file

Select Setup Files from the SOUTHPRO menu and then select Delete. When the Delete Setup Files dialog box appears (Fig. 9), click Delete Management Schedule Data. Select the management schedule setup file you created earlier and then either click Delete or press Enter. When asked if you want to delete the selected data, answer Yes. Only the setup file you selected will be deleted. Therefore, when the Delete Setup File dialog box is displayed again, simply click Cancel.

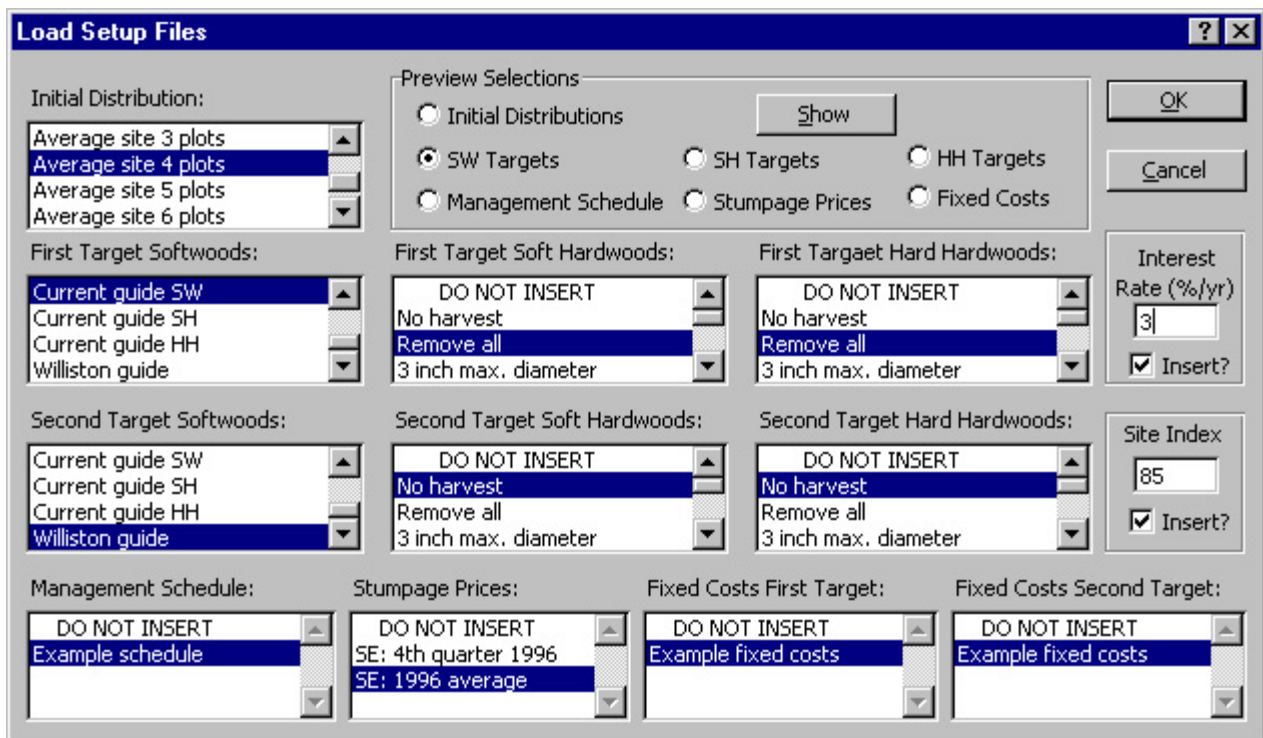


Figure 10—Load Setup Files dialog box.

Setting Up and Running Single Simulations

Running a single simulation in SouthPro is a two-step process. The first step is to prepare the Input Data worksheet, either manually or by loading the data from setup files. The second step is to run the single simulation. Before SouthPro performs a simulation, it verifies that the Input Data worksheet contains only valid data. When SouthPro finds an invalid entry, it highlights it in red and prompts you to enter a new value. Once all entries are valid, the simulation proceeds. SouthPro indicates the progress of the simulation in the Excel status bar.

Loading Setup Files

The Load Setup Files dialog box (Fig. 10) facilitates the loading of setup files into the Input Data worksheet. To access this dialog box, select Single Simulation from the SOUTHPRO menu and click Setup. The Load Setup Files dialog box allows you to load setup files as initial distributions, target distributions, management schedules, stumpage prices, and fixed costs. The default setting for each option is DO NOT INSERT. Thus, only those setup files that you select will be inserted. The six target distribution boxes contain the same setup files. This allows you to choose a different target distribution for each species group. The same is true for the two Fixed Costs boxes. The Load Setup Files dialog box also contains boxes for entering the loblolly pine site index (base age 50 years) and the interest rate. These two parameters will be entered into the Input Data worksheet only if you select the “Insert?” check box.

Finally, if you have forgotten what data you’ve entered in a particular setup file, you can preview the file by selecting the appropriate option in Preview Selections in the Load Setup File dialog box and clicking the Show button. This displays a preview dialog box that contains one or two boxes with all the setup files of the type you’ve selected. When you select a file name in one of these boxes, that file will be displayed in the lower half of the dialog box. Note: If you exit a preview dialog box by clicking OK or pressing Enter, the most recently selected file will appear in the Load Setup File dialog box as the file to be inserted. If you exit a preview dialog box by clicking Cancel, no changes will appear in the Load Setup File dialog box.

Using Output Worksheets

SouthPro writes the output of each simulation to two new worksheets and inserts them into the active workbook. The first of these worksheets is called Stand Development (Figs. 11 to 14) and the second is called Production (Fig. 15). Once a simulation has been completed, you can rename the output worksheets. Double-click on the name of the worksheet and type the new name, then press Enter. If you choose not to rename the worksheet and you later run a second simulation in the same

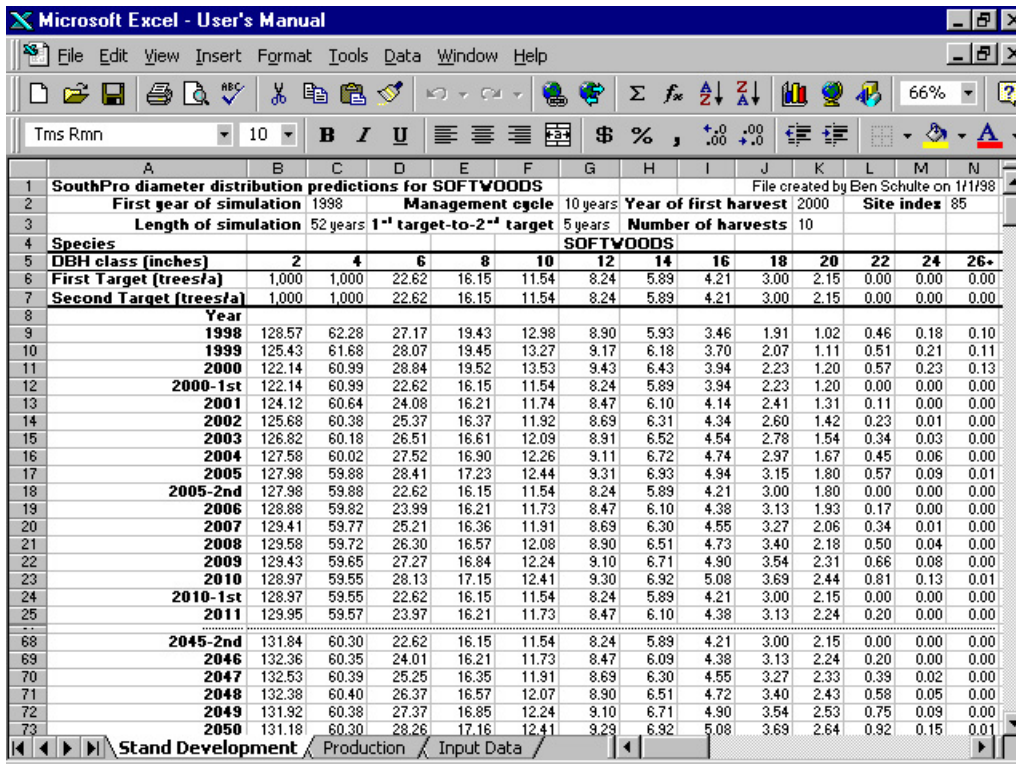


Figure 11—Stand Development output worksheet with softwood predictions.

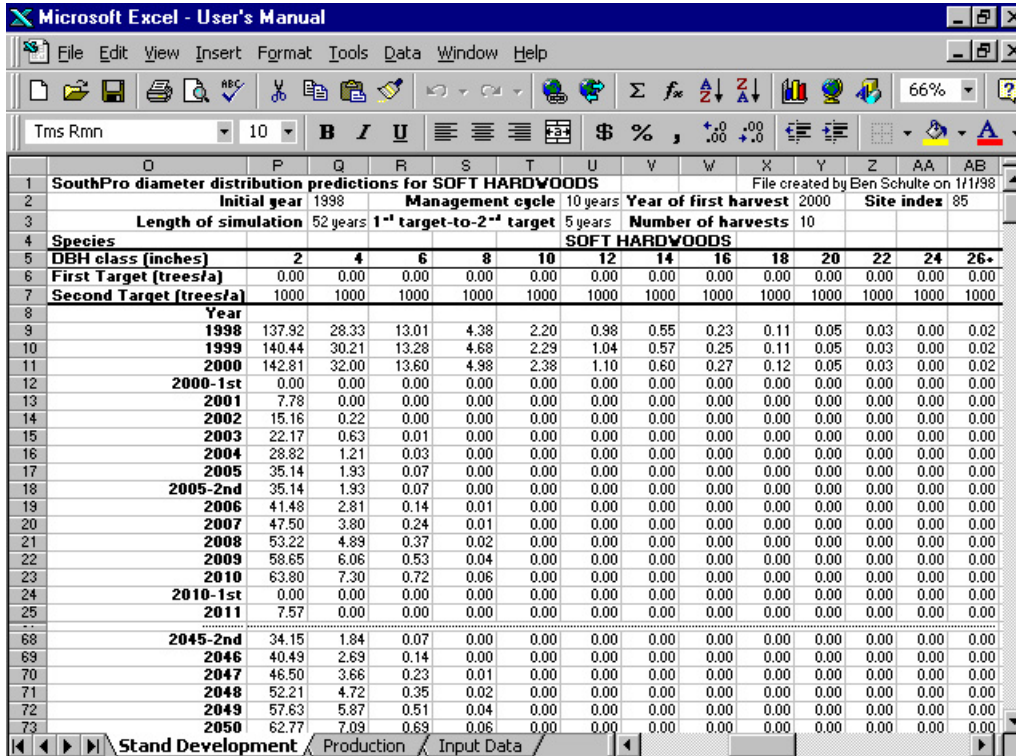


Figure 12—Stand Development output worksheet with soft hardwood predictions.

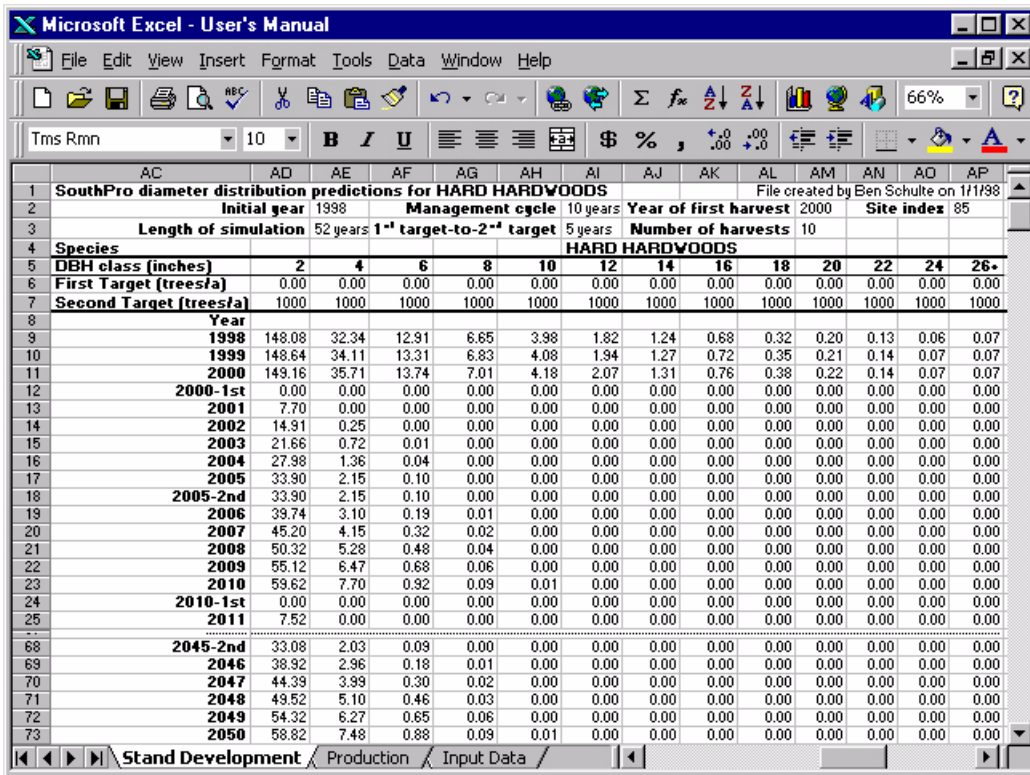


Figure 13—Stand Development output worksheet with hard hardwood predictions.

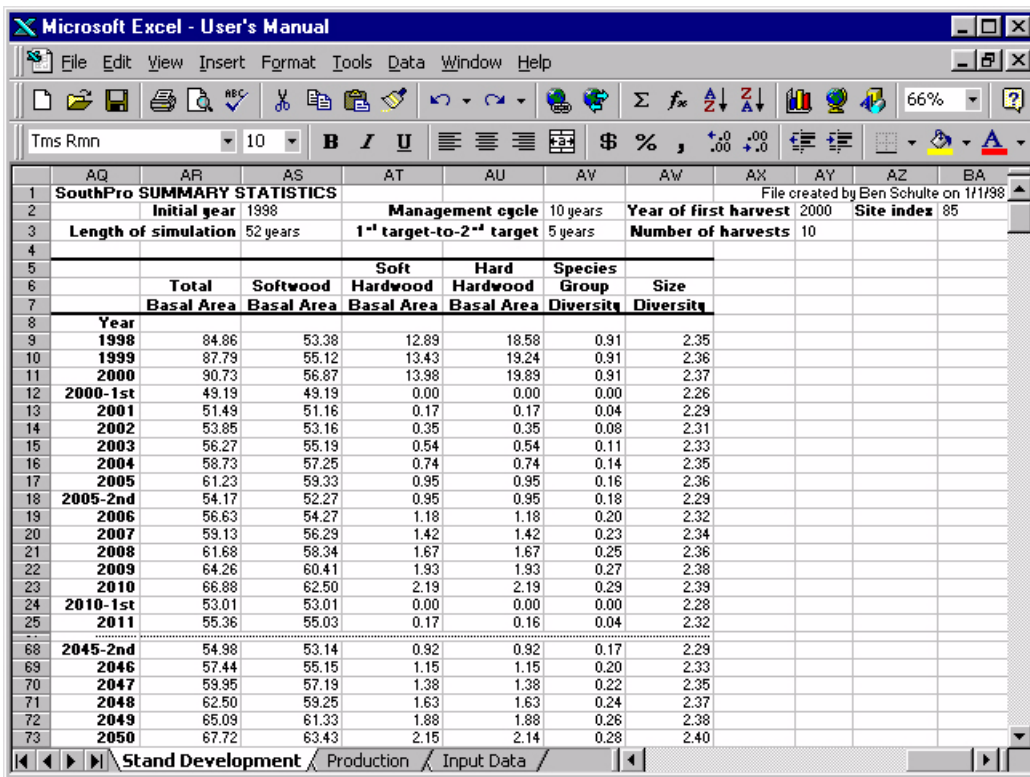


Figure 14—Stand Development output worksheet with summary statistics.

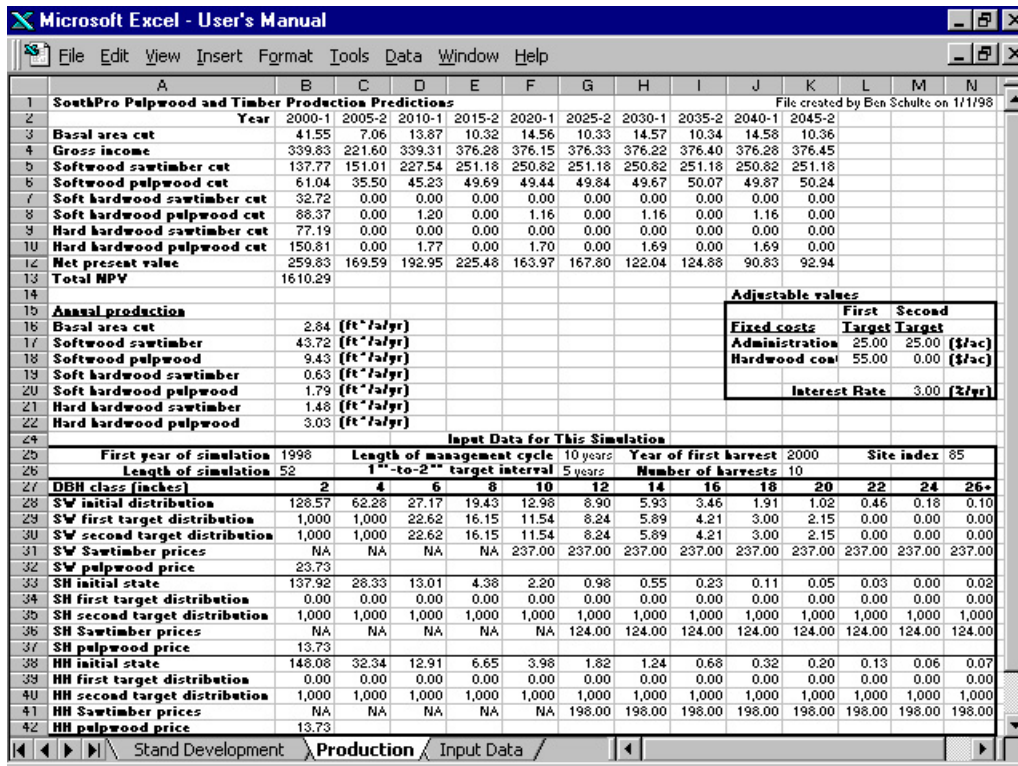


Figure 15—Production output worksheet.

workbook, the new output will be written to worksheets named Stand Development (2) and Production (2). In general, when a workbook already contains a worksheet of a given name (Stand Development, for example), SouthPro assigns a number to subsequent worksheets so that each has a unique name.

Stand Development worksheets show, for each year, the size distribution and total basal area of each species group, the Shannon index of species group diversity, and the Shannon index of size diversity at the beginning of the year and after each harvest. Because each worksheet contains a lot of data, only some data can be viewed at a time. To view the other data, use the arrow keys on your keyboard or the scroll bars at the right and bottom of the worksheet window.

The Shannon diversity indices in Stand Development worksheets are based on the basal area of trees rather than the number of trees, to assign more weight to larger trees. Thus, the index of size diversity reaches its maximum value of 2.56 when the basal area of trees is evenly distributed among all 13 size classes. Likewise, the index of species group diversity reaches its maximum value of 1.10 when the basal area of trees is evenly distributed among the three species groups. If you wish to obtain diversity indices based on the number of trees, as well as those based on basal area, you can tell SouthPro to produce the appropriate stock-and-cut table (see section on Generating Stock-and-Cut Tables and Marking Guides). Note that the theoretical maximum of tree size diversity, when calculated on the basis of number of trees rather than tree basal area, is usually not sustainable in natural uneven-aged stands (Buongiorno and others 1994).

Production worksheets show, for each harvest year, the basal area cut, volume of pulpwood and sawtimber removed by species group, gross income generated, and net present value of the harvest. Production worksheets also report the total net present value of the stand and its mean annual production in terms of basal area cut and volume harvested (Fig. 15).

To help you keep track of the assumptions in each simulation, the Stand Development and the Production worksheets show the initial distribution and other input data. In addition, the name of the person who performed the simulation and the date when it was performed are recorded on each worksheet. The name is the user name given on the General tab in the Excel Options dialog box. To change this name, select Options on the Tools menu and then select the General tab in the Options dialog box.

After a simulation has been performed, the interest rate and the fixed costs in the Adjustable Values box of the Production worksheet can be changed to see the effects on the net present values of individual harvests and on the total net present value of the stand. All other cells are protected and cannot be changed.

Tutorial: Loading input data from setup files

Here you will practice loading input data from setup files. Select Single Simulation from the SOUTHPRO menu and click Setup. In the Load Setup Files dialog box (Fig. 10), enter an interest rate of 3.25 and a site index of 75; click on both Insert ? check boxes. Next, select the following variables:

Initial Distribution: Average site 4 plots

First Target Softwoods: Current guide SW

Second Target Softwoods: Williston guide

First Target Soft Hardwoods: Remove All

Second Target Soft Hardwoods: No Harvest

First Target Hard Hardwoods: Remove All

Second Target Hard Hardwoods: No Harvest

Management Schedule: Example schedule

Stumpage Prices: SE: 1996 average

Fixed Costs First Target: Example fixed costs

Fixed Costs Second Target: Example fixed costs

Examine the softwood target distribution parameters you are about to load into the Input Data worksheet. Select SW Targets from Preview Selections in the Load Setup Files dialog box and click Show to display the Softwoods Target Previews dialog box (Fig. 16). The Current Guide SW setup file should be highlighted in the First Target Softwoods list and Williston guide setup file should be highlighted in the Second Target Softwoods list. The values contained in these setup files should appear in the bottom half of the dialog box. Scroll to the top of the Second Target Softwoods list. Notice that the target distribution you saved earlier in this tutorial is listed between the No harvest setup file and the Remove all setup file. Select this target distribution to verify that it contains the values you originally entered into the Input Data worksheet. The contents of this target distribution should now be displayed at the bottom of the dialog box. Now, either click OK or press Enter to return to the Load Setup Files dialog box.

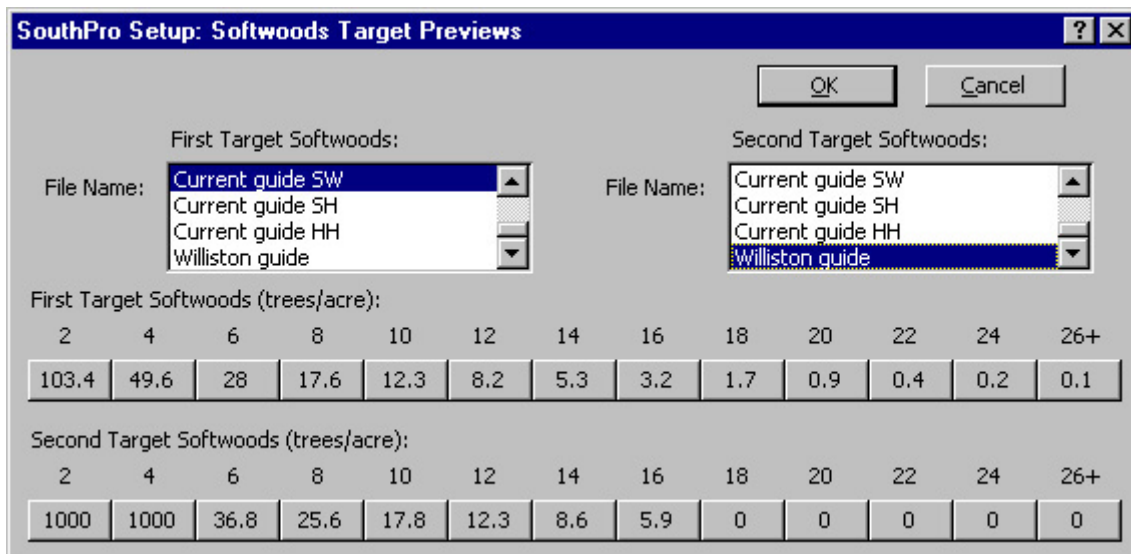


Figure 16—Softwoods Target Previews dialog box.

Notice that the setup file you created earlier is now selected in the Second Target Softwoods list in the Load Setup Files dialog box. (If you had exited the Softwoods Target Previews dialog box by clicking the Cancel button, the Williston guide setup file would still be highlighted.) Load the selected information into the Input Data worksheet by either clicking OK or pressing Enter. The Input Data worksheet should now be complete. It should resemble Figure 3, except that the first target distribution for softwoods, the site index, and the interest rate have new values.

Even though you have used setup files to prepare the Input Data worksheet, it is still possible to make additional changes to the worksheet directly. To try this, manually change the site index (cell B41) to 85, the interest rate (cell B39) to 3.00 (that is, 3.00%/year), and the first target distribution for softwoods (cells B6 through N6) to the values shown in Figure 3. Now, run the simulation by selecting Single Simulation from the SOUTHPRO menu and then clicking on Run.

When the simulation is complete, familiarize yourself with the Stand Development and Production output worksheets. On the Stand Development worksheet, find the size distribution data (cells A9 through N71 for softwoods, cells O9 through AB71 for soft hardwoods, and cells AC9 through AP71 for hard hardwoods), basal area data (cells AR9 through AU71), Shannon indices of species group diversity (cells AV9 through AV71), and Shannon indices of size diversity (cells AW9 through AW71). On the Products worksheet, find the basal area cut data (cells B3 through K3), gross income data (cells B4 through K4), sawtimber and pulpwood volumes removed (cells B5 through K10), and net present value data (cells B12 through K12).

If the length of the first target-to-second target interval had been set to zero in this example, the second target distribution would not have been used and all the cells containing its values would be blank on the Stand Development and Production worksheets. In addition, the values of the second target distribution would have been erased from the Input Data worksheet.

Finally, try changing the interest rate and fixed costs of administration and hardwood control in the Adjustable Values box on the Production worksheet to see their effects on net present value.

Plotting Summary Data

SouthPro has the ability to generate six different types of charts. These charts are grouped into two categories based on the location of the data. The stand development charts use data from Stand Development worksheets; and production charts use data from Production worksheets.

Stand development charts include the

- Diversity Indices Chart,
- Size Distribution Chart, and
- Stand Basal Area Chart.

Production charts include the

- Basal Area Cut Chart,
- Gross Income Chart, and
- Volume Cut Chart.

To create a chart, the corresponding data worksheet must be active. SouthPro verifies that the active worksheet contains appropriate data. If not, an error message is displayed.

Using Chart Dialog Boxes

Each chart includes a dialog box that allows you to select the years over which the data will be plotted. In all but one chart dialog box, years must be entered as a continuous series. The exception is the dialog box for the Size Distribution Chart (Fig. 17), which allows you to select any combination of years. Like other lists of options, you can select one year by clicking on it. However, it is possible to select a series of years by selecting one year, holding down the mouse button, and simultaneously moving the cursor down the list to highlight several years. This action selects a continuous sequence of years. To select a discontinuous series of years, hold down the control key while clicking on the years you wish to select or deselect.

The Diversity Indices Chart dialog box provides check boxes for plotting species group diversity, size diversity, or both. Similarly, the dialog boxes for the Stand Basal Area Chart and the Size Distribution Chart include check boxes for selecting the species groups for the charts. The dialog box for the Volume Cut Chart (Fig. 18) allows you to plot a combination of softwood pulpwood, softwood sawtimber, soft hardwood pulpwood, soft hardwood sawtimber, hard hardwood pulpwood, and hard hardwood sawtimber volumes.

Modifying Charts

The SouthPro chart dialog boxes provide an efficient means for selecting data for plots. In addition, the dialog boxes ensure that each type of data is plotted in a consistent format. Occasionally, you may want to reformat the features of a chart or use a different type of chart to plot the selected data. Once SouthPro has created a chart, you can use Excel to make these changes.

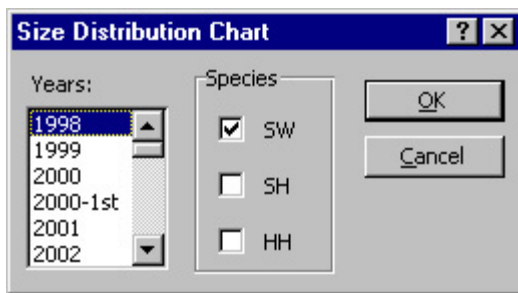


Figure 17—Size Distribution Chart dialog box.

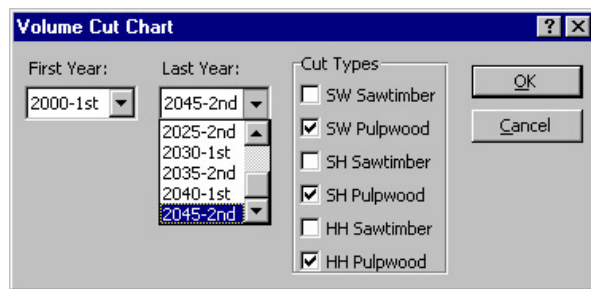


Figure 18—Volume Cut Chart dialog box.

The following tutorial shows how to use the SouthPro chart dialog boxes and introduces a few Excel charting options. You are encouraged to read the appropriate sections of the *Microsoft Excel User's Guide* for additional details.

Tutorial: Working with charts

Creating a volume cut chart—This practice chart will show the volume of pulpwood (in cubic feet per acre) cut in each of the 10 harvests between 2000 and 2045. First, activate the Production worksheet by clicking on the Production tab at the bottom of the Excel window. Select Production Charts from the SOUTHPRO menu and click Volume Cut. In the Volume Cut Chart dialog box (Fig. 18) select 2000 as the First Year and 2045 as the Last Year. In addition, under Cut Types, click the appropriate check boxes to select only the three pulpwood data series. Click OK. When prompted, enter a name for the chart you have just created.

Changing the data series order—It is possible to change the order in which data series are plotted. Practice this by switching the positions of the soft hardwood and hard hardwood pulpwood data. If you are using Excel 5.0, select 3-D Column Group from the Format menu. If you are using Excel 97 or 98, select the hard hardwood data series by clicking a column and then selecting Selected Data Series from the Format menu. With either version of Excel, when the next dialog box appears, select the Series Order tab. Select Hard hardwood pulpwood from the Series Order list if this option is not already selected. Then click the Move Down button to move this option to the middle of the list. Finally, click OK.

Previewing printed charts—Although the data series in the Volume Cut Chart you just created are displayed in color, the chart can be printed on a non-color printer. To preview how the chart will look when printed in black ink, select Page Setup from the File menu. When the Page Setup dialog box appears, select Chart. In the Printing Quality box, check Print in Black and White, and then click Print Preview. Your chart will be displayed as it will appear when printed (Fig. 19). Click Close to return to the Volume Cut Chart.

Reformatting data series—To change the appearance of a data series, double-click on one column. When the Excel Format Data Series dialog box appears, select Patterns. To change the color in which the columns are displayed, select a different color from the Area color palette. You can further modify the appearance of data series by clicking on the Pattern drop-down box if you are using Excel 5.0 or clicking the Fill Effects... button if you are using Excel 97 or 98. Take a moment to experiment with the formatting options that are available with your version of Excel. When you are finished, return to the Volume Cut Chart by clicking OK.

Creating a size distribution chart—To create a chart showing the size distribution of softwoods every 20 years before the harvest, activate the Stand Development worksheet. Next, select Stand Development Charts from the SOUTHPRO menu. Select Size Distributions to access the Size Distribution Chart dialog box (Fig. 17).

Before selecting the data for the chart, take a moment to learn how the extended multi-select list box works. First, click on 1998, then 2000, and then 2002. Notice that you can highlight only one year at a time. Now click on 1998 again, but this time hold down the mouse button. Now, simultaneously move the cursor down toward the bottom of the dialog box. Release the mouse button when 2015 appears. Notice that this action selects a continuous sequence of years. To select a discontinuous series of years, hold down the control key while clicking on the years you wish to select or de-select.

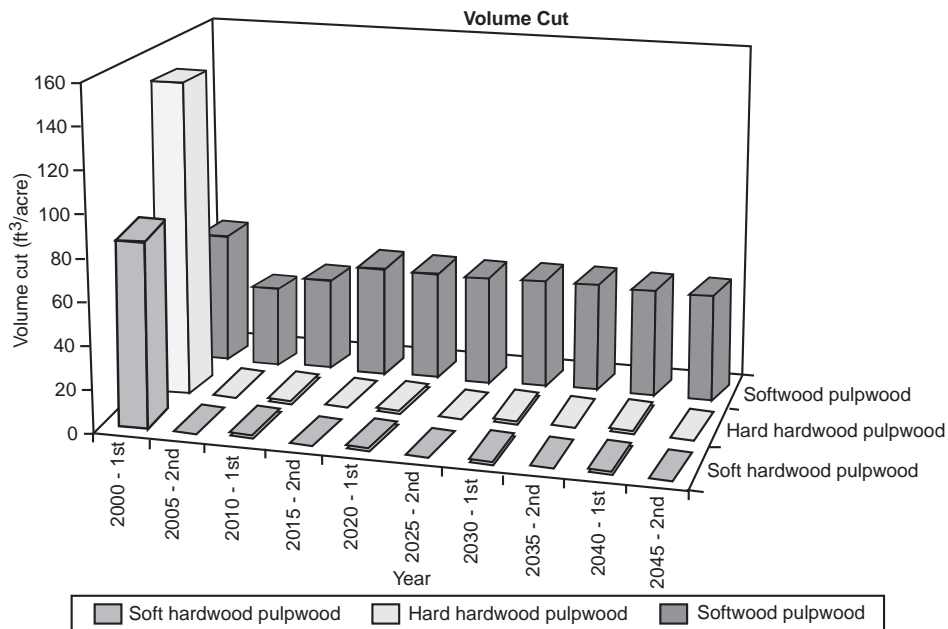


Figure 19—Example 3-D Volume Cut Chart.

Now, select the data to be plotted. Click on the year 2000 (not 2000-1st) so that it becomes the only year selected. Then, while holding down the control key, click on the years 2020 and 2040. In the Species box, click on the appropriate check boxes so that only the softwoods (SW) check box is selected. Complete the chart by clicking OK and naming the new chart when prompted.

Changing chart types—To learn how to change from one type of chart to another, select Chart Type from the Format menu if you are using Excel 5.0 or from the Chart menu if you are using Excel 97 or 98. When the Chart Type dialog box appears, select a variety of chart types and subtypes to preview how the chart would look in these other formats.

Repositioning chart features—In previewing the available chart subtypes, you may have noticed problems with the spatial arrangement of chart features. For example, the legends may be superimposed over the data. Here, you will learn how to correct such problems.

If you are using Excel 5.0, open the Chart Type dialog box, select Column chart from the 2-D options, and click the Options button. Select the first subtype on the Subtype list in the Format Column Group dialog box and click OK. If you are using Excel 97 or 98, open the Chart Type dialog box and select Standard Types. Next, select Column for Chart Type and Clustered Column (upper left) for Chart Sub-type. Click OK.

As you can see, the labels to the *x*- and *y*-axes are not positioned properly. Click once on the center of the chart. A rectangular box should appear around the plot area. This box should have eight small, black squares along its edges: one square on each corner and one in the middle of each edge. Place the cursor over the black square in the upper left-hand corner of the plot area. The cursor should change from a single large arrow to two small arrows that point in opposite directions. Click on the box and hold down the mouse button. Now, drag the box to reposition the top and left edges of the plot area. When you have positioned these edges to your satisfaction, release the mouse button. To reposition the bottom and right edges of the plot area, place the cursor over the black square in the lower right hand corner of the plot area and repeat this process. Your final result should resemble Figure 20, in color. You can use this same general process to reposition the chart title, axes titles, and legend. To reposition the chart title, for example, click on the title, hold down the mouse button, and drag the title to where you want it to be.

Additional exercises—Take a few minutes to experiment with some other Excel charting options on your own. In particular, be sure to try double clicking on the various components of the charts you have created and experimenting with the dialog boxes that appear. Excel has specific dialog boxes for formatting chart areas, plot areas, floors, walls, axes and their labels, legends, chart titles, and data series. These dialog boxes enable you to change the color, pattern, alignment, font, placement, scale, and value of individual chart features. For practice, try to produce the chart in Figure 21. You may use the Delete Sheet command on the Edit menu to delete the chart when finished.

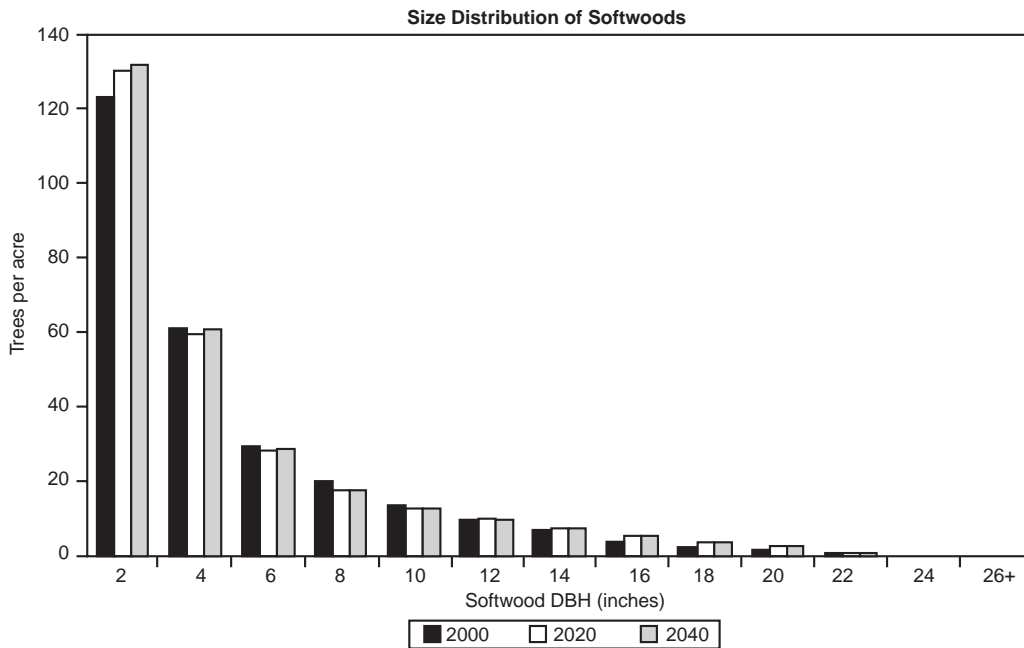


Figure 20—Example 2-D Column Size Distribution Chart.

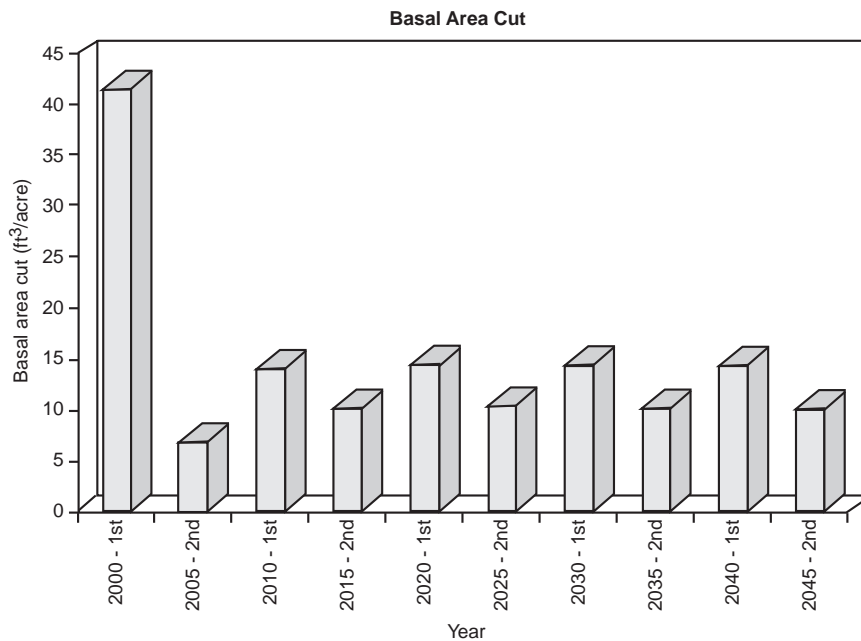


Figure 21—Example 3-D Column Gross Income Chart.

Generating Stock-and-Cut Tables and Marking Guides

The SouthPro stock-and-cut tables show, for selected preharvest and target distributions, the cut and residual stand distributions by species and size (Fig. 22). The per-acre cut in each species–size category is defined as the number of trees by which the preharvest distribution exceeds the target distribution. The residual distribution is what remains after the cut. If the target number of trees is 1,000, SouthPro replaces this value with the number of trees of the preharvest distribution. The stock-and-cut tables also list the basal area, cubic foot volume, and board foot volume of the trees in each species–size category. In addition, these tables show the predicted annual cubic foot and board foot growth of stands with the given preharvest, target, and residual distributions. Finally, the stock-and-cut tables provide the Shannon index of species group diversity and the Shannon index of size diversity in terms of basal area and number of trees.

SOFTWOODS

DBH (Inches)	Pre-Harvest Stand						Target Stand					
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)	
2	128.57	2.80	NA	NA	NA	NA	128.57	2.80	NA	NA	NA	NA
4	62.28	5.43	NA	NA	NA	NA	62.28	5.43	NA	NA	NA	NA
6	27.17	5.33	73.66	NA	3.19	NA	22.62	4.44	54.76	NA	4.20	NA
8	19.43	6.78	143.33	NA	0.64	NA	16.15	5.64	114.47	NA	0.74	NA
10	12.98	7.08	112.99	0.50	4.57	0.02	11.54	6.29	80.99	0.36	2.83	0.01
12	8.90	6.99	185.66	0.95	7.05	0.04	8.24	6.47	158.12	0.81	5.40	0.03
14	5.93	6.34	192.61	1.07	9.15	0.05	5.89	6.29	181.36	1.01	7.18	0.04
16	3.46	4.84	151.65	0.89	11.00	0.06	4.21	5.87	177.06	1.04	7.74	0.05
18	1.91	3.38	105.07	0.65	8.82	0.05	3.00	5.31	159.88	0.98	7.29	0.04
20	1.02	2.22	67.19	0.43	5.96	0.04	2.15	4.68	137.90	0.88	6.21	0.04
22	0.46	1.23	35.74	0.23	3.97	0.03	0.00	0.00	0.00	0.00	15.29	0.10
24	0.18	0.57	16.06	0.11	2.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00
26+	0.10	0.38	10.25	0.07	1.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	272.40	53.38	1094.20	4.89	57.47	0.31	264.64	53.24	1064.54	5.07	56.89	0.31

SOFT HARDWOODS

DBH (Inches)	Pre-Harvest Stand						Target Stand					
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)	
2	137.92	3.01	NA	NA	NA	NA	0.00	0.00	NA	NA	NA	NA
4	28.33	2.47	NA	NA	NA	NA	0.00	0.00	NA	NA	NA	NA
6	13.01	2.55	17.75	NA	0.85	NA	0.00	0.00	0.00	NA	0.00	NA
8	4.38	1.53	26.19	NA	1.99	NA	0.00	0.00	0.00	NA	0.00	NA
10	2.20	1.20	24.35	NA	1.03	NA	0.00	0.00	0.00	NA	0.00	NA
12	0.98	0.77	4.10	0.01	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.55	0.59	8.73	0.03	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.23	0.33	6.33	0.03	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.11	0.19	4.16	0.02	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.05	0.10	2.32	0.01	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.03	0.08	1.84	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26+	0.02	0.07	1.56	0.01	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	187.82	12.89	97.33	0.12	5.66	0.01	0.00	0.00	0.00	0.00	0.00	0.00

HARD HARDWOODS

DBH (Inches)	Pre-Harvest Stand						Target Stand					
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)	
2	148.08	3.23	NA	NA	NA	NA	0.00	0.00	NA	NA	NA	NA
4	32.34	2.82	NA	NA	NA	NA	0.00	0.00	NA	NA	NA	NA
6	12.91	2.54	18.66	NA	0.99	NA	0.00	0.00	0.00	NA	0.00	NA
8	6.65	2.32	38.98	NA	1.25	NA	0.00	0.00	0.00	NA	0.00	NA
10	3.98	2.17	43.31	NA	1.21	NA	0.00	0.00	0.00	NA	0.00	NA
12	1.82	1.43	7.43	0.02	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.24	1.32	15.09	0.06	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.68	0.96	14.14	0.06	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.32	0.57	9.50	0.04	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.20	0.43	7.76	0.04	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.13	0.35	6.42	0.04	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.06	0.20	3.82	0.02	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26+	0.07	0.25	4.81	0.03	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	208.49	18.58	169.91	0.31	7.48	0.02	0.00	0.00	0.00	0.00	0.00	0.00

STAND TOTALS

DBH (Inches)	Pre-Harvest Stand						Target Stand					
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (M bf/a)		Annual Growth (ft ³ /a) (M bf/a)	
2	414.56	9.04	NA	NA	NA	NA	128.57	2.80	NA	NA	NA	NA
4	122.95	10.73	NA	NA	NA	NA	62.28	5.43	NA	NA	NA	NA
6	53.10	10.43	110.06	NA	5.03	NA	22.62	4.44	54.76	NA	4.20	NA
8	30.46	10.63	208.49	NA	3.89	NA	16.15	5.64	114.47	NA	0.74	NA
10	19.17	10.45	180.64	0.50	6.81	0.02	11.54	6.29	80.99	0.36	2.83	0.01
12	11.69	9.18	197.19	0.98	8.16	0.04	8.24	6.47	158.12	0.81	5.40	0.03
14	7.72	8.25	216.43	1.16	10.10	0.05	5.89	6.29	181.36	1.01	7.18	0.04
16	4.38	6.12	172.13	0.97	12.38	0.07	4.21	5.87	177.06	1.04	7.74	0.05
18	2.34	4.14	118.73	0.71	9.93	0.06	3.00	5.31	159.88	0.98	7.29	0.04
20	1.26	2.76	77.26	0.48	6.46	0.04	2.15	4.68	137.90	0.88	6.21	0.04
22	0.63	1.65	44.01	0.28	4.22	0.03	0.00	0.00	0.00	0.00	15.29	0.10
24	0.25	0.77	19.88	0.13	2.39	0.02	0.00	0.00	0.00	0.00	0.00	0.00
26+	0.19	0.70	16.62	0.11	1.24	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	668.70	84.86	1361.44	5.32	70.61	0.33	264.64	53.24	1064.54	5.07	56.89	0.31
Spp. Div.	1.09	0.91					Spp. Div.	0.00	0.00			
Size Div.	1.25	2.35					Size Div.	1.56	2.28			

Figure 22—Stock and Cut Table worksheet.

SOFTWOODS

DBH (Inches)	Cut				Residual Stand					Marking Guide	
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Annual Growth (ft ³ /a) (Mbf/a)		
2	0.00	0.00	NA	NA	128.57	2.80	NA	NA	NA	NA	Pulpwood (5" to < 9") Cut 8 of 47 tr/a or 1 tree in 6
4	0.00	0.00	NA	NA	62.28	5.43	NA	NA	NA	NA	
6	4.55	0.89	10.4	NA	22.62	4.44	53.64	NA	4.19	NA	
8	3.28	1.14	22.7	NA	16.15	5.64	113.67	NA	0.78	NA	
10	1.44	0.79	8.9	0.04	11.54	6.29	77.66	0.35	2.77	0.01	Sm. Sawtimber (9" to < 15") Cut 2 of 28 tr/a or 1 tree in 13
12	0.66	0.51	12.0	0.06	8.24	6.47	155.74	0.79	5.37	0.03	
14	0.04	0.04	1.2	0.01	5.89	6.29	179.66	1.00	7.18	0.04	Med. Sawtimber (15" to < 21") Leave all trees
16	0.00	0.00	0.0	0.00	3.46	4.84	144.82	0.85	10.90	0.06	
18	0.00	0.00	0.0	0.00	1.91	3.38	101.29	0.62	8.98	0.06	
20	0.00	0.00	0.0	0.00	1.02	2.22	65.18	0.41	6.11	0.04	Lg. Sawtimber (21" and up) Cut all trees
22	0.46	1.23	34.6	0.22	0.00	0.00	0.00	0.00	7.30	0.05	
24	0.18	0.57	15.6	0.10	0.00	0.00	0.00	0.00	0.00	0.00	
26+	0.10	0.38	10.0	0.07	0.00	0.00	0.00	0.00	0.00	0.00	
Total	10.72	5.56	115.4	0.50	261.68	47.82	891.66	4.02	53.59	0.28	

SOFT HARDWOODS

DBH (Inches)	Cut				Residual Stand					Marking Guide	
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Annual Growth (ft ³ /a) (Mbf/a)		
2	137.92	3.01	NA	NA	0.00	0.00	NA	NA	NA	NA	Pulpwood (5" to < 11") Cut all trees
4	28.33	2.47	NA	NA	0.00	0.00	NA	NA	NA	NA	
6	13.01	2.55	10.0	NA	0.00	0.00	0.00	NA	0.00	NA	Sm. Sawtimber (11" to < 15") Cut all trees
8	4.38	1.53	23.6	NA	0.00	0.00	0.00	NA	0.00	NA	
10	2.20	1.20	23.0	NA	0.00	0.00	0.00	NA	0.00	NA	
12	0.98	0.77	2.1	0.01	0.00	0.00	0.00	0.00	0.00	0.00	Med. Sawtimber (15" to < 21") Cut all trees
14	0.55	0.59	7.6	0.03	0.00	0.00	0.00	0.00	0.00	0.00	
16	0.23	0.33	5.8	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
18	0.11	0.19	3.9	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
20	0.05	0.10	2.2	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
22	0.03	0.08	1.8	0.01	0.00	0.00	0.00	0.00	0.00	0.00	Lg. Sawtimber (21" and up) Cut all trees
24	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
26+	0.02	0.07	1.5	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
Total	187.82	12.89	81.6	0.11	0.00	0.00	0.00	0.00	0.00	0.00	

HARD HARDWOODS

DBH (Inches)	Cut				Residual Stand					Marking Guide	
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Annual Growth (ft ³ /a) (Mbf/a)		
2	148.08	3.23	NA	NA	0.00	0.00	NA	NA	NA	NA	Pulpwood (5" to < 11") Cut all trees
4	32.34	2.82	NA	NA	0.00	0.00	NA	NA	NA	NA	
6	12.91	2.54	12.1	NA	0.00	0.00	0.00	NA	0.00	NA	Sm. Sawtimber (11" to < 15") Cut all trees
8	6.65	2.32	35.6	NA	0.00	0.00	0.00	NA	0.00	NA	
10	3.98	2.17	41.3	NA	0.00	0.00	0.00	NA	0.00	NA	
12	1.82	1.43	4.2	0.01	0.00	0.00	0.00	0.00	0.00	0.00	Med. Sawtimber (15" to < 21") Cut all trees
14	1.24	1.32	12.9	0.05	0.00	0.00	0.00	0.00	0.00	0.00	
16	0.68	0.96	12.9	0.05	0.00	0.00	0.00	0.00	0.00	0.00	
18	0.32	0.57	8.9	0.04	0.00	0.00	0.00	0.00	0.00	0.00	
20	0.20	0.43	7.4	0.04	0.00	0.00	0.00	0.00	0.00	0.00	
22	0.13	0.35	6.2	0.03	0.00	0.00	0.00	0.00	0.00	0.00	Lg. Sawtimber (21" and up) Cut all trees
24	0.06	0.20	3.7	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
26+	0.07	0.25	4.7	0.03	0.00	0.00	0.00	0.00	0.00	0.00	
Total	208.49	18.58	150.0	0.28	0.00	0.00	0.00	0.00	0.00	0.00	

STAND TOTALS

DBH (Inches)	Cut				Residual Stand					
	Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Trees (#/acre)	BA (ft ² /a)	Volume (ft ³ /a) (Mbf/a)		Annual Growth (ft ³ /a) (Mbf/a)	
2	286.00	6.24	NA	NA	128.57	2.80	NA	NA	NA	NA
4	60.67	5.29	NA	NA	62.28	5.43	NA	NA	NA	NA
6	30.48	5.98	32.5	NA	22.62	4.44	53.64	NA	4.19	NA
8	14.31	4.99	81.9	NA	16.15	5.64	113.67	NA	0.78	NA
10	7.63	4.16	73.2	0.04	11.54	6.29	77.66	0.35	2.77	0.01
12	3.45	2.71	18.3	0.08	8.24	6.47	155.74	0.79	5.37	0.03
14	1.83	1.96	21.7	0.08	5.89	6.29	179.66	1.00	7.18	0.04
16	0.92	1.28	18.8	0.08	3.46	4.84	144.82	0.85	10.90	0.06
18	0.43	0.76	12.9	0.06	1.91	3.38	101.29	0.62	8.98	0.06
20	0.25	0.53	9.6	0.05	1.02	2.22	65.18	0.41	6.11	0.04
22	0.63	1.65	42.5	0.27	0.00	0.00	0.00	0.00	7.30	0.05
24	0.25	0.77	19.3	0.13	0.00	0.00	0.00	0.00	0.00	0.00
26+	0.19	0.70	16.2	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Total	407.03	37.04	346.9	0.89	261.68	47.82	891.66	4.02	53.59	0.28
Spp. Div.	0.80	1.00			0.00	0.00				
Size Div.	1.03	2.29			1.52	2.25				

Figure 22—Stock-and-Cut Table worksheet—con.

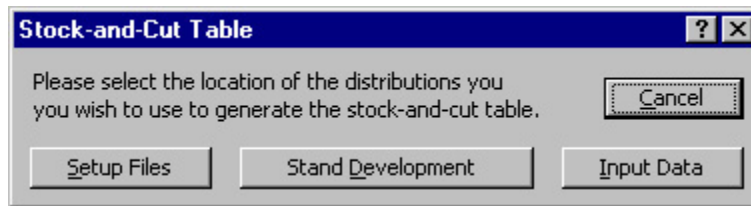


Figure 23—Stock-and-Cut Table dialog box.

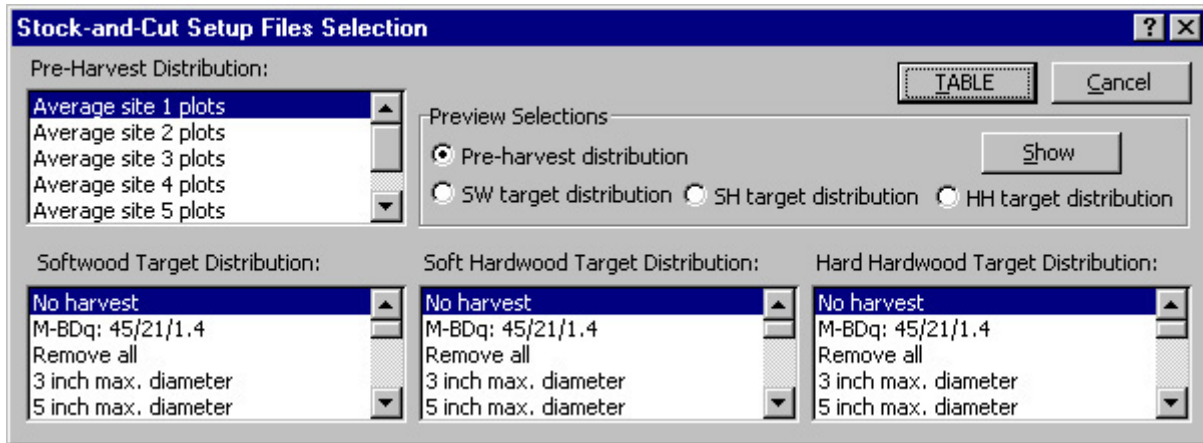


Figure 24—Stock-and-Cut Setup Files Selection dialog box.

To create a stock-and-cut table, first select a preharvest stand distribution and a target distribution from the Setup Files worksheet, the Input Data worksheet, or any SouthPro-generated worksheet in the active workbook that contains stand development predictions. Indicate the location of the desired distributions by selecting Stock-and-Cut Table from the SOUTH-PRO menu and then clicking the Setup Files, Stand Development, or Input Data button (Fig. 23). If the desired distributions are contained in a stand development worksheet, that worksheet must be active.

Stock-and-Cut Setup Files

Selecting the Setup Files option opens the Stock-and-Cut Setup File Selection dialog box (Fig. 24). This dialog box allows you to select the setup files containing the preharvest and target distributions that will be used to generate the stock-and-cut table. The previewing options are similar to those of the Load Setup Files dialog box (see Loading Setup Files in section on Setting Up and Running Single Simulations). After you select the distributions, click TABLE. A worksheet containing the stock-and-cut table and marking guide will be added to the active workbook.

Stock-and-Cut Stand Development

Selecting Stand Development in the Stock-and-Cut Table dialog box (Fig. 23) opens the Stock-and-Cut Stand Development Selection dialog box (Fig. 25). Before displaying this box, SouthPro checks the active worksheet to verify that it contains stand development data. If it does not, SouthPro displays an error message. The Stock-and-Cut Stand Development Selection dialog box contains two drop-down lists, one for selecting the preharvest distribution and the other for selecting the target distribution. Both lists show the target distribution or distributions used in the simulation that generated the active worksheet, along with all the projected distributions contained in the active worksheet. The projected distributions are named by year and harvest type; for example, 2010-1st target designates the distribution in the year 2010, after harvesting. When you select a distribution, this distribution is displayed in the lower portion of the dialog box. Click TABLE to get the corresponding stock-and-cut table and marking guide.

Stock-and-Cut Input Data

Selecting Input Data in the Stock-and-Cut Table dialog box (Fig. 23) opens the Stock-and-Cut Input Data Selection dialog box (Fig. 26). This dialog box gives you the option to use either the first or second target distribution on the Input Data worksheet. The initial stand distribution on the Input Data worksheet automatically becomes the preharvest distribution for the stock-and-cut table. SouthPro checks the contents of these distributions for invalid entries.

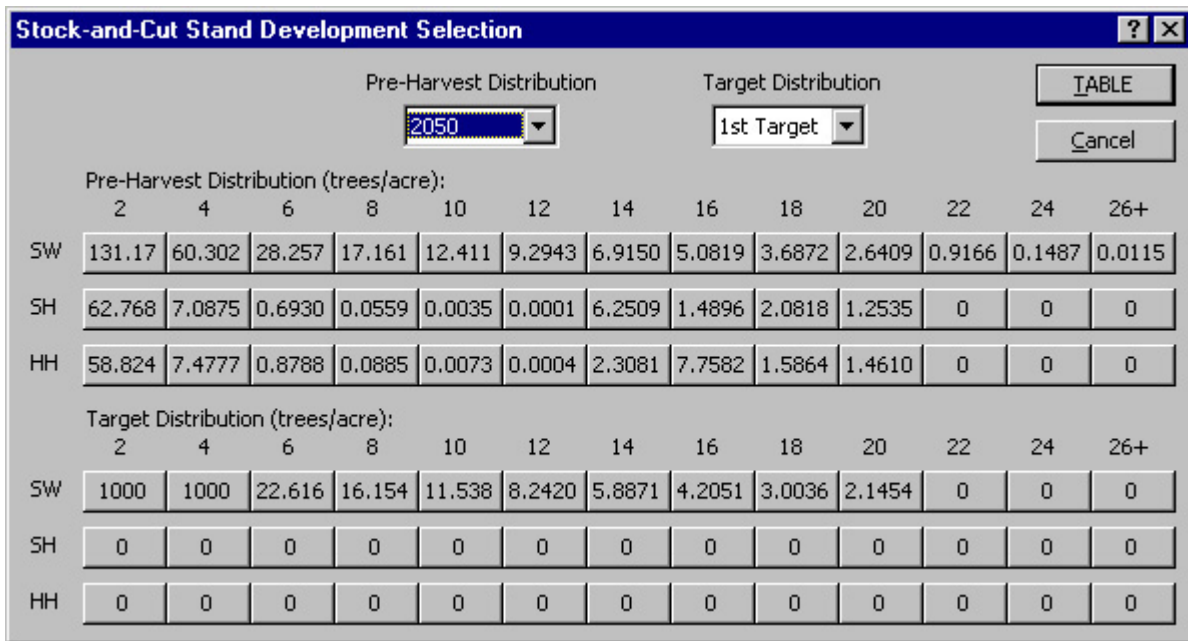


Figure 25—Stock-and-Cut Stand Development Selection dialog box.



Figure 26—Stock-and-Cut Input Data Selection dialog box.

Stock-and-Cut Worksheets

SouthPro writes the stock-and-cut table and its associated marking guide to a worksheet named Stock-and-Cut (Fig. 22). If the active workbook already contains a worksheet with this name, SouthPro changes the name to Stock-and-Cut (x), where x is the lowest positive integer that gives the new worksheet a unique name.

Tutorial: Making a stock-and-cut table

Activate the Stand Development worksheet and then select Stock-and-Cut from the SOUTHPRO menu. Click Setup Files in the Stock-and-Cut Table dialog box (Fig. 23), which will open the Stock-and-Cut Setup File Selection dialog box (Fig. 24). Next, select a setup file in each list. Preview each selection by first clicking the appropriate Preview Selections button and then clicking Show. Finally, click Cancel.

When the Stock-and-Cut Table dialog box appears once again, click Stand Development, which will open the Stock-and-Cut Stand Development Selection dialog box (Fig. 25). Select 2050 as the preharvest distribution and the 1st Target distribution under Target Distribution. These two distributions will be displayed in the lower portion of the dialog box. Now, click Cancel to return to the Stock-and-Cut Table dialog box.

This time, click Input Data, which will open the Stock-and-Cut Input Data Selection dialog box (Fig. 26). Select First to use the first target distribution as the target distribution. Then, click TABLE. A Stock-and-Cut worksheet will appear. Take a few moments to familiarize yourself with the format and contents of this worksheet.

Marking Guides

For each stock-and-cut table, SouthPro calculates the corresponding marking guide (Fig. 22) and appends it to the right of the table. The marking guides indicate the number of trees to cut in each of four product classes:

- Pulpwood (5 to <9 in. DBH for softwoods, 5 to <11 in. DBH for hardwoods)
- Small sawtimber (9 to <15 in. DBH for softwoods, 11 to <15 in. DBH for hardwoods)
- Medium sawtimber (15 to <21 in. DBH)
- Large sawtimber (≥ 21 in. DBH)

Setting Up and Running a Batch of Simulations

When running a large number of simulations, it can be cumbersome to wait for one simulation to finish before preparing the Input Data worksheet for the next simulation. To save time, SouthPro provides the option of running up to 500 simulations in a batch. To take advantage of this option, you need to enter the names of the setup files for each simulation, the site index, and the interest rate into the Batch File worksheet (Fig. 27). If SouthPro does not find a copy of the Batch File worksheet in the active workbook when one is needed, SouthPro will ask if it should insert a Batch File worksheet. When you run the batch of simulations, you will be asked to select a file name and directory for each simulation. This process is necessary because the output worksheets from each simulation are copied to a new workbook. The new workbook is saved and closed before the next simulation is run to conserve memory.

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Simulation	Initial Distribution	Softwoods First Target	Softwoods Second Target	Soft Hardwoods First Target	Soft Hardwoods Second Target	Hard Hardwoods First Target
1	Average site 3 plots	Current guide SW	19 inch max. diameter	Remove all	Remove all	Remove all
2	Average site 5 plots	15 inch max. diameter	15 inch max. diameter	Remove all	No harvest	Remove all
3	Average site 4 plots	21 inch max. diameter	21 inch max. diameter	No harvest	Remove all	No harvest
4						
5						

Batch File | Stand Development | Production | Input Data

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Hard Hardwoods Second Target	Management Schedule	Stumpage Prices	Fixed Costs First Target	Fixed Costs Second Target	Site Index	Interest Rate	Workbook Name
No harvest	Example schedule	SE: 1996 average	Example fixed costs	Example fixed costs	85.00	3.00	C:Asim#1
Remove all	Example schedule	SE: 4th quarter 1996	Example fixed costs	Example fixed costs	85.00	3.00	C:Asim#2
Remove all	Example schedule	SE: 1996 average	Example fixed costs	Example fixed costs	75.00	3.25	C:Asim#3

Batch File | Stand Development | Production | Input Data

Figure 27—Sample Batch File worksheet.

Error Check

To minimize the possibility that errors will interrupt the simulations, SouthPro checks for errors in input data for all simulations before it begins the first simulation. However, SouthPro assumes that all the setup files on the Setup Files worksheet contain valid data. This assumption is made because the data were checked when the setup files were initially added to the Setup Files worksheet, provided that the Setup files were added through the Add Setup Files dialog box. If you edit the Setup Files worksheet directly, rather than through the Add Setup Files or Delete Setup Files dialog boxes, you risk introducing data that could interrupt or abort the execution of a batch of simulations.

Update Batch File Dialog Box

The Update Batch File dialog box (Fig. 28) facilitates entering the names of the Setup Files that will be used for each simulation into the Batch Files worksheet. It is nearly identical to the Load Setup Files dialog box. The main difference is that the Update Batch File dialog box also has a control to number the simulation to which the current data apply. To display the Update Batch File dialog box, select Multiple Simulations from the SOUTHPRO menu. Then select Setup. When the dialog box first appears, the run number is always 1, which indicates that the data you are about to enter will be used for the first simulation unless you change the run number. Once you have entered the data, click Add to copy these data to the Batch File worksheet. A new Update Batch File dialog box will then appear, with the run number incremented to 2. This iteration will continue until you click Cancel.

The dialog box is titled "Update Batch File" and contains several sections for configuring simulation parameters. At the top left, there is a "Set Run Number" spinner set to 1, with "ADD" and "Cancel" buttons to its right. Below the run number is the "Initial Distribution" section with a list box containing "Average site 2 plots", "Average site 3 plots", "Average site 4 plots", and "Average site 5 plots". To the right of this is the "Preview Selections" section with radio buttons for "Initial Distributions", "SW Targets", "SH Targets", "HH Targets", "Management Schedule", "Stumpage Prices", and "Fixed Costs", along with a "Show" button. On the far right is a vertical panel with "Interest Rate (%/year)" set to 3 and "Site Index" set to 85, each with an "Insert?" checkbox checked. The main area contains several list boxes for targets: "First Target Softwoods" (Current guide SW, Current guide SH, Current guide HH, Williston guide), "Second Target Softwoods" (15 inch max. diameter, 17 inch max. diameter, 19 inch max. diameter, 21 inch max. diameter), "First Target Soft Hardwoods" (Current guide SW, Current guide SH, Current guide HH, Williston guide), "Second Target Soft Hardwoods" (13 inch max. diameter, 15 inch max. diameter, 17 inch max. diameter, 19 inch max. diameter), "First Target Hard Hardwoods" (Current guide SW, Current guide SH, Current guide HH, Williston guide), and "Second Target Hard Hardwoods" (13 inch max. diameter, 15 inch max. diameter, 17 inch max. diameter, 19 inch max. diameter). At the bottom are four list boxes for "Management Schedule", "Stumpage Prices", "Fixed Costs First Target", and "Fixed Costs Second Target", each with "DO NOT INSERT" and an example option.

Figure 28—Update Batch File dialog box.

Tutorial: Running a batch of simulations

To open the Update Batch File dialog box (Fig. 28), select Multiple Simulations from the SOUTHPRO menu and click Setup. The run number will be set to 1, so there is no need to change it. First, select the setup files, interest rate, and site index you wish to use for the first simulation. Your choices will be limited until you add more setup files of your own. The options you choose are not important for this exercise. When you have finished making your selections, click Add. This will cause SouthPro to copy your selections to the Batch File worksheet. The Update Batch File dialog box will now appear with the run number incremented to 2. Fill out the Update Batch File dialog box two more times. When the Update Batch File dialog box is displayed for the fourth time, click Cancel.

Verify that the first 13 fields on the Batch File worksheet (columns B through N) are filled for the first three simulations (the Workbook Name field should be empty). If there are empty cells, you have three options:

1. Type the missing data directly into the empty cells.
2. Enter the missing data through the Update Batch File dialog box.
3. Wait for SouthPro to catch the mistake and prompt you for an entry.

To see how SouthPro's error-checking dialog boxes work, choose option 3. To make sure that the file contains an error, delete the entry in cell G7 (first target distribution for hard hardwoods) for the second simulation. In addition, assume that you have decided not to run the first simulation but still wish to complete the second and third simulations. Indicate this by changing the number in cell C2 to 2 and leaving the number 3 in cell C3. Now, run these two simulations by selecting Multiple Simulations from the SOUTHPRO menu and then clicking the Run button.

SouthPro will start its error check by asking you to confirm that you want to run simulations 2 through 3. Respond by clicking Yes. SouthPro will begin its error check routines and stop when it reaches cell G7. Here, SouthPro will insert a red question mark and ask you to enter the name of a valid first target distribution for hard hardwoods setup file. Enter an incorrect name to see what happens. SouthPro will continue to prompt you for a valid name until one is entered or until you click Cancel. If you click Cancel, SouthPro will end the current multiple simulation session. Instead of clicking Cancel, enter Current guide HH. Be careful when typing your entry because the SouthPro name verification routine is case sensitive. For this reason, it is usually best to use the Update Batch File dialog box to enter parameters rather than typing the parameters into the worksheet directly.

Assuming that all the other data were valid, SouthPro will display the File Save As dialog box. The status bar will indicate that the workbook name you enter will be used for simulation number 2. Select an existing file from the current directory or folder and then click OK. If the current directory is empty, select a file from another directory. SouthPro will ask you if you want to overwrite this file with the output workbook. Click NO. Instead, accept SouthPro's default name of sim#2.xls.

SouthPro does not allow you to use the same workbook name for more than one simulation. For example, enter sim#2.xls as the workbook name for simulation number 3 and click OK. SouthPro will inform you that you have already used this name for simulation number 2. Accept SouthPro's default name once again. SouthPro should now run the two simulations uninterrupted. When the simulations have been run, select Open from the File menu to verify that the files were in fact saved in the intended directory. Open the files. Each file will contain a Stand Development worksheet and a Production worksheet. After running a batch of simulations, you can move these worksheets to other workbooks with the same technique you used to copy the Setup Files worksheet to another workbook. To move these worksheets rather than copy them, do not select the Create a Copy check box in the Move or Copy dialog box. If you do elect to move the output worksheets to other workbooks, you may want to rename these worksheets to help you remember which simulation they originated from.

This completes the tutorial. If you wish, you may delete the two practice workbooks you just created.

Chapter 4. Limitations and Cautions

Overview

The purpose of this chapter is to ensure that you use SouthPro wisely. This chapter provides a series of caveats concerning the limitations of the program and appropriate uses of its predictions. The predictive power of the model is discussed, as well as the importance of not extending the growth model and volume equations beyond the range of data used to calibrate them, the potential for the propagation of errors, and the value of performing sensitivity analyses. Suggestions are provided for interpreting SouthPro's results appropriately.

Accuracy and Interpretation of Predictions

It is important to take care in interpreting the SouthPro predictions. For example, because each species group recognized by SouthPro is composed of many different species (Appendix A), the predictions should not be interpreted as forecasting the growth of any one species, even if the actual stand from which the initial distribution was taken was composed of a single species (loblolly pine, for example).

Similarly, the regeneration, growth, and mortality of trees are all highly stochastic processes. Therefore, the SouthPro predictions should not be interpreted as indicating the precise behavior of an individual stand when grown on a site with a particular productivity level and managed according to a given management regime. Rather, the predictions should be interpreted as representing the expected average behavior of a number of such stands. The behavior of the individual stands may vary but, on average, their collective behavior should conform well to the predictions, provided that the stands being simulated are similar to those used to calibrate the growth model and volume equations. Validation tests have shown the accuracy of SouthPro under these conditions (Lin and others 1998).

However, as the differences between the simulated stands and those used to calibrate the growth model increase, the accuracy of the SouthPro predictions will generally decrease. For example, Schulte and Buongiorno (Schulte 1997, Schulte and Buongiorno 1998) have observed that SouthPro tends to produce lower predictions of volume growth on good sites (site indices of 80 to 94 ft) than the observed volume growth reported for several long-term case studies on similar sites (Baker 1986; Baker and Murphy 1982; Farrar and others 1984a, 1989; Reynolds 1969). For additional details, see Baker and others (1996), Grano (1954), Reynolds (1959), and Reynolds and others (1984).

Factors that appear to contribute to these lower predictions include (a) the use of different lower-diameter limits for defining merchantable timber, (b) the inability to salvage natural mortality in the present version of SouthPro, and (c) the fact that the simulations did not follow exactly the management regimes applied in each case study because such detailed information was not available (Schulte 1997). A potentially more important factor contributing to the lower predictions is the difference in the intensity of management applied to the stands in the case studies compared to that applied to the plots used to calibrate the growth model and volume equations. The stands in the case studies were intensively and professionally managed. In contrast, most of the calibration plots received little or no management during the average 7.5 years between the two inventories. Only 45% of the calibration plots showed evidence of having been harvested, and on these a mere 7% of the live cull trees > 5 in. DBH had been cut. Similarly, only 22% of the calibration plots had benefited from any stand improvement activities, other than harvesting (Schulte and other 1998).

Consequently, the SouthPro predictions for less intensively managed stands will generally be more accurate than those for more intensively managed stands. SouthPro can be expected to predict accurately the relative performance of different high-intensity management regimes, but the specific predictions generated should be regarded as conservative estimates.

Predictive Range

The equations that constitute the SouthPro growth model, as well as the equations that SouthPro uses to estimate sawlog and pulpwood volumes, were all obtained by multiple regression (Lin and others 1998). As is true of any regression equation, these equations are most reliable when applied to values that fall within the range of data used in their estimation. For example, the SouthPro calibration data set did not contain plots with a site productivity class of 7 (that is, loblolly site index <51 ft at age 50). Therefore, if SouthPro is used to predict the behavior of stands growing on such unproductive sites, it must be recognized that this is an extrapolation from other sites and thus prone to large errors.

The more plots in the calibration data set that either match or closely approximate the conditions of the stand being modeled, the more reliable the SouthPro predictions are likely to be. For example, predictions for stands growing on sites with a productivity class of 4 will generally be more reliable than predictions for stands growing on sites with a productivity class of 6 since the calibration data set contained 383 plots of the former type and only 6 plots of the latter type.

However, site productivity class is only one of several stand and tree characteristics that need to be considered. The SouthPro growth model and volume equations are also functions of the size class and species group of a tree, the number of trees of the same species group in the stand, and the stand basal area. The information in Table 3 (number of plots by site index range) and Table 4 (number of plots by stand basal area range in the two inventories) can be used to determine how well a stand is represented in the calibration data set. The tables in Appendix A can also be used in this way. Tables A1 and A2 list the average number of trees per acre by species and site, across all plots, at the time of the first and second inventories, respectively; Tables A3 and A4 list similar information by size rather than site; and Tables A5 and A6 list the average number of trees per acre by site, species group, and size, across all plots, at the first and second inventories, respectively.

Table 4—Number of plots, by stand basal area range, in first and second inventories

Inventory	Basal area range (ft ² /acre)									
	0–20	20–40	40–60	60–80	80–100	100–120	120–140	140–160	160–180	>180
First	21	39	112	186	219	183	131	72	24	4
Second	76	84	107	163	163	159	126	72	32	9

Propagation of Errors and Importance of Sensitivity Analysis

The summary statistics produced by SouthPro are typically based on a large number of intermediate calculations. For example, to predict the gross income generated by a harvest in the 50th year of a simulation, SouthPro first estimates the regeneration for each species group and the growth and mortality for each species–size category at 1-year intervals to obtain the pre-harvest distribution at the 50th year. Next, it calculates the number of trees cut from each species–size category and estimates their total heights and sawlog lengths. Then, SouthPro uses these values to calculate the volume of pulpwood and sawtimber produced by species–size category. Finally, it multiplies these volume estimates by the appropriate stumpage prices and sums the resulting values to produce the gross income statistic.

All of the intermediate calculations are prone to errors. As these errors carry through to subsequent calculations, they have the potential of causing larger errors. Consequently, the accuracy of SouthPro projections can generally be expected to decline as the length of the simulation increases. Nevertheless, validation studies have shown that SouthPro growth predictions are not only very good over single cutting cycles but they remain realistic for periods of several centuries (Lin and others 1998). This accuracy is due to the fact that slight overestimates in one calculation tend to be balanced by slight underestimates in another. Nevertheless, it is good procedure to run a given simulation several times, each time making slight alterations in the initial distribution, the target distribution, and/or the management schedule, to observe the sensitivity of the results to small changes in assumptions.

You should also perform sensitivity analyses when you are unsure of the accuracy of the economic data, or when their values are likely to change over time. For example, selecting an interest rate and finding reliable stumpage prices and fixed cost data can be difficult. It is therefore appropriate to examine a variety of scenarios to see what effect they have on the SouthPro predictions.

Other Models

SouthPro is not the only growth and yield model available for uneven-aged stands of loblolly pine. Murphy and Farrar (1982, 1983) developed a stand-level growth and yield model for uneven-aged loblolly–shortleaf pine stands using data from a 36-year methods-of-cutting study (Baker and Murphy 1982, Grano 1954), a 29-year cutting cycle study (Reynolds 1969), and unpublished research, all conducted at the Crossett Experimental Forest in the Coastal Plain of Arkansas. The model consists of a series of equations for estimating future merchantable sawtimber basal areas; current and future merchantable and sawtimber cubic-foot volumes; and current and future Doyle, Scribner, and International 1/4-in. board-foot volumes given the initial merchantable basal area, the initial ratio of sawtimber to merchantable basal area, and the elapsed time or cutting cycle.

These equations have been used to create a series of predictive tables (Farrar and others 1984b) and have been implemented as a spreadsheet template for Corel Quattro Pro 4.0 (Baker and others 1996), making it more accessible than the other models discussed in this section. The major disadvantages of Murphy and Farrar's model are that it is limited to a fairly narrow site index range (85 to 95 ft) and a limited geographic area, it does not explicitly account for regeneration or mortality, and it is of limited utility for examining the effects of different stand structures on growth and yield.

The growth and yield model for uneven-aged loblolly-shortleaf pine developed by Murphy and Farrar (1988) addresses this latter concern to some extent by incorporating the Weibull distribution to account for the effect of maximum diameter. Data for this model came from measurements taken in 1966, 1971, and 1976 on 0.2-acre industrial continuous forest inventory plots in southeastern Arkansas. The authors first developed stand-level equations for merchantable basal area, sawtimber basal area, quadratic mean tree diameter, and maximum tree diameter. They then obtained parameters for the doubly truncated Weibull distribution using the parameter recovery technique and estimates of maximum DBH, quadratic mean DBH, and sawtimber-to-merchantable basal area ratio, thereby maintaining compatibility between the stand-level estimates of basal area and those produced by the Weibull distribution. Despite this improvement, the model still does not explicitly account for site productivity, regeneration, or mortality.

Murphy and Shelton (1994, 1996) developed two models for essentially pure loblolly pine stands, a stand-level model and an individual-tree basal area model. The data for these models were derived from the 5-year preliminary results of an experiment conducted in southern Arkansas and northern Louisiana that was designed to test the effects of three levels of residual merchantable basal area (40, 60, and 80 ft²/acre), maximum DBH (12, 16, and 20 in.) and site index (<81, 81 to 90, and >90 ft) on growth and development of loblolly pine stands managed under uneven-aged silviculture with single-tree selection. The stand-level model predicts annual, per-acre net volume growth (merchantable cubic feet; sawtimber cubic feet; and sawtimber board feet, Doyle rule) and annual, per-acre survivor, ingrowth, and mortality components of basal area growth (Murphy and Shelton 1994). The individual-tree basal area growth model (Murphy and Shelton 1996) predicts the annual basal area increment of the subject tree on a per-hectare basis, given the stand basal area, quadratic mean DBH, and basal area of the stand in trees equal to or greater than that of the subject tree. The lack of equations for regeneration and survival limit the usefulness of this model.

None of the models discussed in this section is suitable for simulating pine-hardwood mixtures. Nevertheless, because each of these models was developed using data from intensively managed stands, these models might provide more accurate growth and yield predictions than the SouthPro model for similarly managed stands on comparable sites. The most appropriate model ultimately depends on the questions being asked and the characteristics of the stand under investigation. The responsibility for selecting the most appropriate model and using it wisely lies with each user.

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Glossary

Basal Area Cut chart—SouthPro-generated chart that shows the total basal area cut, in square feet per acre, for a selected range of harvests.

Batch File worksheet—Worksheet for entering data for running a batch of SouthPro simulations.

BDq distribution—Tree distribution by diameter class defined by a stand basal area (B), a maximum tree diameter (D), and a *q*-ratio, the ratio of the number of trees in a given diameter class to the number of trees in the next larger class.

Ccf—Abbreviation for hundred cubic feet.

Chart sheet—Microsoft Excel sheet for charts that are not embedded in a worksheet.

Cutting cycle—Planned time interval between selection harvests in an uneven-aged stand. See also management cycle.

DBH—Abbreviation for diameter at breast height.

Diversity Indices chart—SouthPro-generated chart that shows changes in the Shannon index of species group and/or size diversity over a selected range of years.

Establishment cut—Harvesting operation that creates the temporary, partial overstory used in the shelterwood method of stand regeneration.

First target-to-second target interval—In SouthPro simulations using two distinct target distributions, the number of years between a harvest using the first target distribution to one using the second target distribution. For simulations using a single target distribution, this value should be set to zero.

Fixed costs—Costs per acre associated with each harvest that are not reflected in the stumpage prices. These may include, for example, the added expense of marking stands for single-tree selection or for controlling hardwood competition.

Gross Income chart—SouthPro-generated chart that shows the gross income generated by a sequence of harvests, in dollars per acre.

Hard hardwoods—See species groups.

Initial distribution—Number of live trees per acre, by species and size, at the start of a simulation.

Input Data worksheet—Worksheet for entering data for running a SouthPro simulation.

Irregular shelterwood method—Variation of the “regular” shelterwood method in which residual trees are retained throughout the succeeding rotation, or even in perpetuity. See also shelterwood method.

Management cycle—In SouthPro, the number of years between successive harvests using the first target distribution. For simulations using two distinct target distributions, this equals the number of years between successive harvests using the second target distribution. For simulations using a single target distribution, the management cycle equals the cutting cycle.

Management schedule parameters—Data that define the chronology of a SouthPro simulation. These data include first year of the simulation, year of first harvest, total number of harvests to be performed, length of management cycle, length of interval from a harvest using the first target distribution to one using the second target distribution, and overall length of the simulation.

Marking guide—A SouthPro table, on the Stock-and-Cut worksheet, that indicates the number of trees to cut in each of four product classes: (1) pulpwood, (2) small sawtimber, (3) medium sawtimber, and (4) large sawtimber. See also pulpwood-size trees and sawtimber.

Mbf—Abbreviation for thousand board feet. A board foot is a measure of volume equal to the volume of a 1- by 12- by 12-in. board.

Microsoft Excel add-in—A command, function, or software program that runs within Microsoft Excel and adds special capabilities to it. SouthPro is an add-in software program.

Net present value—Value of a revenue, net its associated costs, discounted to the present time:

$$NPV = \frac{R - C}{(1 + r)^t}$$

where *NPV* is net present value, *R* revenue, *C* associated costs, *r* real interest rate (%/year), and *t* number of years in the future that the revenue is realized. See also total net present value.

Preharvest distribution —The number of live trees per acre, by species and size, immediately before a harvest.

Production worksheet—SouthPro output worksheet that shows, for each harvest, the basal area cut, volume of pulpwood and sawtimbers removed by species group, gross income generated, and net present value of harvest, as well as the total net present value of the stand and its mean annual production in terms of basal area cut and volumes harvested, on a per acre basis.

Pulpwood-size trees—Trees suitable for the production of pulpwood, but too small to produce sawlogs. In SouthPro, such trees include softwood trees from 5 to <9 in. DBH and hardwood trees from 5 to <11 in. DBH.

Removal cut—A harvest that removes the temporary partial overstory used in the shelterwood method of stand regeneration.

Sawtimber—Trees suitable for the production of sawlogs. The SouthPro marking guides recognize three classes of sawtimber trees: (1) small sawtimbers, softwoods with 9 to <15 in. DBH and hardwoods with 11 to <15 in. DBH; (2) medium sawtimbers, trees with 15 to <21 in. DBH; and (3) large sawtimbers, trees with ≥21 in. DBH.

Setup Files worksheet—Worksheet for storing SouthPro setup files. It is typically hidden.

Setup files—Collections of related input data that are stored together on a Setup Files worksheet. Setup files may contain data for initial distributions, target distributions, management schedules, stumpage prices, or fixed costs, and may be used in varying combinations as input for SouthPro simulations.

Shelterwood method—Even-aged reproduction method in which the mature overstory is removed in a series of two or more successive harvests to provide a source of seed and/or protection for reproduction. This method typically involves an establishment cut, in which a partial shelterwood overstory is created by leaving a substantial number of residual trees scattered across the stand, and a removal cut, in which the partial shelterwood overstory is removed once the reproduction is established. See also irregular shelterwood method.

Site index—For SouthPro simulations, average height of dominant and co-dominant loblolly pines at 50 years of age.

Site productivity class—A measure of site quality based on potential yield in cubic feet/acre of mean annual growth at culmination of the increment in fully stocked stands. The site productivity class is estimated operationally from the average heights and ages of three dominant or co-dominant trees in conjunction with the appropriate conversion table for the species in question.

Size class—One of thirteen 2-in. DBH categories used by SouthPro to classify trees by size. Size classes range from 2 to 26+ in., with each class denoted by its midpoint diameter. Size class 2 is for trees ranging from 1 to <3 in. DBH. The 26+ in. class is for all trees with ≥25 in. DBH.

Size Distributions chart—SouthPro-generated chart that shows, for selected years, the number of live softwoods, soft hardwoods, and/or hard hardwoods in each size class.

Size diversity—Diversity of tree size classes as measured by the Shannon index. Stand Development worksheets report size diversity based on tree basal area and Stock-and-Cut worksheets, size diversity based on basal area and number of trees. With 13 size classes, size diversity reaches its maximum value of 2.56 when the basal area or number of trees is distributed evenly among the size classes.

Soft hardwoods—See species groups.

Softwoods—See species groups.

Species group diversity—Diversity of species groups (softwood, soft hardwoods, and hard hardwoods) as measured by the Shannon index. Stand Development worksheets report species group diversity based on tree basal area, and Stock-and-Cut worksheets report species group diversity based on basal area and number of trees. With three species groups, species diversity reaches its maximum value of 1.10 when the basal area or number of trees is distributed evenly among the three groups.

Species groups—Categories used by SouthPro to classify trees by species. The categories follow the Forest Inventory and Analysis (FIA) classification.

Softwoods (SW): FIA species groups 1 (pines) and 2 (other softwoods). In the data set used to calibrate the SouthPro growth model, the softwoods primarily consisted of loblolly, shortleaf, and longleaf pines (*Pinus taeda*, *P. echinata*, and *P. palustris*).

Soft Hardwoods (SH): FIA species group 3. Dominated by sweetgum (*Liquidambar styraciflua*), Blackgum (*Nyssa sylvatica*), and red maple (*Acer rubrum*).

Hard Hardwoods (HH): FIA species group 4. Dominated by southern red, water, and post oaks (*Quercus falcata* var. *falcata*, *Q. nigra*, and *Q. stellata*).

Stand Basal Area chart—SouthPro-generated chart that shows, for a selected range of years, the per acre basal area of softwoods, soft hardwoods, hard hardwoods, and/or the whole stand.

Stand Development worksheet—SouthPro output worksheet that shows, for each simulated year and harvest, the size distribution and per acre basal area of each species group and the Shannon index of species group and size diversity of the stand.

Stock-and-Cut table—SouthPro-generated table that shows, for selected preharvest and target distributions, the cut and residual stand distributions; basal area, cubic foot volume, and board foot volume of trees in each species–size category; and annual cubic foot and board foot growth of stands with the specified preharvest, target, and residual distributions. The Stock-and-Cut table is on the Stock-and-Cut worksheet.

Stock-and-Cut worksheet—SouthPro-generated output worksheet containing a stock-and-cut table and its associated marking guide.

Stumpage prices—Prices paid to a landowner for standing timber.

Target distribution—Desired number of live trees per acre in each species group and size class after a harvest.

Total net present value—Sum of all discounted revenues minus sum of all discounted costs. See also net present value.

Volume Cut chart—SouthPro-generated chart that shows, for a selected range of harvests, the cubic foot volume of pulpwood and/or sawtimber removed from each of the three species groups.

Workbook—Microsoft Excel file in which work is performed and data are stored. Workbooks are composed of sheets, such as worksheets and chart sheets.

Worksheet—Microsoft Excel sheet for entering data, making calculations, and writing results.

Appendix—Inventory Data

The tables in this Appendix show data on average number of trees per acre at first and second inventories. The data are arranged in three groups: number of trees by species and site (Tables A1 and A2), by species and size (Tables A3 and A4), and by site, species group, and size (Tables A5 and A6). In Tables A1 through A4, species numbers (Sp.#) are taken from Hansen and others (1992).

Table A1—Average number of trees per acre by species and site, across all plots, at the first inventory

Common name	Scientific name	Sp. #	Trees/acre by site					
			1	2	3	4	5	6
Softwoods								
Loblolly pine	<i>Pinus taeda</i>	131	151.84	190.02	220.42	290.80	283.61	400.08
Shortleaf pine	<i>Pinus echinata</i>	110	0.00	39.08	30.35	42.19	47.06	25.17
Eastern redcedar	<i>Juniperus virginiana</i>	68	0.00	2.59	7.56	7.78	10.34	0.00
Longleaf pine	<i>Pinus palustris</i>	121	0.00	2.23	2.20	4.04	9.89	5.82
Slash pine	<i>Pinus elliotii</i>	111	0.00	0.55	0.43	0.97	7.51	0.00
Virginia pine	<i>Pinus virginiana</i>	132	0.00	1.17	0.57	0.51	4.13	0.00
Spruce pine	<i>Pinus glabra</i>	115	0.00	0.06	0.50	0.07	0.14	0.00
Baldcypress	<i>Taxodium distichum</i>	221	0.00	0.00	0.32	0.00	0.12	0.00
Total			151.84	235.70	262.35	346.37	362.80	431.06
Soft hardwoods								
Sweetgum	<i>Liquidambra styraciflua</i>	611	176.56	162.22	113.26	88.90	84.07	83.60
Red maple	<i>Acer rubrum</i>	316	0.00	28.31	45.54	31.56	27.70	0.00
Blackgum	<i>Nyssa sylvatica</i>	693	0.00	28.58	28.97	35.16	25.73	30.56
Winged elm	<i>Ulmus alata</i>	971	48.96	18.86	23.91	14.23	12.78	0.00
Black cherry	<i>Prunus serotina</i>	762	0.00	12.71	9.27	8.46	1.01	0.00
Sassafras	<i>Sassafras albidum</i>	931	0.00	5.66	7.44	4.36	0.23	0.00
White ash	<i>Fraxinus americana</i>	541	0.00	0.90	3.81	2.83	4.00	0.00
Yellow-poplar	<i>Liriodendron tulipifera</i>	621	0.00	1.66	4.32	3.18	0.24	0.00
Green ash	<i>Fraxinus pennsylvanica</i>	544	45.84	2.37	1.80	1.51	2.35	30.56
Sweetbay	<i>Magnolia virginiana</i>	653	0.00	1.26	1.87	2.44	2.01	0.00
Southern magnolia	<i>Magnolia grandiflora</i>	652	0.00	2.08	0.35	1.35	0.00	0.00
American elm	<i>Ulmus americana</i>	972	0.00	1.44	1.14	0.63	0.05	0.00
Sugarberry	<i>Celtis laevigata</i>	461	0.00	0.68	0.48	0.31	1.61	0.00
Slippery elm	<i>Ulmus rubra</i>	975	0.00	1.36	0.74	<0.01	0.08	0.00
Redbay	<i>Persea borbonia</i>	721	0.00	0.00	0.24	1.12	0.00	0.00
Willow	<i>Salix</i> sp.	920	0.00	0.07	0.74	0.00	0.14	0.00
Eastern redbud	<i>Cercis canadensis</i>	471	0.00	0.00	0.48	0.00	0.75	0.00
Water tupelo	<i>Nyssa aquatica</i>	691	0.00	0.04	0.37	0.27	0.00	0.00
Swamp tupelo	<i>Nyssa sylvatica</i> var. <i>biflora</i>	694	0.00	0.00	0.00	0.64	0.00	0.00
White basswood	<i>Tilia heterophylla</i>	952	0.00	0.00	0.00	0.39	0.07	0.00
American basswood	<i>Tilia americana</i>	951	0.00	0.00	0.07	0.27	0.03	0.00
Hackberry	<i>Celtis occidentalis</i>	462	0.00	0.00	0.00	0.00	0.86	0.00
Boxelder	<i>Acer negundo</i>	313	0.00	0.08	0.00	0.00	0.75	0.00
Sycamore	<i>Platanus occidentalis</i>	731	0.00	0.12	0.01	0.03	0.02	0.00
Cucumbertree	<i>Magnolia acuminata</i>	651	0.00	0.10	0.00	0.06	0.00	0.00
River birch	<i>Betula nigra</i>	373	0.00	0.00	0.03	0.00	0.00	0.00
Cedar elm	<i>Ulmus crassifolia</i>	973	0.00	0.00	0.00	0.02	0.00	0.00
Cottonwood	<i>Populus</i> sp.	740	0.00	0.00	0.00	0.02	0.00	0.00
Total			271.36	268.52	244.86	197.74	164.49	144.72

Table A1—Average number of trees per acre by species and site, across all plots, at the first inventory—con.

Common name	Scientific name	Sp. #	Trees/acre by site					
			1	2	3	4	5	6
Hard hardwoods								
Flowering dogwood	<i>Cornus florida</i>	491	0.00	40.60	41.55	29.37	18.45	15.28
Water oak	<i>Quercus nigra</i>	827	1.30	26.24	30.60	24.73	12.27	20.84
Southern red oak	<i>Quercus falcata</i> var. <i>falcata</i>	812	0.00	16.76	20.77	24.11	18.83	31.96
Post oak	<i>Quercus stellata</i>	835	10.12	9.50	16.84	29.30	20.28	16.16
White oak	<i>Quercus alba</i>	802	0.00	18.37	9.01	14.08	9.66	15.28
Hickory sp.	<i>Carya</i> sp.	400	4.99	5.30	8.22	16.94	8.69	18.29
Sparkleberry	<i>Vaccinium arboreum</i>	981	0.00	6.11	6.70	14.43	17.28	0.00
Common persimmon	<i>Diospyros virginiana</i>	521	0.00	8.15	8.26	9.97	18.76	0.00
Hawthorn	<i>Crataegus</i> sp.	500	0.00	11.54	7.00	11.80	9.02	0.00
Sourwood	<i>Oxydendrum arboreum</i>	711	0.00	8.52	7.29	7.27	8.69	1.35
American holly	<i>Ilex opaca</i>	591	0.00	7.66	8.08	8.36	3.07	0.00
Eastern hornbeam	<i>Ostrya virginiana</i>	701	0.00	18.45	5.88	5.42	1.66	0.00
American hornbeam	<i>Carpinus caroliniana</i>	391	0.00	16.88	7.19	1.24	2.54	0.00
Willow oak	<i>Quercus phellos</i>	831	0.00	7.95	3.18	7.01	2.71	30.75
Laurel oak	<i>Quercus laurifolia</i>	820	0.00	6.42	7.55	0.86	0.91	0.00
Cherrybark oak	<i>Quercus falcata</i> var. <i>pagodaefolia</i>	813	0.00	5.21	4.35	4.07	2.05	0.00
Blackjack oak	<i>Quercus marilandica</i>	824	0.00	1.55	0.90	5.23	12.12	6.50
Mockernut hickory	<i>Carya tomentosa</i>	409	0.00	4.91	3.73	4.08	0.00	30.56
Black oak	<i>Quercus velutina</i>	837	0.00	0.44	1.53	4.72	4.10	2.76
Pignut hickory	<i>Carya glabra</i>	403	0.00	1.65	2.17	1.76	0.00	0.00
Plums, cherries	<i>Prunus</i> sp.	764	0.00	0.00	2.63	1.34	0.00	0.00
Turkey oak	<i>Quercus laevis</i>	819	0.00	0.23	0.04	0.79	4.70	0.00
Red mulberry	<i>Morus rubra</i>	682	0.00	2.74	0.78	0.27	0.75	0.00
Bluejack oak	<i>Quercus incana</i>	840	0.00	0.00	0.55	0.99	0.75	0.00
Chestnut oak	<i>Quercus prinus</i>	832	0.00	0.68	0.24	0.90	1.01	0.00
Florida maple	<i>Acer barbatum</i>	311	0.00	0.68	0.09	1.10	0.00	0.00
American beech	<i>Fagus grandifolia</i>	531	0.00	1.45	0.70	0.04	0.04	0.00
Bigleaf magnolia	<i>Magnolia macrophylla</i>	654	0.00	0.86	0.81	0.10	0.00	0.00
Northern red oak	<i>Quercus rubra</i>	833	0.00	0.72	0.24	0.73	0.00	0.00
Shumard oak	<i>Quercus shumardii</i>	834	0.00	0.10	0.34	0.53	0.11	0.00
Scarlet oak	<i>Quercus coccinea</i>	806	0.00	0.00	0.35	0.48	0.13	0.00
Unknown		999	0.00	1.39	0.04	0.16	0.23	0.00
Honeylocust	<i>Gleditsia triacanthos</i>	552	0.00	0.68	0.27	0.00	0.00	0.00
Osage-orange	<i>Maclura pomifera</i>	641	0.00	0.00	0.03	0.00	1.50	0.00
Black hickory	<i>Carya texana</i>	408	0.00	0.35	0.34	0.04	0.00	0.00
Apple sp.	<i>Malus</i> sp.	660	0.00	0.00	0.00	0.53	0.00	0.00
Black locust	<i>Robinia psuedoacacia</i>	901	0.00	0.00	0.26	0.14	0.00	0.00
Chittamwood	<i>Bumelia lanuginosa</i>	381	0.00	0.00	0.07	0.27	0.00	0.00
Chinese tallowtree	<i>Sapium sebiferum</i>	925	0.00	0.00	0.16	0.05	0.00	0.00
Black walnut	<i>Juglans nigra</i>	602	0.00	0.39	0.01	0.05	0.00	0.00
Swamp chestnut oak	<i>Quercus michauxii</i>	825	0.00	0.06	0.08	0.03	0.00	0.00
Pecan	<i>Carya illinoensis</i>	404	10.96	0.09	0.02	0.00	0.00	0.00
Overcup oak	<i>Quercus lyrata</i>	822	0.00	0.12	0.02	0.03	0.00	0.00
Chinaberry	<i>Melia azedarach</i>	983	0.00	0.00	0.00	0.06	0.00	0.00
Shagbark hickory	<i>Carya ovata</i>	407	0.00	0.00	0.04	0.00	0.00	0.00
Serviceberry	<i>Amelanchier</i> sp.	355	0.00	0.00	0.03	0.00	0.00	0.00
Live oak	<i>Quercus virginiana</i>	838	0.00	0.00	0.00	0.03	0.00	0.00
Sugar maple	<i>Acer saccharum</i>	318	0.00	0.03	0.00	0.00	0.00	0.00
Waterlocust	<i>Gleditsia aquatica</i>	551	0.00	0.00	0.00	0.00	0.03	0.00
Total			27.37	232.77	208.93	233.39	180.34	189.73

Table A2—Average number of trees per acre by species and site, across all plots, at the second inventory

Common name	Scientific name	Sp. #	Trees/acre by site					
			1	2	3	4	5	6
Softwoods								
Loblolly pine	<i>Pinus taeda</i>	131	93.64	118.91	156.53	237.31	235.92	294.02
Shortleaf pine	<i>Pinus echinata</i>	110	0.00	26.37	14.49	23.80	33.76	19.26
Eastern redcedar	<i>Juniperus virginiana</i>	68	0.00	1.65	7.37	5.89	12.17	0.00
Longleaf pine	<i>Pinus palustris</i>	121	0.00	2.19	1.16	3.81	6.66	3.78
Virginia pine	<i>Pinus virginiana</i>	132	0.00	0.49	2.11	0.21	15.65	0.00
Slash pine	<i>Pinus elliotii</i>	111	0.00	0.47	0.63	1.06	10.02	0.00
Spruce pine	<i>Pinus glabra</i>	115	0.00	0.03	0.44	0.32	0.18	0.00
Baldcypress	<i>Taxodium distichum</i>	221	0.00	0.00	0.27	0.00	0.23	0.00
Total			93.64	150.10	183.00	272.40	314.59	317.05
Soft hardwoods								
Sweetgum	<i>Liquidambra styraciflua</i>	611	120.95	145.48	103.31	93.60	98.24	70.01
Red maple	<i>Acer rubrum</i>	316	0.00	32.21	40.65	28.76	34.93	15.28
Blackgum	<i>Nyssa sylvatica</i>	693	0.00	26.44	28.18	28.73	24.60	0.00
Winged elm	<i>Ulmus alata</i>	971	48.54	16.71	19.64	13.95	12.62	15.28
Black cherry	<i>Prunus serotina</i>	762	0.00	8.63	10.24	9.41	5.53	0.00
Sassafras	<i>Sassafras albidum</i>	931	0.00	8.17	3.97	3.18	0.07	0.00
Yellow-poplar	<i>Liriodendron tulipifera</i>	621	0.00	2.46	4.15	3.61	1.95	1.51
Sweetbay	<i>Magnolia virginiana</i>	653	0.00	3.35	2.47	2.96	1.82	0.00
Green ash	<i>Fraxinus pennsylvanica</i>	544	45.84	2.16	2.28	1.28	6.11	30.56
White ash	<i>Fraxinus americana</i>	541	0.00	1.74	2.59	1.73	1.36	0.00
American elm	<i>Ulmus americana</i>	972	0.00	1.60	1.95	0.50	2.30	0.00
Southern magnolia	<i>Magnolia grandiflora</i>	652	0.00	2.12	0.27	0.93	0.00	0.00
Slippery elm	<i>Ulmus rubra</i>	975	0.00	2.04	0.27	0.27	0.08	0.00
Sugarberry	<i>Celtis laevigata</i>	461	0.00	0.71	0.48	<0.01	0.08	0.00
Redbay	<i>Persea borbonia</i>	721	0.00	0.68	0.00	0.58	0.00	0.00
Eastern redbud	<i>Cercis canadensis</i>	471	0.00	0.00	0.24	0.27	0.20	0.00
Hackberry	<i>Celtis occidentalis</i>	462	0.00	0.00	0.00	0.53	0.09	0.00
Water tupelo	<i>Nyssa aquatica</i>	691	0.00	0.03	0.45	0.00	0.00	0.00
White basswood	<i>Tilia heterophylla</i>	952	0.00	0.00	0.00	0.39	0.06	0.00
Willow	<i>Salix</i> sp.	920	0.00	0.00	0.28	0.00	0.05	0.00
Swamp tupelo	<i>Nyssa sylvatica</i> var. <i>biflora</i>	694	0.00	0.00	0.00	0.32	0.00	0.00
Boxelder	<i>Acer negundo</i>	313	0.00	0.00	0.00	0.00	0.75	0.00
Sycamore	<i>Platanus occidentalis</i>	731	0.00	0.11	0.03	0.02	0.02	0.00
Cucumbertree	<i>Magnolia acuminata</i>	651	0.00	0.09	0.00	0.04	0.00	0.00
American basswood	<i>Tilia americana</i>	951	0.00	0.00	0.06	0.00	0.02	0.00
River birch	<i>Betula nigra</i>	373	0.00	0.02	0.03	0.00	0.00	0.00
Cedar elm	<i>Ulmus crassifolia</i>	973	0.00	0.00	0.00	0.02	0.00	0.00
Cottonwood	<i>Populus</i> sp.	740	0.00	0.00	0.00	0.01	0.00	0.00
Total			215.32	254.75	221.53	191.09	190.88	132.64

Table A2—Average number of trees per acre by species and site, across all plots, at the second inventory—con.

Common name	Scientific name	Sp. #	Trees/acre by site					
			1	2	3	4	5	6
Hard hardwoods								
Flowering dogwood	<i>Cornus florida</i>	491	0.00	43.14	41.16	28.35	29.82	30.56
Water oak	<i>Quercus nigra</i>	827	0.82	31.93	34.91	26.39	15.59	32.44
Southern red oak	<i>Quercus falcata</i> var. <i>falcata</i>	812	0.00	11.10	15.06	24.71	16.57	31.13
Post oak	<i>Quercus stellata</i>	835	9.12	7.41	11.07	19.44	27.42	50.75
White oak	<i>Quercus alba</i>	802	0.00	18.92	9.40	11.31	5.74	94.16
Hickory sp.	<i>Carya</i> sp.	400	4.76	3.85	5.59	13.39	10.33	34.57
Sparkleberry	<i>Vaccinium arboreum</i>	981	0.00	4.07	6.94	10.96	12.02	0.00
American holly	<i>Ilex opaca</i>	591	0.00	7.60	7.57	9.30	7.15	0.00
Hawthorn	<i>Crataegus</i> sp.	500	0.00	10.19	6.76	9.10	6.01	0.00
American hornbeam	<i>Carpinus caroliniana</i>	391	0.00	12.45	11.20	3.02	3.36	0.00
Sourwood	<i>Oxydendrum arboreum</i>	711	0.00	7.24	7.32	5.86	10.92	15.28
Eastern hornbeam	<i>Ostrya virginiana</i>	701	0.00	9.91	5.39	5.74	4.63	0.00
Willow oak	<i>Quercus phellos</i>	831	0.00	6.77	2.82	10.06	1.03	0.00
Common persimmon	<i>Diospyros virginiana</i>	521	0.00	4.75	4.95	4.60	9.70	0.00
Laurel oak	<i>Quercus laurifolia</i>	820	0.00	6.57	7.19	3.20	3.09	0.00
Cherrybark oak	<i>Quercus falcata</i> var. <i>pagodaefolia</i>	813	0.00	3.98	3.21	2.37	4.78	0.59
Blackjack oak	<i>Quercus marilandica</i>	824	0.00	0.76	0.59	2.80	13.61	5.49
Black oak	<i>Quercus velutina</i>	837	0.00	1.10	2.44	3.54	4.19	1.59
Mockernut hickory	<i>Carya tomentosa</i>	409	0.00	1.51	2.61	1.29	0.00	30.56
Plums, cherries	<i>Prunus</i> sp.	764	0.00	0.00	2.39	2.14	0.75	0.00
Pignut hickory	<i>Carya glabra</i>	403	0.00	1.13	2.40	0.68	0.00	0.00
Chinese tallowtree	<i>Sapium sebiferum</i>	925	0.00	1.20	2.29	0.50	0.00	0.00
American beech	<i>Fagus grandifolia</i>	531	0.00	4.15	1.22	0.03	0.00	0.00
Turkey oak	<i>Quercus laevis</i>	819	0.00	0.18	0.03	1.08	3.90	0.00
Red mulberry	<i>Morus rubra</i>	682	0.00	2.04	0.97	0.33	0.75	0.00
Florida maple	<i>Acer barbatum</i>	311	0.00	0.68	0.52	1.44	0.00	0.00
Bigleaf magnolia	<i>Magnolia macrophylla</i>	654	0.00	1.62	0.80	0.08	0.00	0.00
Chestnut oak	<i>Quercus prinus</i>	832	0.00	0.68	0.24	0.59	0.51	0.00
Northern red oak	<i>Quercus rubra</i>	833	0.00	0.71	0.00	0.91	0.00	0.00
Serviceberry	<i>Amelanchier</i> sp.	355	0.00	0.00	0.27	0.00	2.25	0.00
Bluejack oak	<i>Quercus incana</i>	840	0.00	0.00	0.26	0.49	0.75	0.00
Black hickory	<i>Carya texana</i>	408	0.00	0.19	0.57	0.30	0.00	0.00
Osage-orange	<i>Maclura pomifera</i>	641	0.00	0.00	0.26	0.00	1.50	0.00
Unknown		999	0.00	0.46	0.27	0.20	0.39	0.00
Scarlet oak	<i>Quercus coccinea</i>	806	0.00	0.00	0.40	0.18	0.09	0.00
Honeylocust	<i>Gleditsia triacanthos</i>	552	0.00	0.68	0.27	0.01	0.00	0.00
Sugar maple	<i>Acer saccharum</i>	318	0.00	0.00	0.24	0.27	0.00	0.00
Shumard oak	<i>Quercus shumardii</i>	834	0.00	0.13	0.33	0.00	0.09	0.00
Black locust	<i>Robinia pseudoacacia</i>	901	0.00	0.00	0.25	0.00	0.00	0.00
Apple sp.	<i>Malus</i> sp.	660	0.00	0.00	0.00	0.27	0.00	0.00
Nuttall oak	<i>Quercus nuttallii</i>	828	0.00	0.00	0.24	0.00	0.00	0.00
Swamp chestnut oak	<i>Quercus michauxii</i>	825	0.00	0.31	0.02	0.07	0.00	0.00
Black walnut	<i>Juglans nigra</i>	602	0.00	0.29	0.01	0.04	0.00	0.00
Shagbark hickory	<i>Carya ovata</i>	407	0.00	0.00	0.05	0.07	0.00	0.00
Overcup oak	<i>Quercus lyrata</i>	822	0.00	0.13	0.01	0.02	0.00	0.00
Pecan	<i>Carya illinoensis</i>	404	7.44	0.08	0.01	0.00	0.00	0.00
Chittamwood	<i>Bumelia lanuginosa</i>	381	0.00	0.00	0.07	0.00	0.00	0.00
Chinaberry	<i>Melia azedarach</i>	983	0.00	0.00	0.00	0.05	0.00	0.00
Live oak	<i>Quercus virginiana</i>	838	0.00	0.00	0.00	0.03	0.00	0.00
Waterlocust	<i>Gleditsia aquatica</i>	551	0.00	0.00	0.00	0.00	0.02	0.00
Total			22.14	207.91	200.59	205.21	196.98	327.10

Table A3—Average number of trees per acre by species and size, across all plots, at the first inventory

Common name	Sp. #	Trees/acre by size class (inches)													Total
		2	4	6	8	10	12	14	16	18	20	22	24	26+	
Softwoods															
Loblolly pine	131	109.63	55.82	28.82	18.43	13.18	9.15	6.25	3.87	2.13	1.15	0.56	0.22	0.18	249.37
Shortleaf pine	110	15.27	8.97	4.51	3.23	2.63	1.63	0.77	0.35	0.15	0.05	0.01	<0.01	<0.01	37.60
Eastern redcedar	68	5.09	1.48	0.47	0.08	0.07	0.04	<0.01	<0.01	<0.01	<0.01	0.00	0.00	<0.01	7.24
Longleaf pine	121	1.02	0.83	0.49	0.45	0.29	0.28	0.23	0.11	0.07	0.03	<0.01	<0.01	0.00	3.80
Slash pine	111	0.56	0.19	0.29	0.22	0.13	0.07	0.03	0.02	<0.01	<0.01	0.00	0.00	0.00	1.50
Virginia pine	132	0.19	0.37	0.23	0.13	0.10	0.03	0.02	<0.01	0.00	0.00	0.00	0.00	0.00	1.06
Spruce pine	115	0.00	0.09	0.00	0.08	0.02	<0.01	0.02	0.02	<0.01	0.00	0.00	<0.01	<0.01	0.24
Baldcypress	221	0.00	0.00	0.12	0.02	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.14
Total		131.75	67.75	34.92	22.64	16.42	11.20	7.33	4.39	2.37	1.23	0.57	0.23	0.18	300.97
Soft hardwoods															
Sweetgum	611	71.70	21.09	8.60	3.34	1.67	0.81	0.33	0.19	0.06	0.03	0.01	<0.01	<0.01	107.86
Red maple	316	28.89	4.35	1.78	0.53	0.15	0.05	0.03	<0.01	0.00	<0.01	0.00	<0.01	<0.01	35.79
Blackgum	693	24.15	3.89	1.49	0.53	0.28	0.10	0.07	0.06	0.02	<0.01	<0.01	<0.01	<0.01	30.61
Winged elm	971	15.74	1.57	0.68	0.23	0.10	0.04	0.02	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	18.41
Black cherry	762	6.05	1.58	0.48	0.15	0.09	0.01	<0.01	0.00	<0.01	<0.01	0.00	0.00	<0.01	8.37
Sassafras	931	4.26	0.74	0.13	0.05	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	5.19
White ash	541	2.22	0.56	0.14	0.07	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.00	<0.01	3.07
Yellow-poplar	621	1.85	0.19	0.43	0.17	0.14	0.12	0.06	0.03	0.02	<0.01	<0.01	<0.01	<0.01	3.03
Green ash	544	1.67	0.28	0.06	0.05	0.03	<0.01	<0.01	0.00	<0.01	0.00	<0.01	0.00	<0.01	2.11
Sweetbay	653	1.20	0.46	0.12	0.11	0.03	0.02	0.02	0.01	<0.01	<0.01	0.00	0.00	0.00	1.99
Southern magnolia	652	0.65	0.19	0.04	0.00	0.00	0.00	<0.01	<0.01	<0.01	0.00	0.00	0.00	<0.01	0.89
American elm	972	0.56	0.19	0.05	0.05	0.02	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86
Sugarberry	461	0.37	0.19	0.00	0.02	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	<0.01	0.58
Slippery elm	975	0.37	0.09	0.00	0.00	0.01	0.00	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.48
Redbay	721	0.46	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
Willow	920	0.19	0.09	0.00	0.03	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
Eastern redbud	471	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Water tupelo	691	0.19	0.00	0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.24
Swamp tupelo	694	0.09	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
White basswood	952	0.09	0.00	0.04	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
American basswood	951	0.09	0.00	0.02	0.00	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	<0.01	0.12
Hackberry	462	0.09	0.00	0.00	0.01	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.11
Boxelder	313	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Sycamore	731	0.00	0.00	0.02	0.00	0.00	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.04
Cucumbertree	651	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
River birch	373	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Cedar elm	973	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Cottonwood	740	0.00	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Total		161.22	35.54	14.17	5.44	2.62	1.20	0.57	0.32	0.12	0.07	0.02	0.01	0.02	221.33

Table A3—Average number of trees per acre by species and size, across all plots, at the first inventory—con.

Common name	Sp. #	Trees/acre by size class (inches)													Total
		2	4	6	8	10	12	14	16	18	20	22	24	26+	
Hard hardwoods															
Flowering dogwood	491	26.19	6.58	1.23	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.12
Water oak	827	19.52	3.15	1.24	0.68	0.41	0.26	0.14	0.09	0.05	0.03	0.01	<0.01	0.01	25.60
Southern red oak	812	11.76	4.16	1.71	1.39	0.89	0.47	0.34	0.17	0.14	0.06	0.04	0.01	0.02	21.16
Post oak	835	11.38	4.45	2.13	1.20	0.63	0.30	0.22	0.10	0.05	0.05	0.02	<0.01	0.02	20.56
White oak	802	7.49	2.87	0.68	0.40	0.21	0.16	0.15	0.09	0.04	0.02	0.02	<0.01	0.01	12.14
Hickory sp.	400	8.14	1.30	0.64	0.44	0.18	0.12	0.07	0.03	0.02	0.01	<0.01	<0.01	<0.01	10.95
Sparkleberry	981	10.27	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.55
Common persimmon	521	9.25	0.65	0.13	0.02	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.06
Hawthorn	500	8.88	0.56	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.47
Sourwood	711	5.18	1.48	0.74	0.16	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.57
American holly	591	6.11	1.11	0.19	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.44
Eastern hornbeam	701	6.11	0.65	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.87
American hornbeam	391	4.81	0.74	0.17	0.07	0.02	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	5.82
Willow oak	831	4.16	0.37	0.29	0.22	0.09	0.04	0.04	0.01	0.01	<0.01	<0.01	<0.01	<0.01	5.26
Laurel oak	820	2.87	0.83	0.25	0.11	0.06	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	4.20
Cherrybark oak	813	2.13	0.93	0.34	0.23	0.16	0.12	0.06	0.03	0.01	0.02	<0.01	<0.01	<0.01	4.05
Blackjack oak	824	2.50	0.65	0.33	0.23	0.10	0.05	0.02	0.02	0.00	<0.01	0.00	0.00	0.00	3.90
Mockernut hickory	409	2.96	0.37	0.16	0.08	0.02	0.06	0.03	0.01	<0.01	<0.01	<0.01	0.00	0.00	3.71
Black oak	837	1.94	0.56	0.13	0.07	0.03	0.04	0.01	0.01	<0.01	<0.01	<0.01	0.00	<0.01	2.80
Pignut hickory	403	1.11	0.37	0.09	0.04	<0.01	0.02	0.02	<0.01	<0.01	<0.01	0.00	<0.01	0.00	1.67
Plums, cherries	764	1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48
Turkey oak	819	0.56	0.09	0.16	0.07	0.01	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.90
Red mulberry	682	0.74	0.09	0.00	0.01	0.00	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.86
Bluejack oak	840	0.37	0.19	0.06	0.02	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65
Chestnut oak	832	0.46	0.00	0.06	0.03	0.03	0.02	<0.01	<0.01	<0.01	0.00	<0.01	0.00	0.00	0.62
Florida maple	311	0.46	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51
American beech	531	0.37	0.00	0.02	0.01	0.03	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	0.49
Bigleaf magnolia	654	0.37	0.00	0.09	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46
Northern red oak	833	0.28	0.09	0.04	0.01	0.00	0.01	<0.01	0.00	<0.01	0.00	0.00	<0.01	<0.01	0.44
Shumard oak	834	0.09	0.19	0.02	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.00	<0.01	0.00	0.34
Scarlet oak	806	0.09	0.09	0.05	0.02	0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.32
Unknown	999	0.09	0.00	0.15	0.04	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Honeylocust	552	0.19	0.00	0.00	0.00	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Osage-orange	641	0.19	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
Black hickory	408	0.09	0.00	0.02	0.06	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Apple sp.	660	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Black locust	901	0.09	0.00	0.04	0.00	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Chittamwood	381	0.09	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Chinese tallowtree	925	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
Black walnut	602	0.00	0.00	0.04	<0.01	<0.01	0.00	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.00	0.07
Swamp chestnut oak	825	0.00	0.00	0.00	0.02	<0.01	<0.01	<0.01	0.00	<0.01	<0.01	0.00	0.00	0.00	0.05
Pecan	404	0.00	0.00	0.02	0.01	0.00	0.00	0.00	<0.01	<0.01	0.00	0.00	0.00	<0.01	0.04
Overcup oak	822	0.00	0.00	0.02	<0.01	0.00	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.03
Chinaberry	983	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Shagbark hickory	407	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Serviceberry	355	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Live oak	838	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Sugar maple	318	0.00	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Waterlocust	551	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Total		158.77	32.96	11.55	5.86	3.04	1.80	1.18	0.64	0.37	0.22	0.13	0.05	0.08	216.64

Table A4—Average number of trees per acre by species and size, across all plots, at the second inventory

Common name	Sp. #	Trees/acre by size class (inches)													Total
		2	4	6	8	10	12	14	16	18	20	22	24	26+	
Softwoods															
Loblolly pine	131	81.50	39.41	21.37	15.43	9.90	7.70	5.88	3.86	2.33	1.25	0.65	0.32	0.24	189.85
Shortleaf pine	110	6.20	5.83	2.97	2.06	1.76	1.40	0.82	0.38	0.18	0.06	0.03	<0.01	<0.01	21.70
Eastern redcedar	68	4.16	1.67	0.56	0.10	0.04	0.05	0.02	<0.01	<0.01	<0.01	0.00	<0.01	<0.01	6.61
Longleaf pine	121	0.56	0.74	0.30	0.28	0.34	0.23	0.19	0.14	0.08	0.04	0.02	<0.01	0.00	2.91
Virginia pine	132	2.13	0.19	0.22	0.23	0.04	0.05	0.03	<0.01	<0.01	0.00	0.00	0.00	0.00	2.88
Slash pine	111	0.56	0.56	0.35	0.19	0.05	0.13	0.04	0.02	0.01	<0.01	0.00	0.00	0.00	1.91
Spruce pine	115	0.09	0.09	0.00	0.03	0.03	0.02	0.01	<0.01	0.02	<0.01	<0.01	0.00	<0.01	0.30
Baldcypress	221	0.00	0.00	0.04	0.09	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.13
Total		95.20	48.48	25.81	18.40	12.17	9.57	7.00	4.43	2.62	1.36	0.70	0.33	0.25	226.29
Soft hardwoods															
Sweetgum	611	68.46	20.63	8.87	3.62	1.80	0.83	0.38	0.18	0.07	0.03	0.02	<0.01	<0.01	104.90
Red maple	316	27.57	3.98	1.86	0.74	0.17	0.07	0.04	0.02	0.00	0.00	<0.01	0.00	<0.01	34.45
Blackgum	693	21.09	3.89	1.30	0.60	0.28	0.13	0.09	0.04	0.04	<0.01	0.00	<0.01	<0.01	27.46
Winged elm	971	12.12	3.05	0.74	0.27	0.19	0.04	0.01	0.01	<0.01	0.00	<0.01	0.00	<0.01	16.44
Black cherry	762	6.38	1.76	0.59	0.21	0.09	0.03	<0.01	0.00	<0.01	<0.01	<0.01	0.00	<0.01	9.07
Sassafras	931	2.78	0.83	0.08	0.04	0.02	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	3.75
Yellow-poplar	621	2.04	0.37	0.40	0.24	0.10	0.13	0.07	0.04	0.03	0.01	<0.01	<0.01	<0.01	3.44
Sweetbay	653	1.94	0.37	0.14	0.09	0.05	0.02	0.03	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	2.66
Green ash	544	2.13	0.37	0.04	0.06	0.03	0.02	<0.01	<0.01	0.00	0.00	<0.01	<0.01	<0.01	2.65
White ash	541	1.48	0.28	0.14	0.06	0.02	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	2.00
American elm	972	1.11	0.09	0.13	0.05	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42
Southern magnolia	652	0.46	0.19	0.03	0.01	0.01	0.00	0.00	<0.01	<0.01	<0.01	0.00	0.00	<0.01	0.72
Slippery elm	975	0.28	0.19	0.00	0.00	0.01	<0.01	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.49
Sugarberry	461	0.28	0.00	0.00	0.01	0.00	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	<0.01	0.30
Redbay	721	0.28	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Eastern redbud	471	0.19	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21
Hackberry	462	0.19	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.20
Water tupelo	691	0.09	0.00	0.04	0.02	0.01	<0.01	0.00	<0.01	<0.01	0.00	0.00	0.00	0.00	0.18
White basswood	952	0.09	0.00	0.04	0.00	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
Willow	920	0.00	0.09	0.00	<0.01	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.11
Swamp tupelo	694	0.00	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
Boxelder	313	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
Sycamore	731	0.00	0.00	0.02	0.01	0.00	0.00	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.04
Cucumbertree	651	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
American basswood	951	0.00	0.00	0.02	0.00	0.00	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	<0.01	0.02
River birch	373	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.01
Cedar elm	973	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Cottonwood	740	0.00	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Total		149.04	36.17	14.50	6.08	2.81	1.31	0.65	0.33	0.17	0.06	0.04	0.01	0.02	211.19

Table A4—Average number of trees per acre by species and size, across all plots, at the second inventory—con.

Common name	Sp. #	Trees/acre by size class (inches)													Total
		2	4	6	8	10	12	14	16	18	20	22	24	26+	
Hard hardwoods															
Flowering dogwood	491	26.27	7.68	1.28	0.20	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.45
Water oak	827	22.67	3.33	1.28	0.69	0.45	0.23	0.18	0.11	0.06	0.04	0.02	0.01	0.01	29.09
Southern red oak	812	10.18	3.33	1.37	1.11	0.79	0.45	0.36	0.22	0.12	0.09	0.05	0.02	0.03	18.11
Post oak	835	7.86	3.42	1.83	1.08	0.73	0.31	0.22	0.12	0.05	0.04	0.03	<0.01	0.01	15.72
White oak	802	6.75	2.41	1.08	0.43	0.24	0.14	0.12	0.10	0.07	0.02	0.02	<0.01	0.02	11.40
Hickory sp.	400	6.29	1.02	0.62	0.40	0.24	0.11	0.06	0.04	0.01	0.02	<0.01	<0.01	<0.01	8.81
Sparkleberry	981	8.23	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.51
American holly	591	6.11	1.67	0.19	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.06
Hawthorn	500	7.49	0.37	0.02	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.89
American hornbeam	391	6.48	0.65	0.20	0.12	0.03	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	7.48
Sourwood	711	4.72	1.48	0.74	0.27	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.28
Eastern hornbeam	701	4.90	0.93	0.14	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.99
Willow oak	831	4.26	0.74	0.25	0.13	0.12	0.03	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	5.62
Common persimmon	521	4.81	0.37	0.12	0.03	0.02	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.35
Laurel oak	820	3.70	0.93	0.20	0.16	0.08	0.05	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5.16
Cherrybark oak	813	1.76	0.46	0.26	0.24	0.17	0.13	0.05	0.06	0.02	0.02	<0.01	<0.01	<0.01	3.20
Blackjack oak	824	1.76	0.56	0.32	0.14	0.14	0.05	0.03	0.01	<0.01	0.00	0.00	0.00	0.00	3.01
Black oak	837	2.04	0.37	0.25	0.08	0.03	0.03	0.03	<0.01	<0.01	<0.01	0.00	<0.01	<0.01	2.85
Mockernut hickory	409	0.93	0.46	0.26	0.07	0.02	0.06	0.02	<0.01	0.02	<0.01	<0.01	0.00	0.00	1.85
Plums, cherries	764	1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.76
Pignut hickory	403	0.74	0.37	0.13	0.03	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	1.32
Chinese tallowtree	925	0.56	0.37	0.22	0.07	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.22
American beech	531	0.93	0.00	0.03	0.01	0.02	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.05
Turkey oak	819	0.65	0.09	0.05	0.08	<0.01	<0.01	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.89
Red mulberry	682	0.74	0.09	0.02	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.86
Florida maple	311	0.65	0.09	0.04	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79
Bigleaf magnolia	654	0.37	0.09	0.06	0.02	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
Chestnut oak	832	0.28	0.00	0.07	0.03	0.02	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.45
Northern red oak	833	0.19	0.19	0.02	<0.01	0.00	<0.01	<0.01	<0.01	0.00	<0.01	0.00	0.00	<0.01	0.41
Serviceberry	355	0.37	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
Bluejack oak	840	0.09	0.19	0.06	0.02	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.36
Black hickory	408	0.19	0.09	0.00	0.06	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.35
Osage-orange	641	0.19	0.09	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Unknown	999	0.09	0.00	0.13	0.05	<0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Scarlet oak	806	0.09	0.00	0.04	0.03	0.01	0.01	0.02	<0.01	0.00	<0.01	<0.01	<0.01	<0.01	0.23
Honeylocust	552	0.09	0.09	0.00	0.00	<0.01	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.20
Sugar maple	318	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Shumard oak	834	0.09	0.00	0.02	0.02	<0.01	<0.01	0.00	<0.01	<0.01	<0.01	<0.01	0.00	<0.01	0.16
Black locust	901	0.09	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Apple sp.	660	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
Nuttall oak	828	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
Swamp chestnut oak	825	0.00	0.00	0.06	0.00	0.00	<0.01	<0.01	<0.01	<0.01	<0.01	0.00	0.00	0.00	0.08
Black walnut	602	0.00	0.00	0.02	0.01	<0.01	<0.01	0.00	0.01	0.00	<0.01	0.00	0.00	0.00	0.06
Shagbark hickory	407	0.00	0.00	0.03	0.01	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Overcup oak	822	0.00	0.00	0.00	0.01	0.01	0.00	<0.01	0.00	<0.01	0.00	0.00	0.00	0.00	0.03
Pecan	404	0.00	0.00	0.02	<0.01	0.00	0.00	<0.01	0.00	0.00	<0.01	0.00	0.00	<0.01	0.03
Chittamwood	381	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Chinaberry	983	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Live oak	838	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01
Waterlocust	551	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<0.01	0.00	0.00	0.00	0.00	0.00	<0.01
Total		145.61	32.29	11.48	5.79	3.29	1.72	1.23	0.76	0.40	0.25	0.16	0.07	0.09	203.15

Table A5—Average number of trees by site, species group, and size, across all plots, at the first inventory

Site	Species group	Trees/acre by size class (inches)													Total
		2	4	6	8	10	12	14	16	18	20	22	24	26+	
1	Softwoods	0.00	45.84	13.75	39.19	0.00	4.59	17.69	10.63	9.56	7.13	2.84	0.63	0.00	151.84
	Soft hardwoods	137.52	0.00	58.90	17.86	3.12	4.80	1.86	1.47	0.00	0.00	0.00	0.00	0.00	225.52
	Hard hardwoods	0.00	45.84	10.96	10.23	0.00	2.28	1.92	1.30	0.00	0.00	0.69	0.00	0.00	73.21
2	Softwoods	78.10	46.18	30.56	21.86	20.32	14.71	9.99	6.81	3.37	1.87	1.05	0.45	0.43	235.70
	Soft hardwoods	184.04	45.50	19.26	8.47	3.85	1.99	1.18	0.62	0.16	0.09	0.03	0.05	<0.01	265.25
	Hard hardwoods	173.85	35.31	11.72	6.71	3.16	1.89	1.39	0.75	0.61	0.33	0.14	0.04	0.12	236.04
3	Softwoods	97.45	62.26	30.67	23.00	16.98	12.01	8.98	5.09	3.07	1.51	0.77	0.32	0.25	262.35
	Soft hardwoods	172.52	39.76	14.96	5.94	3.03	1.47	0.44	0.35	0.14	0.08	0.03	0.01	0.02	238.76
	Hard hardwoods	157.79	31.88	11.85	5.58	2.94	1.91	1.38	0.72	0.40	0.25	0.16	0.07	0.10	215.03
4	Softwoods	167.59	78.12	37.79	23.49	15.94	10.53	5.93	3.70	1.83	0.97	0.31	0.11	0.06	346.37
	Soft hardwoods	145.94	27.53	12.48	3.93	1.82	0.76	0.53	0.23	0.09	0.05	<0.01	<0.01	0.02	193.39
	Hard hardwoods	170.80	38.54	13.49	6.95	3.62	1.99	1.07	0.59	0.32	0.17	0.11	0.04	0.05	237.74
5	Softwoods	190.12	81.91	45.84	19.92	12.36	6.89	3.14	1.53	0.54	0.31	0.13	0.06	0.05	362.80
	Soft hardwoods	116.48	25.55	8.69	3.84	1.68	0.60	0.30	0.14	0.05	0.04	0.01	0.00	<0.01	157.39
	Hard hardwoods	147.29	24.80	7.01	3.58	2.22	0.92	0.76	0.38	0.21	0.14	0.06	<0.01	0.05	187.44
6	Softwoods	336.16	30.56	25.03	17.42	8.22	8.65	3.13	0.95	0.70	0.00	0.24	0.00	0.00	431.06
	Soft hardwoods	30.56	76.40	7.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	114.16
	Hard hardwoods	168.08	30.56	5.42	7.22	4.64	1.60	0.00	0.94	1.01	0.30	0.24	0.19	0.09	220.29
All plots	Softwoods	131.75	67.75	34.92	22.64	16.42	11.20	7.33	4.39	2.37	1.23	0.57	0.23	0.18	300.97
	Soft hardwoods	157.06	34.70	13.96	5.32	2.54	1.19	0.56	0.32	0.11	0.07	0.02	0.01	0.02	215.87
	Hard hardwoods	162.93	33.80	11.76	5.98	3.12	1.81	1.19	0.64	0.38	0.22	0.13	0.05	0.08	222.10
	Total	451.74	136.25	60.64	33.94	22.08	14.20	9.07	5.35	2.86	1.51	0.72	0.29	0.28	738.93

Table A6—Average number of trees by site, species group, and size, across all plots, at the second inventory

Site	Species group	Trees/acre by size class (inches)													Total
		2	4	6	8	10	12	14	16	18	20	22	24	26+	
1	Softwoods	0.00	0.00	10.58	15.36	17.46	2.10	3.49	13.36	14.84	11.17	2.95	1.81	0.54	93.64
	Soft hardwoods	45.84	45.84	33.26	19.71	13.76	7.70	0.00	2.70	0.00	0.00	0.68	0.00	0.00	169.48
	Hard hardwoods	0.00	45.84	7.44	9.41	0.00	0.00	3.82	0.00	0.00	0.82	0.66	0.00	0.00	67.98
2	Softwoods	26.49	32.60	20.34	15.19	15.21	12.51	10.54	7.61	4.33	2.53	1.51	0.67	0.59	150.10
	Soft hardwoods	165.02	46.86	21.01	9.24	4.32	1.94	1.20	0.70	0.35	0.08	0.05	0.04	0.02	250.85
	Hard hardwoods	146.01	37.35	12.38	6.53	3.50	1.98	1.57	0.82	0.66	0.55	0.25	0.10	0.13	211.82
3	Softwoods	68.94	34.95	21.83	16.32	11.51	10.15	7.79	5.15	3.23	1.59	0.80	0.42	0.32	183.00
	Soft hardwoods	146.98	42.13	14.84	6.63	3.01	1.54	0.64	0.32	0.19	0.05	0.04	0.02	0.02	216.42
	Hard hardwoods	146.50	33.99	11.21	5.81	3.02	1.80	1.32	0.94	0.48	0.24	0.18	0.08	0.12	205.70
4	Softwoods	128.57	62.28	27.17	19.43	12.98	8.90	5.93	3.46	1.91	1.02	0.46	0.18	0.10	272.40
	Soft hardwoods	137.92	28.33	13.01	4.38	2.20	0.98	0.55	0.23	0.11	0.05	0.03	0.00	0.02	187.82
	Hard hardwoods	148.08	32.34	12.91	6.65	3.98	1.82	1.24	0.68	0.32	0.20	0.13	0.06	0.07	208.49
5	Softwoods	157.81	67.63	40.92	25.92	9.01	6.84	3.89	1.40	0.69	0.20	0.14	0.07	0.07	314.59
	Soft hardwoods	145.03	21.79	8.78	4.66	1.83	0.61	0.30	0.09	0.05	0.03	0.01	0.00	<0.01	183.21
	Hard hardwoods	161.57	25.55	9.10	3.40	2.51	1.06	0.56	0.49	0.10	0.16	0.06	0.04	0.06	204.65
6	Softwoods	168.08	106.96	22.44	11.88	2.10	3.42	1.94	0.00	0.00	0.00	0.23	0.00	0.00	317.05
	Soft hardwoods	45.84	45.84	8.89	1.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	102.08
	Hard hardwoods	290.32	45.84	9.77	5.96	1.42	1.63	1.21	0.00	0.70	0.30	0.24	0.20	0.08	357.66
All plots	Softwoods	95.20	48.48	25.81	18.40	12.17	9.57	7.00	4.43	2.62	1.36	0.70	0.33	0.25	226.29
	Soft hardwoods	145.24	35.52	14.30	5.96	2.77	1.29	0.64	0.32	0.17	0.05	0.04	0.01	0.02	206.33
	Hard hardwoods	149.41	32.93	11.68	5.91	3.34	1.73	1.24	0.77	0.40	0.26	0.16	0.07	0.10	208.01