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User's Guide to the Stand-Damage Model: a Component of the Gypsy Moth Life System Model

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Abstract

The Stand-Damage Model (a component of the Gypsy Moth Life System Model) simulates the growth of a mixed hardwood forest and incorporates the effects of defoliation by gypsy moth or tree harvesting as prescribed by the user. It can be used to assess the damage from expected defoliation, view the differences between various degrees of defoliation, and describe the effects of defoliation on a stand under user-defined silvicultural prescriptions and defoliation scenarios. This user's guide provides the information necessary to install and use the model software on DOS microcomputers. The reference section provides a more experienced user with a structure map of the system.

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Internet e-mail address and World-Wide-Web site URL can be found in the "readme" file on the installation disk.

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Contents

Introduction

The Gypsy Moth Stand-Damage Model simulates the growth of a mixed-hardwood forest stand and incorporates the effects of stand defoliation by gypsy moth or tree harvesting as prescribed by the user. It can be used to assess the damage from expected defoliation, view the difference between various degrees of defoliation, and, when additional stand management operations are implemented, describe the effects of defoliation on a stand under user-defined silvicultural prescriptions and defoliation scenarios.

This user's guide assists in the installation and use of the model and introduces the model interface for DOS microcomputers. Once experience has been gained, the reference section beginning on page 22 can serve as your manual. To understand the computations and organization of the Stand-Damage Model, refer to the documentation of the formulation and biological basis for this model found in "Description of the Stand-Damage Model: a part of the Gypsy Moth Life System Model" (Colbert and Sheehan 1995). A complete description of the program interface to access the model and manage input and output data files is found in "Guide to the Stand-Damage Model Interface Management System" (Racin and Colbert 1995).

The Stand-Damage Model is a tool for assessing ecological processes and relationships on relatively small, homogeneous, forested areas, and the impacts of defoliation by the gypsy moth. It can be used to assess the effects of man's attempts to minimize the damage caused by the insect through silvicultural practices and a direct reduction in defoliation. This model is derived from the family of GAP models and is an extension of the JABOWA model developed by Botkin and others (1972) and extended by Shugart (1984). Models such as this are being used to analyze similar ecological processes and problems (Botkin 1993; Bugmann and Fishlin 1992), integrating climate, soil, and stochastic disturbances (Sykes et al. 1992). When integrated into even larger models, they are useful in obtaining answers to more global questions (Smith et al. 1992). Users can manipulate the stand as a whole, by individual species, or by diameter classes of trees within the stand. Summary weather data for each year of a simulation also can be manipulated.

What the Model Does

The Stand-Damage Model simulates growth, mortality, and management of the predominant tree species in a stand; up to 12 distinct species can be followed in any one simulation. The user sets the inventory year and the length of a simulation, and then describes the initial stand and defoliation history for 2 years prior to the simulation. Defoliation episodes can be specified by canopy strata for each host within selected years, as can management actions and timings. Weather data are provided by default as a constant degree-day total for each year. These can be changed to any desired values.

As mentioned previously, the Stand-Damage Model is one component of the Gypsy Moth Life System Model (GMLSM) but can be operated as a stand-alone model. It estimates annual foliage production for each species and passes this information to the gypsy moth model where defoliation takes place. The gypsy moth component tracks the details of foliage and gypsy moth growth, and gypsy moth feeding and foliage destruction. Defoliation of each host species is then passed back to the stand model for use in adjusting growth, mortality, and the next year's foliage production. The stand model also provides the gypsy moth model with a measure of the resting sites or refugia for gypsy moth during daylight hours. Resting sites are calculated for the crowns and boles of each tree species.

Describing the Initial Stand

Little is required to describe the stand. You are provided with the parameters and information needed to initiate a simulation; a full set of defaults along with initial conditions for a sample stand are included. Additional sample stands and related simulation instructions are contained in the input files that were provided in the input package. The collection of parameters that affect the stand as a whole are grouped together. When new species are desired, there are full parameter sets for each of the 21 alternate species of trees and an initial parameter set for a user-defined species. When you select a new species, the default parameters for that species are automatically loaded into memory from a disk storage file. To follow a stand of particular interest, you need only have an inventory of the stand as a collection of tree counts, by diameter size class and species. At any time the menu system is active, you may add or delete species, or edit the initial conditions or parameters for an active species (those previously selected for a simulation).

Simulation Length

The default length of a simulation is 5 years, with 1979 as the first year for which tree growth is simulated. This assumes that the initial conditions were taken between the fall of 1978, after growth has ceased for the year, and the spring of 1979, before any growth had taken place. The maximum length for a simulation is 100 years.

Simulating Defoliation by Gypsy Moth

Defoliation is prescribed by the user. There are three defoliation years prescribed in the default data set. The values used in this case, a rise and fall with differences between species in accordance with feeding-preference data (Colbert 1991), are not the default values found when adding a new year of defoliation or adding another tree species. When you add defoliation, you first choose a year, then enter defoliation data for each species. These defoliation data fields are initially set to zero (0). A data-entry window appears allowing these data to be edited. You also can account for defoliation that has taken place in the stand prior to the first growth year.

Defoliation for the 2 years prior to the initial simulation year can be entered. If you add another tree species and defoliation already has been entered, all defoliation for the new species will be initialized to zero.

Simulating Stand-Management Actions

After selecting a year in which management is to be performed, one of two management action types must be selected. Target cutting allows you to specify a residual target stem count for each species and the diameter limits (the range of diameters that can be affected) for possible removal of each species. If targets are higher than the available stem count, no action takes place. Alternately, selecting proportional cutting means removing the prescribed proportions of all stems within the diameter limits you provide for each species, irrespective of pre- or post-treatment stocking.

Direct Control of Gypsy Moth

Direct control of the gypsy moth is simulated by altering the user-supplied defoliation scenarios. When the full GMLSM is used, several direct control actions are available. In that case, details regarding timing, type, and dosage of pesticides are provided. Here, the end result of removing gypsy moth (reduced defoliation) must be provided.

Companion Publications and Documentation

This publication will guide you through installation of the software and use of the access-control system for the Stand-Damage Model. As you make use of the menu-driven access-control system, you will find context-sensitive help by pressing the **F1** function key ([F1]). The Help system provides information on specific menu choices, screens, and data fields that are not documented elsewhere. The Help system and other internal documentation references specific portions of a companion publication, General Technical Report NE-208 (Colbert and Sheehan 1995), which includes details of the model itself: the equations, their parameters, and the order and way in which they are invoked and interact. That publication also provides documentation on the basis by which parameter values were chosen and the formulations used. As you become more involved with manipulating the model and its parameters, you will find that the documentation will be more useful and essential in making certain manipulations and interpreting generated outputs. The appendices to that publication contain code structure charts, descriptions, and complete listings of the code and related data structures. You will find those useful in understanding the calculations that gave rise to particular results.

The other companion publication, General Technical Report NE-209 (Racin and Colbert 1995), provides detailed descriptions of the default and stand files, their structure and content, and the complete program controlling the user interface and the installation software. Programmers or others interested in developing similar user-interface software will find this publication a complete guide to the design and fabrication of this user-control system.

Typographic Conventions

To avoid confusion and provide consistent interpretation between this and the other publications, several conventions are used in this user's guide:

[F1]	A key that must be pressed to activate some process.
[CTRL] - [↑]	key combinations (when multi-key combinations are indicated, hold down those shown first, followed by the final key).
Bold	menu, view, or edit window items; these should provide context connections as you move through the user-interface system.
`Monospace font`	DOS prompts, DOS commands, file names, and data-entry example text; these are either the characters to be entered by the user or produced on the screen by the program.

We have attempted to provide safeguards to data loss and other critical items. The following notations should assist you in locating these areas.

<u>Underscore</u>	emphasis for important items.
Bold Italic	Caution: critical situations where data may be lost.

Installation and Setup

Installing Program Software and Associated Files

There are three files on the installation disk for this model:

`MODEL.PKD`	Compressed model and associated files,
`INSTALL.EXE`	Program to unpack and install the model under your direction,
`READ_ME.1ST`	Text file containing up-to-date instructions as well as additions and corrections to documentation.

By using your favorite text viewer/editor, you can scroll through the `READ_ME.1ST` file or use the DOS TYPE and MORE commands with a pipe (|) to step forward through the file as shown here:

```
A:>type read_me.1st | more
```

This file will contain information on new releases and updates or corrections to installation documentation when they become available. It also provides requirements and assistance with installation, user-support address, and phone numbers. Finally, it contains the registration request. By sending in a registration form you will be provided with updates to documentation and program files as they become available.

Backing Up Program Files

As with any software, the first thing to do is make a backup copy of the installation disk. These files will all fit on one 360K floppy disk. Format the backup disk, if necessary; then use the DOS COPY command:

```
x>COPY y:*.* z:
```

where x is the drive (and possibly the path) currently active, y is the drive letter for the drive in which you have inserted the original installation disk, and z is the target drive where you want to store the backup copy. Of course, you may add a path to the target if desired. For example:

```
C:\>copy b:*.* a:
```

is the command given from the root directory on the C hard disk to copy all files from the distribution disk, placed in the B drive, to a formatted backup disk in the A drive. Refer to your DOS manual for additional instructions and information. Before beginning the installation, read the file named READ_ME.1ST for further installation instructions, including up-to-date directions for additions and corrections to this and other documentation.

Checking for Monitor Type

The installation software always asks if the model will be running on a grey-scale VGA-monochrome monitor. If you are using a portable or other machine with a grey-scale VGA-monochrome monitor, select the VGA-monochrome option during installation. The model software automatically detects whether your computer is true monochrome (HG or B&W standard), but VGA-monochrome detection is not possible. After you respond to the monitor type question, a variable in the default file is set. Once the model installation is complete and you initiate a session, a selected menu option should be distinguishable from other options on the menu bar or pull-down menu (one item should be in reverse video on monochrome displays or in a different color). If this is not the case, check to see if running in monochrome mode corrects the problem by initiating a monochrome session. Do this by placing an M on the command line following DAMAGE:

```
C:\DAMAGE\> DAMAGE M [ENTER]
```

If this corrects the problem, reinstall the program, selecting the VGA-monochrome option. If you are still stuck, see the section on trouble reports (page 20) or the read-me file for our address, modem, or FAX phone number. If you have other installation problems, do not hesitate to contact us.

Installation Location

One final consideration before initiating the installation program: where should it reside? We suggest allowing the installation program to create a new directory for the program files. Decide where it will reside before installation, i.e., choose the directory it should be subordinate to. This reduces the chance of damaging program files. You can place the files on any drive and in any directory with sufficient space. The model and associated files will take up just under 710K of disk space initially. Saved input and output will consume additional disk space. Be sure that the drive on which you intend to install the software has at least 1 megabyte free before installation and 500K free for temporary files during model executions and to save data before exiting a session.

Running Install Routine

The installation program installs the model software. First, it asks for the drive where you inserted the installation disk; then it asks where to put the program files. When information is provided, it ensures that your computer can accept the installation as instructed and indicates problems encountered. Read each screen carefully before making a choice. After you make your selections, the program displays acquired information and requests that your choices be validated before it performs the installation. You may abort the installation at this point.

After you designate a place for the program and its associated files to reside, files in the following list are installed:

DAMAGE.EXE	Executable model program.
HELP	Context-sensitive help system.
HELP.IDX	Help system index.
INTRO	Text for the introductory screen that is displayed first when you execute the program.
DEFAULT	Default initial conditions and parameters for the stand model.
SPECIES	Parameter values for 22 tree species.
OAK.PCX	Graphics logo for initial screen.
ROMAN.FON	Graphics font file.
COURB.FON	Graphics font file.
COMPARE.EXE	Comparison utility program.
EXAMPLE.INP	Example input file containing documentation and referencing sample output. This file is used to create EXAMPLE.TBL.
EXAMPLE.TBL	Example output generated from the sample input.
NOW_READ.ME	Additional instructions for running the model, including information and documentation corrections not available at the time this guide was published.
READ_ME.1ST	Installation instructions and associated documentation copied from the installation disk as you installed the model.

The first nine files are required for proper execution of the model and should be kept together. The read-me files can be stored elsewhere. Create a backup copy of installed files so that corrupted files can be replaced without reinstalling the program. Follow the previous instructions or consult your DOS manual.

Two additional subdirectories should be created, one for storage of model input files and one for output files. This reduces the chance of inadvertently removing, overwriting, or losing track of previous work. These subdirectories are not created automatically during installation. If you have the installation program create a new directory and you want these to be subordinate to that new directory, create them after installation. The program can access files only within the working (default) directory. Move files between the storage directories and model directory to make them available for specific applications. Any output can be regenerated from the associated input file.

System Setup

Operating System and Disk Communication

DOS Version 2.1 or later is required to run the Stand-Damage Model. About 650K of disk space is required for storage and 540K of memory is required to run the program. To assure that system, program, and temporary file communication function properly, the following two lines should be in the `CONFIG.SYS` file:

```
BUFFERS=20
FILES=50
```

A larger number of buffers or file handles is acceptable. When your computer starts, some memory is used by the operating system and by drivers for disk and monitor access and control. Some may not be necessary to run the Stand-Damage Model. If the program will not load and an "insufficient memory" error is displayed, refer to the section on smaller systems. The program creates several temporary files to pass information to the model. If less than 100K of disk space is free following installation, consider some house cleaning before proceeding. Once running (especially if operating from a floppy disk), consider creating a virtual disk in high memory to accelerate program speed. ***Caution***: should you exercise this option, a virtual disk is a portion of volatile memory above the normal 640K base, and its contents are lost when the computer is turned off. Before turning off the computer, copy files created during the session to a hard or floppy disk.

Conflicts with Other Software

The program accesses the operating system to permit model operation and file retrieval and storage. Software such as disk-management and user-service programs may redirect standard operating system calls or may leave system pointers misaligned. In the event of erratic program behavior or program lock up, reboot your computer and remove Terminate and Stay Resident (TSR) programs before executing the `DAMAGE.EXE` program again. Currently, the program will not run as a Microsoft Windows[1] application, but does function as a DOS application from within Windows.

Fitting into Smaller Systems

The model will load and run on 8086 or 8088 machines with 640K of memory, though you should expect simulations to take several minutes. We have found that the program operates well on older 386 class machines running DOS 4.01 and acceptably on 286 class machines under DOS 3.2. On a 20MHz 386DX machine, a 20-year simulation can be generated in less than one minute. If the program will not load into memory, remove memory resident programs. If this does not provide sufficient memory, review your machine's memory use. Use the DOS CHKDSK command to obtain total and currently available memory. Examine `CONFIG.SYS` and `AUTOEXEC.BAT` files to see if "`DEVICE=<filename>`" or other program loading lines can be removed temporarily. This can be done by adding "`REM` " to the beginning of the line.

If you encounter problems with model execution and believe that necessary disk-access or video drivers are to blame, consider using memory management software that moves some of these and parts of the operating system to high memory. If this is not possible and your system has a color monitor driver, consider using the monochrome version of the model and using your monitor in monochrome or black-and-white mode.

Using the Model

Starting the Program

Make the directory where you installed the model files your working or default directory. To start the program, type `DAMAGE` at the DOS prompt and press [ENTER]. You will see an oak leaf graphic followed by the introductory window (Fig. 1).

Use the [↑] and [↓] keys or the [PG UP] and [PG DN] keys to read this introductory information. Note the slide bar and small arrowhead along the right edge of the window. As you move within a window, an arrowhead will appear at the top if there is additional text above the current view, and at the bottom if there is additional text below. Use the [ESC] key to proceed to the main menu (Fig. 2).

[1] The use of trade, firm, or corporate names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement of approval by the U.S. Department of Agriculture of the Forest Service of any product or service to the exclusion of others that may be suitable.

```
Introduction

      STAND-DAMAGE MODEL: PART OF THE GYPSY MOTH LIFE SYSTEM MODEL
      ************************************************************
  The Stand-Damage Model, a component of the Gypsy Moth Life System Model,
calculates tree diameter and height growth, foliage production, and
mortality.  Data on weather variation and management prescriptions can be
entered.  It contains parameters for twenty-one tree species, six of which
can be simulated in a single stand.  In addition to tree counts by species
and diameter class, the user provides one of three soil-moisture categories
for the stand. Each year, potential resting sites for gypsy moth are
calculated from tree height.  Also, the software calculates potential
foliage biomass on the basis of estimated growth in the absence of gypsy
moth.  It calculates diameter growth of trees as a function of relative
stocking (a measure of tree crowding), shading, temperature, and
defoliation.  Base tree mortality rate is altered according to reduced
growth, gypsy moth defoliation, and other stresses.  Following mortality
calculations, tree growth is updated for the residual stems by moving
portions of trees between diameter classes; new stems are recruited to the
smallest classes.
   *********************************************************
    For HELP running this program, use the PAGE DOWN KEY NOW

Press Escape
F1-Help  ARROW KEYS-Maneuver  ENTER KEY-Select Option  ESC-Exit Window  Q-Quit
```

Figure 1. Introductory window that appears when the model is executed.

```
STAND DAMAGE MODEL: part of the Gypsy Moth Life System Model   Version 1.1
  Setup  File  Stand  Trees  Manage  Weather  Output  Run  Quit

default
```

Figure 2. Main menu.

Navigating among Menus, Windows, Screens

You have just used several of the keys that are used within the control-access system. All manipulations start from this horizontal menu of the major topics. Highlight an item using the left and right arrow keys (← →) or type the first letter of a menu item. Once the desired item is highlighted, press ENTER or ↓ to activate a pull-down menu associated with that item. Typing the first letter of an item will both select and activate it. Using ↑, ↓ or typing the first letter of an item will move you between choices on a pull-down menu. Again, typing the first letter of an item both selects and activates your choice. Figure 3 shows the main menu with the **Trees** submenu activated and the **Add tree species** item highlighted.

There are four types of windows: edit, view, pick lists, and selection lists. Edit windows contain several data-entry fields that can be edited. You can highlight only a single item on a pick list, while on a selection list you can mark a

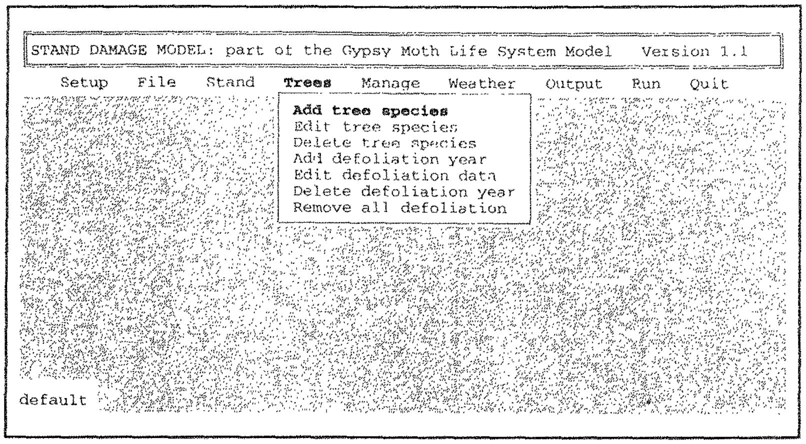


Figure 3. The Trees pull-down menu provides access to add, edit, or delete tree species-specific data, including defoliation by canopy strata within species.

number of items to be processed in sequence. Use the following keys to navigate within or between menus, windows, and data-entry fields:

[ESC]	Press to exit a menu or window. In most instances, [ESC] will not activate a process but will return you to the next higher level in the menu-window hierarchy. [ESC] or [ENTER] can be used to process items on a selection list. For example, [ESC] or [ENTER] can be pressed after selecting host species to edit from the list of those currently active. [ESC] will not undo changes made to edit fields.
[←] [→] [↑] [↓]	[←] and [→] will move between adjacent main menu items, even with a pull-down menu activated. [↑] and [↓] move the cursor between adjacent pull-down menu items or, within an edit window, between data-entry fields. When data are arranged in a rectangular array, the [←] and [→] keys can move horizontally between fields.
[ENTER]	Activates a menu item or selection(s). Moves the cursor to the next data-entry field within an editing window. At the last data field, exits the window.
First letter of menu items:	Selects and activates a menu item that starts with that letter.
[SPACE]	Marks items in a selection list. In this type of list you can mark several items.
[PG UP] or [PG DN]	When a view (e.g., the introduction, a help message, or an output file viewing window) or data-entry window is displayed, [PG UP] moves up a full screen of information and [PG DN] moves down one full screen.
[CTRL] - [←] or [CTRL] - [→]	When a document is wider than the viewing window, these keys position the document so that the far left or right edge is visible in the view window.
[HOME] or [END]	When a text file is displayed on the screen, [HOME] moves to the beginning of the file and [END] to the bottom of the file. On menus or list windows, [HOME] moves to the top of the list and [END] moves to the bottom of the list. [HOME] moves the cursor to the left-most character position in data fields containing character strings or real numbers. [END] moves the cursor to the right-most character position.

Figures 1 and 4 show viewing windows where only a portion of available text is visible. As with other screens where text exceeds window borders, scroll bars at the right window edge with small arrows at the top or bottom indicate the direction of additional text.

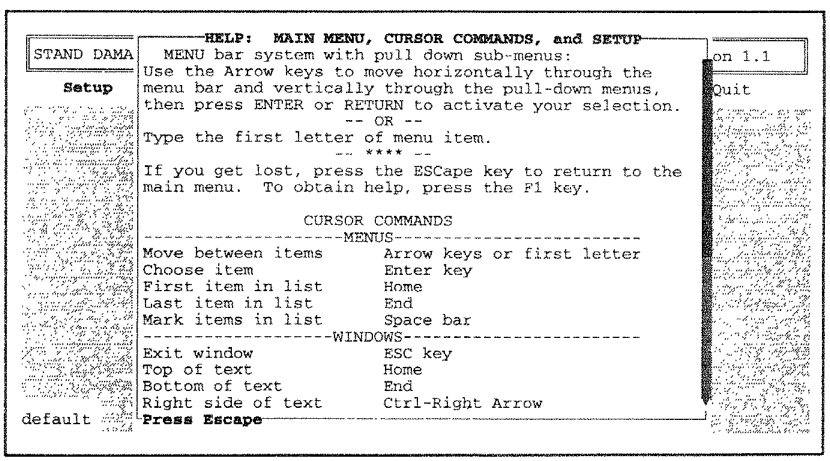
Mouse Control

The program will respond to a mouse (assuming that a mouse driver has been loaded). Refer to your mouse documentation for loading the driver for DOS applications. To select a menu or list item, position the mouse pointer over the item and click. Mouse actions are not independent of the cursor. The cursor will follow the mouse as it is repositioned within an edit widow. Drag-and-drop and resizing of windows is done as in most windowing software. Scroll bar arrowheads can be click-activated for single-line or single-column movement within a view window. Scroll box can be dragged to move the viewing window. A mouse click outside of the active window will close that window. When several windows are present, only the topmost is active and can be manipulated.

Context-Sensitive Help

If you need additional information at any point in the program, press [F1] to obtain context-sensitive help. Figure 4 shows the Help screen for the main menu. The help message windows can be moved or resized with the mouse. Help is not available when the model is running or when error messages are being displayed. The Help system references the equations, figures, and tables in General Technical Report NE-208 (Colbert and Sheehan 1995).

If you are lost or wish to return to the main menu, press [ESC] several times. If you do not want to retain changes or you are not sure what the current settings are, select the **File** options pull-down menu and choose **Reload default file** to re-initialize the program with default values. This will clear all previous changes and return you to a situation similar to initiating the program from the DOS prompt. There is no facility to undo specific changes. If you are concerned about loss of information, you can retain a copy of the current setup by using the **Save** option on the **File** pull-down menu and comparing the saved file with the defaults to locate specific value changes. At the DOS prompt, type COMPARE to execute the file comparison utility program. See General Technical Report NE-209 (Racin and Colbert 1995) to interpret the file formats.



```
STAND DAMA | HELP: MAIN MENU, CURSOR COMMANDS, and SETUP | on 1.1
Setup      |  MENU bar system with pull down sub-menus:   | Quit
Use the Arrow keys to move horizontally through the
menu bar and vertically through the pull-down menus,
then press ENTER or RETURN to activate your selection.
                       -- OR --
Type the first letter of menu item.
                       -- **** --
If you get lost, press the ESCape key to return to the
main menu.  To obtain help, press the F1 key.

                    CURSOR COMMANDS
--------------------MENUS------------------------
Move between items        Arrow keys or first letter
Choose item               Enter key
First item in list        Home
Last item in list         End
Mark items in list        Space bar
-------------------WINDOWS------------------------
Exit window               ESC key
Top of text               Home
Bottom of text            End
Right side of text        Ctrl-Right Arrow
default    Press Escape
```

Figure 4. Example of context-sensitive help; press [F1] from the main menu to get this help window.

Your First Simulation

The simplest simulation is performed using default options:

1. Type DAMAGE at the DOS prompt and press [ENTER].
2. Press [ESC] to bring up the main menu.
3. Type R to highlight **Run** on the main menu and bring the **Run Model** pull-down menu into view.
4. Press [ENTER] to start the default simulation.

You will see a pop-up message box appear with the total length of the simulation noted at the top. It has a status bar that goes from dark to light as each year's simulation is chronicled. Once the simulation is complete, the OK button is activated and clicking it with the mouse or pressing [ENTER] returns control to the main menu. At this point, [←] will invoke the **Output** pull-down menu. When **View** is selected, there will be one available output (by default): the Stand Table. Press [ENTER] to view the table. The file is formatted for printing on a wide carriage (132 column) or in compressed mode, but you can scroll up and down as well as right to left throughout this file. Figure 5 shows a portion of the parameters with some of the initial conditions for the default simulation.

Monochrome Mode

The Stand-Damage Model can be operated in monochrome mode even if installed to run in color. Typing DAMAGE M at the DOS prompt executes the program in monochrome. This may be particularly useful if you copied the installed program files to a machine with a grey-scale VGA monitor.

Customizing a Simulation

You now should be ready to make alterations to the default input data and proceed on your own. First consider some options for customizing defaults: length of simulation, the amount of output to generate, the changes to default inputs you wish to make, and other items to add to the simulation. We consider these in turn.

As you begin use of the model control panel, note the prompt at the bottom of the window. It changes as the cursor is moved between data fields. The prompt line contains the permissible range for data entry and provides the parameter or variable name. The interface performs range checking and does not permit the entry of out-of-range data. Initially, each data field is loaded with the default value. When you load a previously saved input file from disk, the values present at the time the save was made are reloaded. The Help system provides a brief description of each item and an explanation of how it is used by the model. Since it is easy to alter data, note changes when you make them. Use the notepad under **Edit job description** from the **Setup** options menu item to maintain a description of changes made to the defaults as well as source-data information. If you are not sure that the changes you made are correct and you want to start over with the original default values, select the **File** pull-down menu and choose the **Reload defaults** option. This resets all parameters and variables to their default conditions.

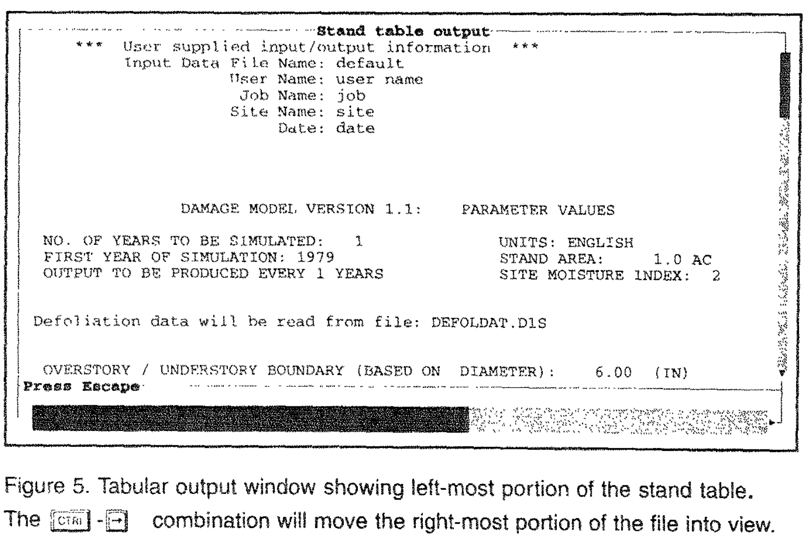


Figure 5. Tabular output window showing left-most portion of the stand table. The [CTRL]-[→] combination will move the right-most portion of the file into view.

Start and Duration of Simulation

By choosing **Stand** from the main menu and then **General data** off the pull-down menu, a screen similar to Figure 6 is displayed. Data fields in this window, discussed individually, should be considered an example of the means to view, understand background information, and edit the associated item.

This and similar edit windows allow you to alter default inputs. First you see the **Starting Year**, the first year for which growth is simulated. Note that as you move the cursor with the ↓ key, press ENTER or point at data fields (to the right of each colon) with the mouse, the prompt at the bottom of the window changes to provide item-specific information. Enter a new calendar year as the start of the simulation or change the simulation length. Here you also can access two random-number seeds used in simulating regeneration variability and mortality of stressed trees. By changing the value of one of these seeds, you will cause the random sequence that affects variation to change. The heat multiplier allows you to make changes to the effect of temperature uniformly across all years. For example, changing the value from 1.0 to 1.05 would be equivalent to raising the value of each annual degree-day total by 5 percent. These last three items generally are not altered. They appear in this window along with other items that are not associated with the ecological aspects of the stand but affect the general form of a simulation. The final field permits changing from English to metric units of measure. All data entry and output units are converted by this one switch.

Output Volume

As you increase the simulation length, you add to the amount of output. There also are additional files that you may wish to create. These files are used by the interface to plot output graphically; they contain summary data without headings, in formats ready for use in statistical or graphics software. See the reference section for descriptions of these data, file formats, and examples of the output files. The **DEBUG** option traces details of model operation and produces output associated with many of the intermediate calculations. Using **DEBUG** means that considerable additional file storage space is needed for these data. The first 32,000 characters of any of these files can be seen in the **Output/View** window. The rest of the file is present but unavailable for viewing within this program. It can be printed or you can use your favorite editor or word-processing software to view the remainder of large output files.

Reducing Output

There are two ways to reduce output file size: (1) produce output data at regular intervals but not every year; or (2) select specific years for producing output data. Figure 7 shows an individual-year selection screen. The model is designed to simulate growth by calendar year, but it may be more reasonable to view growth and mortality of trees on a decade or 5-year basis.

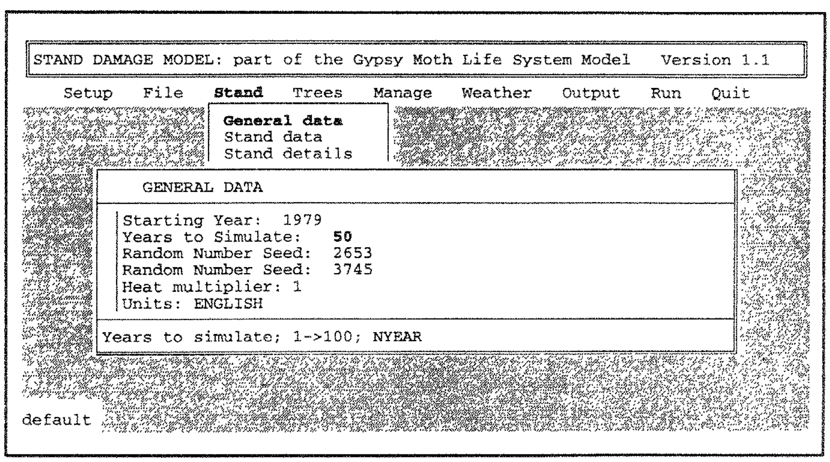


Figure 6. General data-entry window with the length of the simulation changed from the default value of 5 to 50 years.

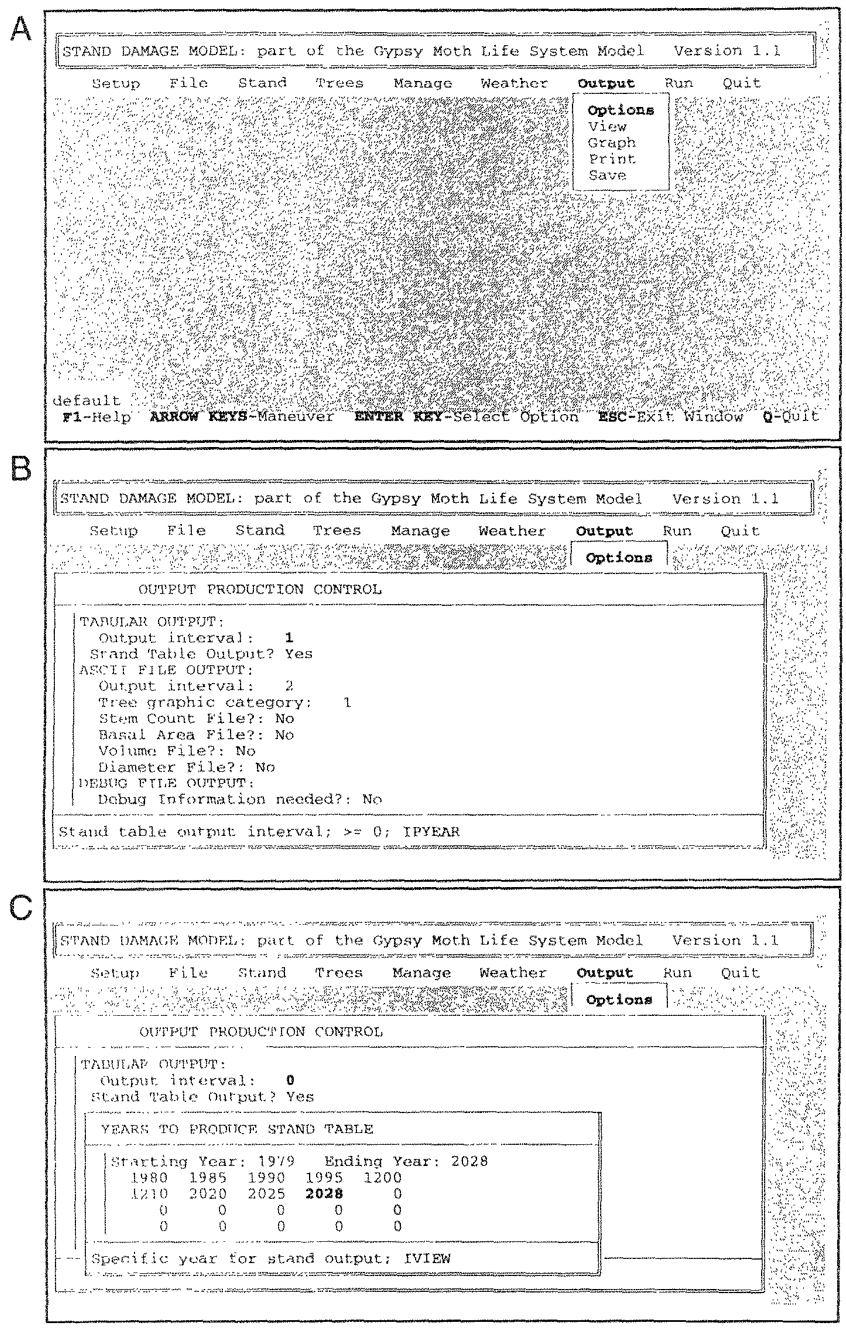


Figure 7. (A) **Output** pull-down showing submenus; (B) **Options** activated; (C) Output interval edit window.

In this last case, only the last year would be produced assuming a default duration of 5 years. With longer simulations, these options provide a way to limit the size of summary output data. Open the **Output production control** window by choosing the **Options** item from the **Output** pull-down menu. You are now ready to designate the output you want the model to produce during the simulation. Set the frequency of tabular and graphic (ASCII text file) data output to be produced. Turn on or off any output control options by changing the Yes/No answers with the [SPACE] or mouse.

Stand Information

There are a number of parameters that operate across the stand and affect all trees similarly. These data are found by selecting the **Stand** item from the main menu and choosing **Stand data** from the pull-down menu.

The **Stand data** screen contains the stand-level information that users need to edit most often. To ensure that the default values are appropriate for a particular stand, review this screen before initiating a simulation. Be sure that the site moisture index (variable ISITE), sample plot area (PLOTAR), and stand size (STNDAR) represent your stand. The sample plot area is used to convert the diameter counts to a per-unit-area basis. The stand area is used only in reporting whole-stand summary statistics. All measurements are assumed to be in English units but you can switch to metric in the **General data** edit window.

The trees in a stand are organized by species and within species are divided into overstory and understory classes. Users can specify whether a tree height or diameter will be used as the break point between overstory and understory trees. Since there is just one break point that is used for all species, the type is accessed under the **Stand data** item off the **Stand** pull-down menu. The actual height or diameter to be used can be edited as the first data field in the **Stand details** edit window.

Information that rarely requires manipulation by the user is contained in the **Stand details** screen (Fig. 8). Only a portion of this information will be visible at one time. You should find that the prompt (field-description) text at the bottom of the window and the associated Help screen provide ample descriptions of particular parameters, including the range of permissible values. The variable names and Help screens are keyed to General Technical Report NE-208 (Colbert and Sheehan 1995).

```
                              STAND  DETAILS

Boundary Diameter: 6
Solar insolation factor: 1
Shade effect on diameter growth - light degradation rate: 0.0002

Effect of Available Light on Diameter Growth (X, Y values of interpolation)
   by tree shade tolerance class

Intolerant   Intolerant  Tolerant    Tolerant    Red Maple    Red Oak
             /Intermed.  /Intermed.

  X     Y      X     Y     X     Y     X     Y     X     Y     X     Y

  0     0.1    0     0.2   0     0.3   0     0.4   0     0.4   0     0.2
  0.31  0.15   0.34  0.25  0.37  0.35  0.4   0.45  0.4   0.45  0.34  0.25
  0.8   0.95   0.75  0.85  0.7   0.75  0.65  0.65  0.8   0.95  0.8   0.95
  1     1      1     0.9   1     0.8   1     0.7   1     1     1     1

Shading Influence Area: 0.2
Minimum value for Shade: 0.05
Minimum Value of Temperature effect: 0.05
Minimum value for effect of CROWDing on diameter growth: 0.75
Slope of defoliation effect on foliage production: 0.15

    Effect of Defoliation on Diameter Growth
Intercept for effect of defol. on diameter growth:  0.968895
Slope for the effect of defol. on diameter growth:  -0.00405025
Coefficient for effect of defol. on diameter growth:  1.34177
Intercept for effect of defol. on diameter growth:  0.0053971

    Quadratic equation coefficients to produce relative stocking RSTOCK
      by stocking class x
     STOCKS(x,1)    STOCKS(x,2)    STOCKS(x,3)

x=1: 0.0033033      0.020426       0.0006776
 x=2: -0.027142      0.024257       0.0015225
x=3: -0.0027935     0.0058959      0.0047289

Relative stocking effect: 0.0025

   Effect of relative stocking on recruitment (values for interpolation)

Intolerant   Intolerant  Tolerant    Tolerant    Red Maple    Not Used
             /Intermed.  /Intermed.

  X     Y      X     Y     X     Y     X     Y     X     Y     X     Y

  0     1      0     1     0     1     0     1     0     1     0     0
  30    1      35    1     40    1     45    1     30    1     0     0
  50    0.05   70    0.05  80    0.05  90    0.05  90    0.05  0     0
  120   0.05   120   0.05  120   0.05  120   0.05  120   0.05  0     0

Minimum Stem count sufficient to perform growth calc.: 0
Sufficient stem count to carry stems to next size class:  0
Target thinning STEM count lower limit: Epsilon 1: 0
Lower limit for total stem count for removal: Epsilon 2: 0
Lower bound for total stems to be cut: 0
Minimum count of total stems in a strata to be displayed: 0
Exponential decay rate: -0.084
Nonstress Mortality Factor: 0
Stress Induced Mortality Factor: 0.15
Stress Probability (Site 1):0
Stress Probability (Site 2):0
Stress Probability (Site 3):0
Stress option:    0

0:no stress, 1:random stress, 2:specify years of stress; 0 -> 2;(ISOPT)
```

Figure 8. **Stand details** data entry; only a portion of this is visible at one time.

Tree Data

Species-specific tree data are accessed through the **Trees** item on the main menu. While similar to the stand-data screens in access and edit characteristics, there are two important differences. First, you may add a species to or delete a species from the stand. Second, if you remove a tree species, all data associated with that species are lost. Therefore, two steps are taken to delete the data. Select **Delete tree species** from the pull-down menu and you will see a numbered species list. Enter the item number associated with the species to be deleted. A warning message showing the common name of the species selected will ask you to confirm the deletion.

Select **Add tree species** to obtain a list of the available species. To select one, highlight it using the [↓] and [↑], then press [ENTER] (or point and click with the mouse). When you choose a species, a full set of default parameters for that species and one tree in the smallest diameter class are provided in an edit window. (The one tree assures that the model always will have at least one tree at the start of a simulation.) Note that the model is designed so that only species selected for simulation will regenerate; that is, if you want to see ingrowth of a species as the simulation progresses, include it in the list initially and set the desired initial stocking. Choosing **Edit tree species** provides a pick list of the species currently included in the stand. Use the [SPACE] to toggle on (or off) one or more of the species or point and click with the mouse. As you exit this screen, the data associated with each of the selected species are presented for editing, one after the other. A full list of initial condition and parameter entry fields for northern red oak is shown in Figure 9.

```
Northern Red Oak
 Species: Northern Red Oak      Code: RO       Host Code: 833

       INITIAL CONDITIONS
          Stem Counts
Indexed by diameter class midpoint;  class width(in.) = 2.0
 1.0:4          3.0:2          5.0:2          7.0:6
 9.0:8         11.0:16        13.0:4         15.0:4
17.0:2         19.0:2         21.0:2         23.0:0
25.0:0         27.0:0         29.0:0         31.0:0
33.0:0         35.0:0         37.0:0         39.0:0

      Defoliation History Index
0:None  1: 1 30 per cent   2: 31 65 per cent   3: >65 per cent
         Overstory      Understory
Sample year              0              0
Previous year            0              0

       PARAMETER VALUES
Maximum Age: 250
Maximum Height: 80
Maximum Diameter: 35.8
Diameter Growth: 121.5
Slow Growth Threshold: 0.01
Minimum Degree Days: 731
Maximum Degree-Days: 8499
Relative stocking Class:    2
Shade Tolerance Indexes
    Recruitment:    2
    Diameter growth:    6

Recruitment: 30
Biomass/Surface Area: 457

Tree Mortality Following Heavy Defoliation: >65 per cent
SITE            1YR        2YR        3YRs or more
Dry             0.1        0.2        0.35
Moderate        0.1        0.2        0.35
Moist           0.1        0.2        0.35
Used to calculate base tree mortality rate; >0; AGEMAX
```

Figure 9. Host species-specific data-entry window.

Weather Data

Select **Weather** from the main menu, and press [ENTER] after **Edit weather data** appears (Fig. 10). The data-edit screen containing one entry for each year to be simulated is shown. The weather data that affect tree growth are annual accumulated degree-days above 42°F (5.5°C). This base was used by Shugart and West (1977) to produce many of the parameters included here. It is these annual summary statistics that the model uses as the weather effects for tree growth each year. Each tree species has a maximum and minimum annual total associated with its range. As the annual total differs from the tree species-specific modal value, the temperature effect on growth of that species is felt more strongly until the temperature effect multiplier is reduced from its optimal of 1.0 to 0.05. Figure 10 shows an example of the Weather Data Entry window. Edit fields for altering the degree-day range (minimum and maximum values) for an individual species are shown in Figure 9 while the minimum value for the temperature effect multiplier is set for all species (Fig. 8).

Defoliating a Stand

There are two classes of defoliation data that can be entered: initial history (2 years) prior to the simulation and that for any year during the simulation. Defoliation history is entered as one of four classes. To describe defoliation that should take effect during a simulation, select the year and enter data as percentages. Two defoliation estimates are required for each host species, the average defoliation for all overstory trees and the average defoliation for all understory trees.

Accounting for Past Defoliation

From the **Tree** pull-down menu, select **Edit tree species** to gain access to the initial-conditions data fields where you enter the defoliation history. These data are entered just after the initial stand stocking data (stem counts by diameter class) at the top of the host-species data screen (Fig. 9). You designate one of four classes of defoliation (values 0-3) for each of the two canopy strata, for each of the 2 years prior to the first year to be simulated: year "0" and "-1." For example, using the defaults, the first year of simulated growth is 1979, so 1977 would be year "-1" and 1978 would be year "0." These initial conditions are used to account for the effects of past defoliation on the first 2 years of simulated growth. As each year is simulated, the defoliation history is updated from that specified for simulation years.

Specifying Defoliation During Simulation

To alter defoliation that will take place during a simulation, select among **Add defoliation year**, **Edit defoliation data**, or **Delete defoliation year** from the **Tree** pull-down menu. There are 3 years of defoliation data in the default data set. These data are specific to the species selected for the default stand. As tree species are added to the stand, two "0.0" default defoliation values will be added to the data already present. ***Caution:*** you cannot access defoliation data fields for a tree species before adding that species to the initial inventory for the stand. First edit the stand data and select and edit the tree data for use in a simulation; then edit or replace the defoliation data as desired. Figure 11 shows the editing of defoliation data for northern red oak trees that are part of the defaults, simulating a harder hit group of trees. To edit a group of defoliation data, use the SPACE to select (check off) year(s) from the pick list. Upon exit from the pick-list screen, the data will be presented in an edit window, one for each year, in sequence.

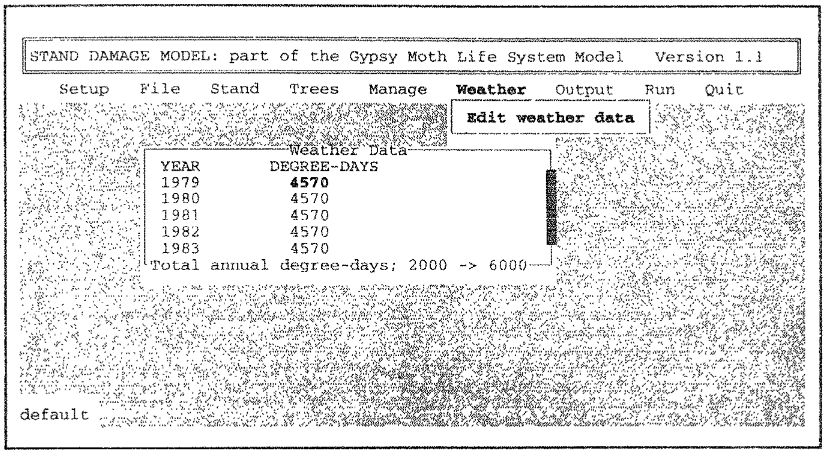


Figure10. Weather data-entry window as seen under default conditions.

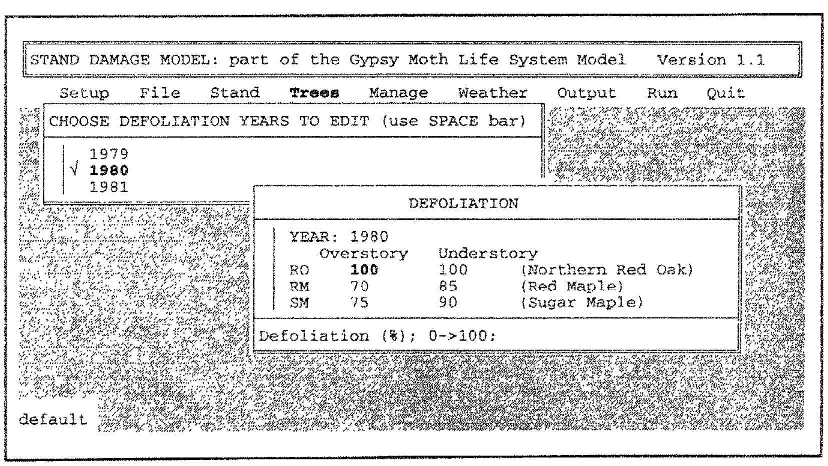


Figure 11. Entering different defoliation for each group of red oak directs the model to apply different effects.

Defoliation Effects

Defoliation directly affects the rate of diameter growth and is tree-species specific. As defoliation increases, growth rate decreases. The method used to calculate the rate of decrease is decided by reviewing the recent defoliation history. Percent defoliation in each of the past 2 years is used to classify the history as none, light, moderate, or heavy. The effects of current defoliation will be greater if the classification of recent defoliation is higher. Gypsy moth defoliation directly affects tree-mortality probability, and continued slow growth induced by defoliation heightens mortality.

Prescribing Stand Cultural Practices

Select **Manage** from the main menu, then **Add management year** from the pull-down menu. Once a management action has been prescribed, it can be altered through the **Edit management year** or the **Change management year**, or removed using the **Delete management year** options. During any year being simulated, tree removal can be stipulated using one of two criteria. First provide a year; then choose either the proportional or target-thinning method. In the proportional method, one selects the proportions of the stem counts to be removed within prescribed diameter limits for each species. In the target thinning method, one stipulates the final total stem count for each species and the diameter limits within which trees may be removed. Because the target residual-tree count for a species includes both the total count outside the diameter limits and some portion of the count within the limiting diameters, a small value for the residual may remove more trees than expected. Tally all trees outside the diameter limits and add that to the desired residual tally within the diameter limits. Figure 12A shows the selection of management method; Figure 12B shows the data-entry window for entering data for a proportional thinning.

Reducing Stocking

By using the two methods described and selecting years, methods, diameter limits, and target counts or proportions, you can simulate most harvest practices.

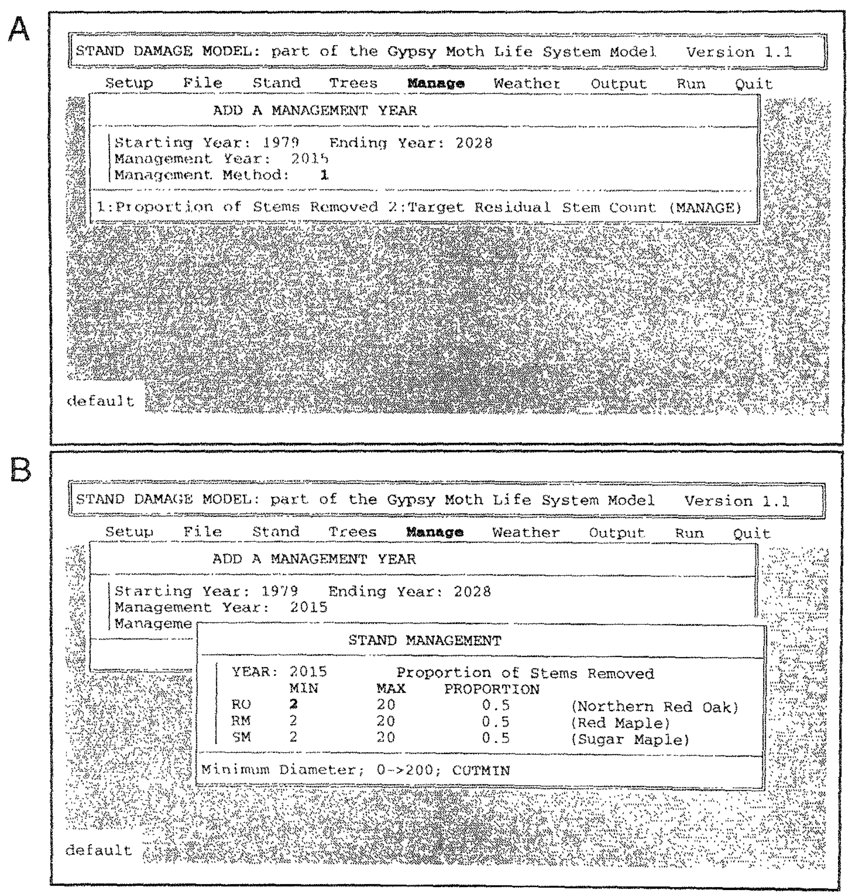


Figure 12. Select management actions: (A) select year and method and (B) stipulate diameter limits and rate parameters.

Thinning

To uniformly thin a stand, choose proportional cut and set the diameter limits for the cut at the upper and lower limits of the stand table. Then set the desired proportion to be removed for each species. This removes the same proportion from all diameter classes. To thin from below to a specified diameter, set the lower limit to 0.0, the upper limit to the desired diameter, and the proportion to 100 percent (1.0). This removes all trees below the desired limit. Similarly, one could prescribe a thinning from above.

Shelterwood Cutting

Shelterwood practices may take place over a wide range of stand ages and involve larger numbers of stand entries. Before removing the old stand in a series of cuttings, you should first have some appreciation of the stand composition and density at the times that you might consider partial cuts. To obtain detailed descriptions of the stand at various points in time, select management but set the removal parameters so that no trees are actually removed. This can be done by using the Target Method and setting the residual stem count above the total tree count for each species. Thus, no stems will be removed but a complete stand table will be produced in the output file. You may find it useful to have several such tables so that you can determine the best timing for removals. Since the model does not simulate a specific spatial arrangement of trees, the output will be useful only for estimating a homogeneous spatial application.

Seed-Tree Cutting

For seed-tree removals, select the species and diameter limits for leave trees, and remove all remaining trees by either method, depending on whether you want to leave a prescribed number of seed trees per unit area or a proportion of the original stems within some diameter limits. By setting the target residual stem count low and enclosing the diameter classes to be removed, you can be sure that all trees within the selected range will be removed. With target removals, only those trees within the diameter limits are eligible for removal, but the target residual count includes trees outside the diameter limits. In some instances, it is most efficient to simulate the removal in steps (consecutive years). First remove all trees that are outside the leave-tree diameter range; then thin the remaining stand to the desired leave-tree stocking. When seedlings are well established, remove the seed trees.

Harvesting

For total tree removal, choose proportional thinning and set the diameter limits to 0.0 and the maximum possible diameter, and the proportion to 100 percent (1.0).

Altering Species Composition

Since you specify the method and diameter limits for each species at each cutting, it is simple to remove one or more species. For example, use target thinning to remove a species by setting the diameter lower limit to 0.0 and the upper limit at or above the maximum diameter for that species. Then set the target count to zero (0). To keep another species from being removed, set the target residual above the current stocking or the proportion to be removed to 0.0 for that species.

Regenerating a Site

While prescribed planting is not available in this version, you can select the amount of natural regeneration by altering the maximum regeneration capacity (stems/acre/year) for a species. Setting the random number seed for regeneration (ISEED[1]) to 0 selects the same regeneration (equal to the chosen potential) each year of the simulation.

Direct Control of Gypsy Moth

While direct suppression is only simulated in the full Gypsy Moth Life System Model, the user has full control of the prescribed defoliation scenarios. Prescriptions can reflect the effect of control measures that alter defoliation, and hence the "what if's" of different defoliation episodes and levels of gypsy moth suppression can be investigated, assuming one is willing to provide the effects of suppression on defoliation.

Using the Files System: Saving/ Retrieving a Simulation Design

Now that you have created some input that differ from the defaults, you may want to reuse it later. Before saving data to a disk file, use **Setup** from the main menu and **Edit job description** to open the window that allows you to document your run (changes made to the defaults, the reason for making the simulation, and associated information such as output file names). To this end, a 500-character notepad is part of the setup window. If this information is entered before you make a simulation, it also will be produced at the top of your tabular output, thus cross-referencing your input and associated output. Such internal documentation is not required but is highly recommended. The example input file included at installation provides examples of what has been found to be reasonable background information.

What the Program Recognizes

The program is "smart" enough to know that you have entered an edit window, but <u>the program does not keep track of the values in individual data fields</u>, so it will notify you as you attempt to exit the program (**Quit**) without saving, even if you entered a data-entry window only to view versus alter data. If you have made changes to the data and are not sure that you have saved the most recent changes, you can give the same file name that you provided earlier and replace that file with a more recent revision. If you have saved more than one data file and are not sure whether they are exactly the same, a utility program, `COMPARE.EXE`, will compare any two ASCII text files, line by line, and provide you with the location of each difference or notify you that they are identical.

Saving Data to File

After choosing a file name and adding the background information needed to archive your data, select the **Files** option from the main menu and then the **Save input file** option. You will be asked to supply an eight-character file name. The software checks to be sure a valid DOS file name was entered and then adds the "`.INP`" extension. The use of this standard extension allows the software to search the default directory and provide a list of all the available data files. ***Caution:*** Do not use the `.INP` extension for files that may be confused with saved input data files for the model. The software expects specific formats for these data files and will not operate properly if the data in a file do not conform to expected standards.

Retrieving Data from Disk File

From the **Files** option pull-down menu, you have two choices: (1) If you know the name of a data file, you can use the **Load** and directly enter the eight-character name as requested. ***Do not*** enter the extension; it is understood and will be added by the software before searching the default or working directory for the file; (2) To find a file, use the **Pick** option to request a pick list of all files with the `.INP` extension. Select a file from the pick list that is displayed by highlighting it using [↑] and [↓] and pressing [ENTER] or point and click. If the program cannot locate files with the `.INP` extension in the working directory, the screen shown in Figure 13 will appear.

Resetting Data to Defaults

If you want to start over as if you had just started the program from the DOS prompt, go to the **Files** option pull-down menu and select the **Reload default file.** Doing this will replace all existing data with the defaults.

Running the Model

Once input data and output options have been developed and this information has been backed up to disk, you are ready to initiate a simulation. Select the **Run** option from main menu and press [ENTER] with the **Run Model** pull-down menu showing. You will see a pop-up message box appear with the total length of the simulation noted at the top. It has a status bar that goes from dark to light as each year's simulation is chronicled. Once the simulation is complete, the OK button is activated and clicking it with the mouse or pressing [ENTER] returns control to the main menu.

Output Generated by Model

After a simulation has been run, go to the **Output** pull-down menu. Here you can **View** output that was created and resides in temporary files, view a **Graph** of simulation results, **Print**, or **Save** your output to disk. The software will assist you in management of generated output. Use the **Save** option to permanently archive any output that you created. The stand table is the only output produced by default and consequently *is not* automatically designated for permanent archiving. A list of all output created in the last simulation will be provided when you choose the **Save** output files option. Temporary output files that are not produced by default will be set for permanent archiving automatically. You can change any of the save-file settings. Once you decide which files to save, you are provided with a file-name entry window for

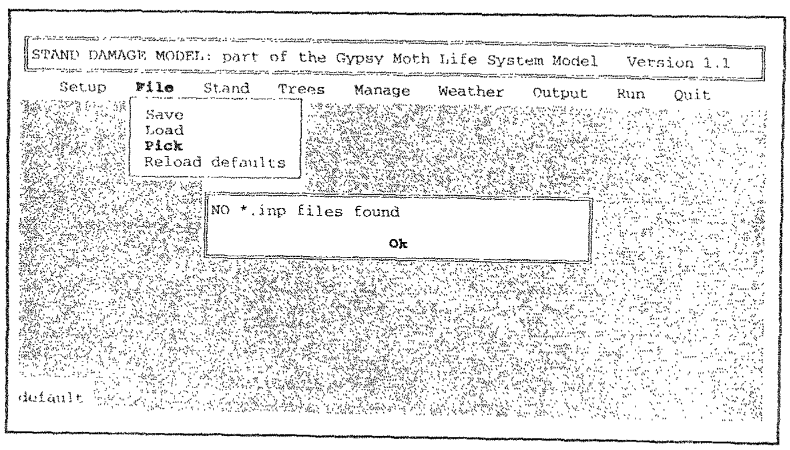


Figure 13. File pull-down menu allows you to save or retrieve data files; the Choose input file option provides a pick list. If none are found in the working directory, this warning appears.

each file that is to be archived. Provide a DOS file name of up to eight characters and, optionally, an extension of three or fewer characters for each disk file.

Tables

All tables are generated similarly but the output control options selected will cause more or less output. First, the setup information is placed at the top of the output file. Next, input parameters that were used to create the simulation (first for the stand, and then for each tree species that was simulated) are written. Included there is information on weather, defoliation, and management options that were designated. Following this is the initial-conditions section, which contains the stand table (stem counts organized by species and diameter class) and the defoliation history for the stand. Next come annual summary statistics for the stand each year or less often if selected (see sections on Output Volume and Reducing Output). Selecting management action causes an additional stand table (stem counts by species and diameter class) to be written following the management action. A final stand table always is presented that describes the final standing crop. The reference section includes a copy of the table generated by the example parameters. Tables created are saved as temporary files for viewing. As you **Quit** the program, temporary files will be deleted from disk unless you have requested that they be saved and provided DOS file names. Access the **Save** option on the **Output** pull-down menu to change the default for saving the table from No to Yes. Upon exit from the window, you will be asked to supply a name for each file that is to be archived. For more control of the size of the tabular output file, set the output interval on the Output Production Control Window to a larger number or zero (0) and select specific years for which you want output produced (see Figure 7).

ASCII Data Files

Data files that are designed for use in other programs can be produced. These are the same data that the program uses to produce the screen graphs following a simulation (see the section that follows). Total stems, basal area, volume, and the quadratic mean diameters can be produced for one of the following categories: overstory trees, understory trees, or all trees. One line of output is produced for each year requested: the year is the first data value, followed by one value for each tree species. By default, these are produced every other year. You can change the output interval (IGYEAR) under **Output Options**. You still have the option not to save the temporary files that are produced.

If you want to use these data in another program, you need to use the **Save** option on the **Output** pull-down menu to select the files to be saved. Upon exiting the selection screen you will be prompted to enter file names for each of the files that you requested be saved.

Graphing Output

You can view output graphically by first selecting **Options** from the **Output** menu to ensure that the appropriate files have been designated (set to Yes) for production during the simulation. Next, run the model (**Run Model** from the **Run** menu). Then select **Graph** from the **Output** menu (see Figure 7A). A pick list of the available graphs is presented. Use [↑] and [↓] to highlight a choice and press [ENTER] or use the mouse to pick the desired output for viewing. Figure 14 is a graph of stem count per acre versus years for red oak (RO) and red maple (RM). Press any key to exit this screen.

Printing Output

You can print output directly from the program. Before running a simulation, select **Options** from the **Output** menu to ensure that the appropriate files will be produced during the simulation. Then run the model (**Run Model** from the **Run** menu). After a simulation has been completed, select **Print** from the **Output** menu (Fig. 15).

Make sure than the printer is turned on, and on-line, and that it is using parallel port LPT1. The software will first check to see that the printer is ready to accept output. If the printer cannot be initialized (as is the case for some laser printers), a warning message will be displayed. You still can send output to the printer by answering yes to the question: "Proceed with Print Job?", but proceed with caution as no further error checking will be done before the file is sent to the printer. If the printer is not functioning properly, proceeding with the print job may abort the program. If you are experiencing difficulty with printing, you may want to save the input file that has generated the output prior to proceeding with printing. If the program is somehow aborted, having saved the input allows you to rerun the simulation after reloading the saved input file. Details on how to recover from a crash are discussed on Page 20 .

Keeping Files Organized

As should be obvious at this point, many distinct simulations can be run in a very short time and a number of output files can be created with each. You can annotate the input file with the names of the output files that are associated with it. Keep files not related to the current analysis in separate directories. The installation instructions provide additional assistance with file management.

Exiting the Program

Using the **Quit** option on the main menu assures that your work is not corrupted. Upon exit, the program examines temporary files that were created to determine whether any need to be saved to disk before it erases the temporary copies. ***Caution:*** If a DOS error message was produced at any point during your session or upon exiting the program, reboot your computer as soon as you **Quit.**

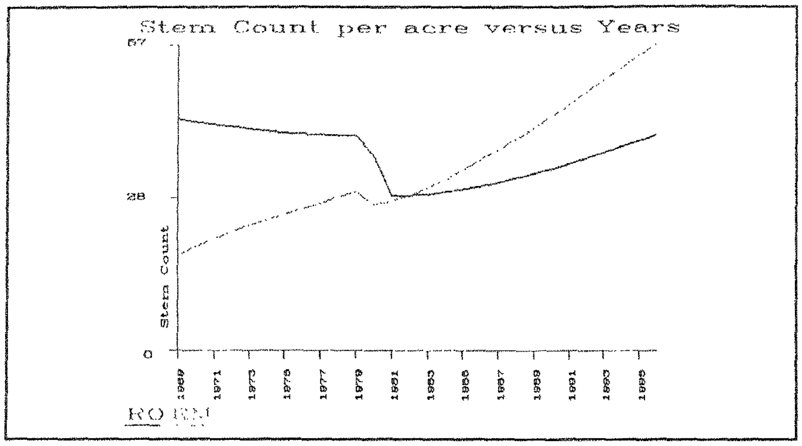


Figure 14. Graphing output: representation of 28-year simulation.

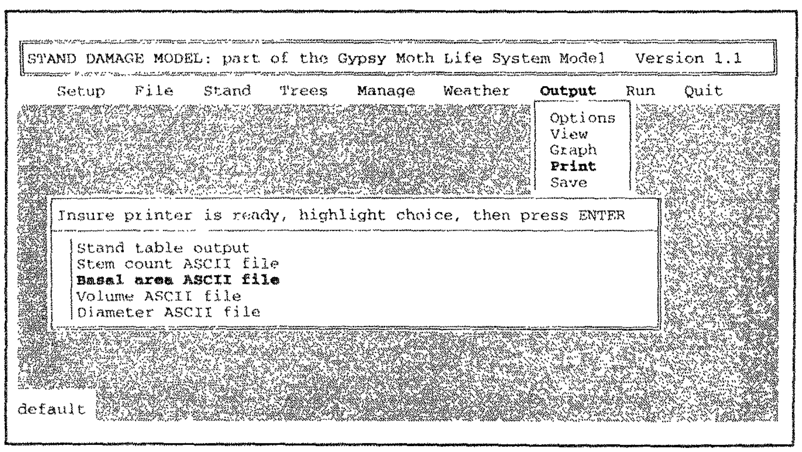


Figure 15. Printing output files.

Exploring the Model

The real power of this software is now at your disposal. Alter any of the parameters and initial conditions for simulations and explore the results. It may take some time to become acquainted with the location of specific data-input fields. We believe that the organization of menu items and the structure of data-entry screens will afford quick access to the parameters and initial conditions for simulating the effects of gypsy moth defoliation on growth and yield. All factors that affect model output are accessible through items on the main menu. Parameters that operate similarly for all tree species are found under the **Stand** item. Species-specific items (including **Defoliation**) are found under the **Trees** item; scheduling and prescription for cutting practices are found under **Manage**; and annual degree-day heat summaries are found under **Weather**.

As you develop specific stands and their parameters to describe the interrelationships of growth, mortality, and regeneration, you will want to save your work and prepare for the next task at hand. To save one set of input data, select a file name for saving the data by using the **Disk File Name** field in the **Setup** data-entry screen (Fig. 16), or by choosing the **Save** option on the **File** pull-down menu (Fig. 13).

If you already have provided a disk file name, the software will write to a file with that name. If you have not yet specified a name, the software will prompt you to supply one. Once you have saved the previous data, you can remove all traces of them and return all parameters to their default values by choosing **Reload default file** on the **File** pull-down menu. You are thus assured that particular changes that were made to the defaults to simulate one stand do not become attached to another stand that you are about to describe.

Retrieve Saved Data

Once you have saved input and output associated with a particular simulation, you can return to previous work, i.e., initiate work starting with data previously saved. Select **Pick** from the **File** pull-down menu. This will provide a list of files with ".INP" extensions in the current (default or working) directory. If you have created a special directory or disks for archiving data files, you must copy them to the working directory before running the model.

Adjusting for Local Conditions

There are a number of factors you may want to consider when initiating a simulation. Figures 8-10 provide variable lists that determine the general trajectory of a simulation. As you review these data, the Help system will direct you to relevant places in the documentation. You can adjust the base growth, mortality, and regeneration rates of the various species, and change the effects of canopy position, stocking, defoliation, and weather on these base rates. You set the initial stocking, defoliation history, defoliation scenario, and management practices that each species will experience during a particular simulation. Rather than attempt to address the majority of the various permutations that you may want to consider, we have provided a single example file that demonstrates use of the documentation to adjust for species composition and base growth rates of trees in a stand. Similar adjustments can be made when mortality or regeneration data are available.

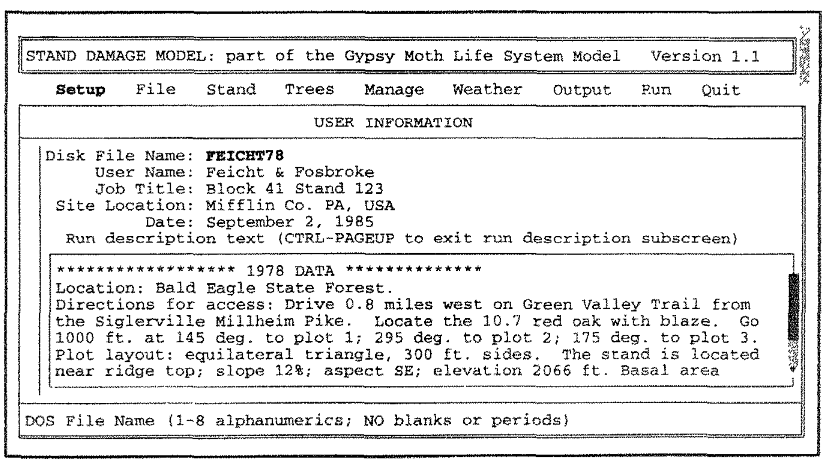


Figure 16. Notepad within the User Information Edit Window showing stand-input data.

Documenting Tools

We have described the process for saving input data and simulation output. Here we describe documentation standards for archiving and maintaining input and output data.

Annotating Input Files

To annotate your input file, select **Setup** from the main menu. There are five data fields and a 500-character notepad (Fig. 14) for documenting the collection of data associated with a simulation. All disk files will have names of your choosing. Use names that contain some common thread (stand number, etc.) and note the names of associated output files in the notepad. Be sure to note the alterations made to the defaults used to generate the input-data set. Initial conditions can be tied to dates of field collections and study numbers or similar records. Since the notes are produced as header information in the stand table, they will link that file to the source data and other output files that are noted there. Because the tabular output will contain all the data and notes in a form organized for reading, the name chosen should reflect the fact that it will be the principle file in any set of files.

Documenting Source Data

The file name, site location, and date fields in the setup window are sufficient to link the disk files to the source-field data sheets and related study information. Use the date field to specify the collection date of data used in the model; this ties the source data to the input and output files.

Documenting Parameter Changes

The most difficult alterations for the model to track are parameter changes. Use the notepad to list model parameter names and tree-species abbreviations (e.g., RO for red oak in Figure 9) associated with the data changes that were made; space permitting, list default along with the altered value. Using this technique allows you to immediately judge both the relative magnitude and direction of all changes made to parameters. Bounds are set to control the range of parameters supplied, but there may be combinations yet unexplored that will not produce reasonable behavior. An incremental process of altering single parameters and testing the effects of that change before continuing with other changes is recommended.

Annotating Output Files

Add the names that you plan to give to output archive files to the notepad. This will link the output generated to the input data and the original field data used to initiate a simulation. Because the ASCII data files will not have a distinguishing title or other internal documentation, noting the names you choose in the notepad will provide a way to trace the source of these data.

Saving Data

When you save input data, the software will not overwrite files with the same name until it first warns you, permitting you to change the proposed file name. But in the case of output files, no confirmation is required. You can choose any name for an output file, using the full eight-character name plus the three-character extension. If the name chosen is one that already exists, the earlier file will be overwritten without a warning. If you have saved the input-data files for particular simulations, you can regenerate the outputs by retrieving the inputs and rerunning the simulations. While not in a readable form, the saved input file will contain all of the notes and documentation needed to create, name, and save permanent output files.

Overwriting a File

It is possible to overwrite an existing input file. Use the ← key or the mouse to change the default "No" answer to the question "Overwrite existing file?" and the program will overwrite the file. When the **Load** or the **Pick** option is used while retrieving a previously saved file, the software will first check to see if any edit windows have been accessed since the last save. If it finds that one has, it will suggest that you consider saving the input data prior to overwriting it by loading another input file. The software is not so conservative when saving output files. The assumption is that output files can be reproduced readily from input files.

Program Crash

If you find that the computer locks up or the program stops in the middle of a simulation, the work that you were doing is not completely lost. Find your way to the `DOS` prompt and look for the file `CRASHED.INP` in the working directory for the model (the directory containing `DAMAGE.EXE`). Then use the `DOS` copy command to make a copy of that file with the name that you would have chosen to save the input data. Remember to use the standard model input-data file extension "`.INP`" so that it can be read into the control system later. Start the program again by typing `DAMAGE` at the `DOS` prompt and immediately retrieve the `CRASHED.INP` file. Note that ***this file will be erased*** the next time that you **Run** the model (activate the **Run Model** option). If you do not copy the file before you start the program, use the **Save** option on the **File** pull-down menu to save the data ***but be sure to use another file name.***

Trouble Reports and Suggestions

We are interested to hear about the problems that you find with the model or the control system. To report problems, use the guidelines that follow. We also are interested in your suggestions for improving or enhancing the model. First, describe the point in the program where the problem arose. We need to know the screen or window that was active at the time the problem occurred. If the model was executing, retrieve the `CRASHED.INP` file. This file will allow us to reproduce the problem under a controlled, `DEBUG` environment, where we can pinpoint the cause of the problem. If the system or the program leaves a diagnostic or Error message on your screen, be sure to jot that down as well.

We need to know exactly what you were attempting to do. Was this the first time that you ran the model after starting it from the DOS prompt? How were you accessing the model, i.e., were you running through a graphical user interface or a multitasking environment manager? Did you have a memory manager, file manager, or other software in memory or active at the time? Did you have any other terminate-and-stay-resident (TSR) programs loaded into memory at the time of the problem? Programs like Xtree, Sidekick, or Norton Commander should be noted. What version of DOS were you operating? Have you had similar problems with other software packages?

Next, print a copy of your `AUTOEXEC.BAT` and `CONFIG.SYS` files and have them available if you call, or send them along with the other material as part of your trouble report. To submit trouble reports or suggestions or if you have other questions or comments regarding the program, contact:

USDA Forest Service, NEFES-4557
180 Canfield St.
Morgantown WV 26505-3101
(304)285-1600 FAX: (304)285-1505

Be sure to include your name, phone number, and address so that we can contact you if we have additional questions or send you the results of our investigations. If you notify us by FAX, include both your FAX number and voice number.

We are interested in hearing from users regarding suggestions for improving the model and control system. We also would appreciate knowing how to contact you, if necessary, for additional details so that we can implement your suggestions.

Input and Default Data

All initial conditions and a large number of parameters are available to the user upon executing the program. The initial default values for these are held in files that are described in detail in General Technical Report NE-209 (Racin and Colbert 1995). Here we describe the menu selections, windows, and data as they appear in the various data-edit screens, starting with the **Setup** option and working across the main menu bar. Figure 17 is a structure chart for the various menu items and associated selection or edit windows. Following the descriptions associated with menu choices are sections detailing the outputs that the model can generate. The tables, figures, and equations referenced under descriptions associated with data fields within Edit windows are in General Technical Report NE-208 (Colbert and Sheehan 1995). When the primary action associated with a menu selection is not data-edit related, descriptive text follows the section heading; for edit windows, each edit field is described in a display table that includes the variable name, description, range, and default value for the variable. Variables are arranged in the display tables in the same order that their corresponding edit fields appear in the windows. The variables used in the model proper (the FORTRAN code) are in capital letters while those that are used only to carry information from the user interface to output files are in lower case.

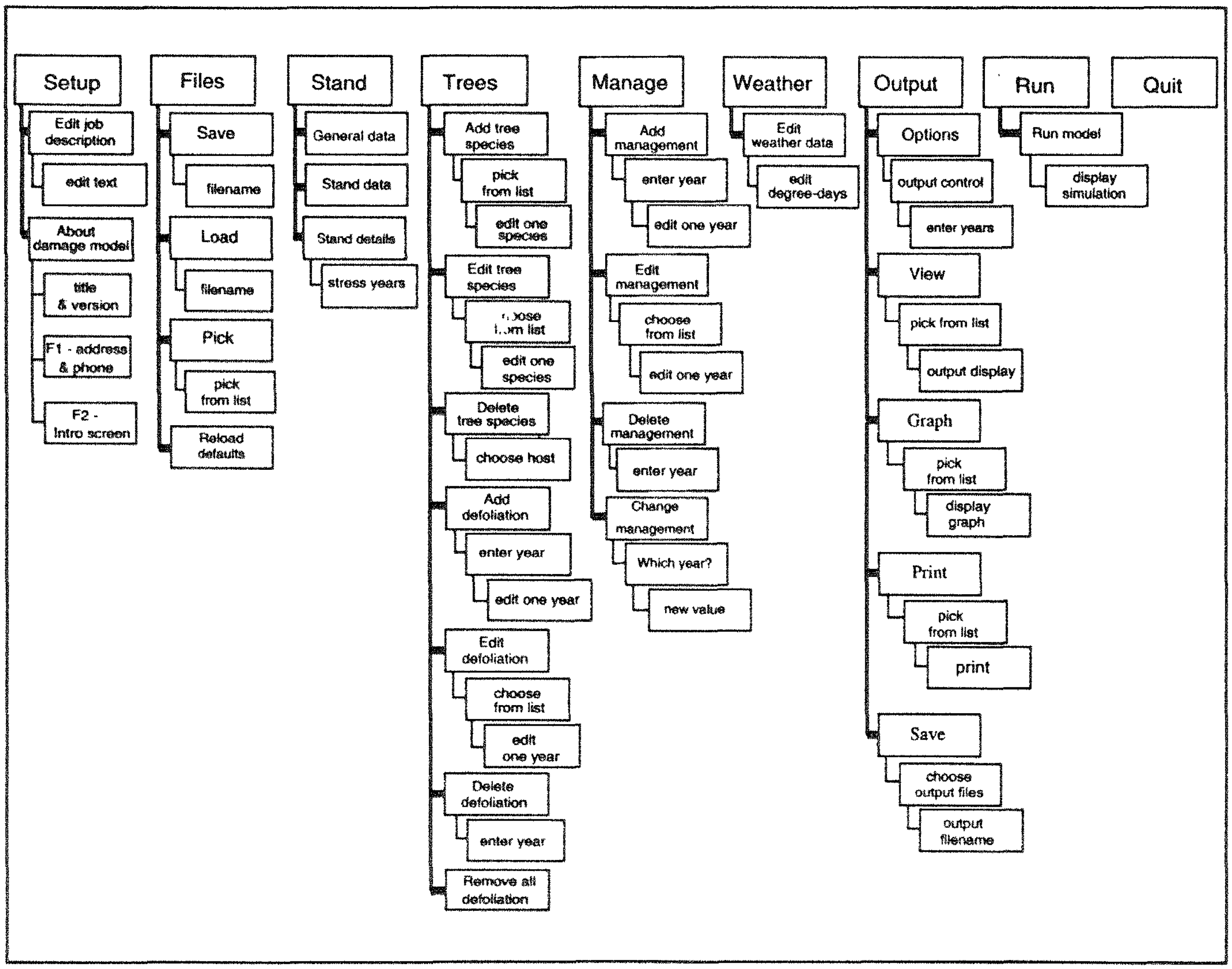


Figure 17. Structure of the menus and subordinate screens and windows.

Data-entry fields require specific formats. When the range of valid entries is described withthe letter "i," only integer values are accepted; when the range is described with the letter "x," decimal fractions are accepted; otherwise, only the optional values specified are accepted. ***Warning:*** the software will not allow you to exit a field with invalid data. If no response is obtained or you get a beep in response to a keystroke, an invalid entry has been made. This sometimes requires the removal of invalid digits or characters. If the entry-field window is filled, the software will not accept keystroke input. Use the [DEL] or backspace key to remove unwanted entries before keying in new values. If you are not sure what entries are valid, use [F1] to activate the Help system for the item you are editing. This will also refresh the prompt line at the bottom of the active window. The various key combinations that will assist you in navigating among menu items, selection screens, and edit windows are found on pages 4-7.

Setup

This provides a means to annotate work and associated archived data files. There also are means to access support and general background information.

Edit Job Description

The **Edit job description** item under the **Setup** pull-down menu brings the User Information Window (Fig. 16) that provides the resources to document your use of the model and maintain records of the data you bring to the model and the changes you make to the defaults.

User Information Window

Data field	Description, comments	Range (default value)
file	File name (up to 8 characters).	
name	User supplied Name (20 characters).	'name'
job	User supplied Job title (20 characters).	'job'
site	User supplied Site name (20 characters).	'site'
date	User supplied Date (20 characters).	'date'
notepad	This will hold up to 500 characters; you are free to use it as you see fit. Information placed here will be saved with other input data and be reproduced as part of the tabular output.	

About Damage Model

Here you can access the model version number, release date, address for source and update information, or the general background information window that appears upon initial execution of the program.

File

Here you will find **File** options are for saving model input data; loading data files saved previously, either by supplying the DOS file name (**Load** option) or from a pick list (**Pick** option); or reloading the default parameters and initial conditions for the model. By selecting the **Save** option on the pull-down menu, you are prompted to enter an 8-character DOS file name. The software adds the file extension "`.INP`" after checking to be sure that the input is valid.

Stand

All general and stand-wide parameters are found through menu choices off this item. **General data** option provides access to data that are not specific to the stand; the **Stand data** option provides access to most frequently edited data; **Stand details** provides access to the remaining data that have stand-wide effects.

General Data

The **General data** option opens a window containing six data fields.

General Data Edit Window

Data field	Description, comments	Range (default value)
ISYEAR	Calendar year to label start of simulation and variable to increment current year through the simulation.	positive integers (i≥1) (1979)
NYEARS	No. of years to simulate.	1≤i≤100; (5)
ISEED(I)	Random number generator seeds, for:	0 < i < 8192
	1. Establishing new trees;	(2653)
	2. Calculating stress mortality of trees.	(3745)
TFAC	Heat units input scaling factor, 1.0 means no change, 0.9 means a 10% reduction.	0.1≤x≤10.0 (1.0)
UNITS	Measurement units conversion switch that permits the user to work in English or metric units of measure.	METRIC/(ENGLISH)

Stand Data

These stand-wide data (Fig. 8) are most frequently revised as new stands are introduced to the model.

Stand Data Edit Window

Data field	Description, comments	Range (default value)
ISITE	Site moisture index: 1 = wet, 2 = medium, 3 = dry.	1,(2),3
PLOTAR	Total fixed area of plots used to estimate stocking for stand. Units may be either acres or hectares, depending upon UNITS.	x≥0.01 (1.0)
STNDAR	Area of the stand being simulated.	x≥0.01, (1.0)
IBOUND	Overstory/understory boundary type: either tree height (1) or diameter (2) can be used in the decision of assignment of trees.	tree height or (tree diameter)
DLENBASE	Base diameter class width. All classes have the same width; the smallest is [0.0,DLENBASE]; for integer n, class midpoints are n*DLENBASE - DLENBASE/2.0	2.0≤x≤4.0 (2.0)

Stand Details

The majority of the data here need not be manipulated by most users. The first parameter, HOVER, will be of interest to anyone needing to alter the overstory-understory boundary. For those interested in manipulating the details of the ecological processes being modeled, this window provides access to all stand-wide parameters. The tables, figures, and equations referenced under descriptions associated with data fields within Edit windows are in General Technical Report NE-208 (Colbert and Sheehan 1995).

Stand Details Edit Window

Data field	Description, comments	Range (default value)
HOVER	Boundary tree height (feet or m; IBOUND = 1); or boundary diameter (DBH in inches or cm; IBOUND = 2).	$x>0.0$ (5.0)
TLIGHT	Annual insolation factor, eqn. 10.	$0.0 \le x \le <1.0$, (1.0)
TKL	Exponential decay rate in eqn. 10.	$0.0 \le x \le 1.0$ (0.0002)
SHX(I,J)	I=1-6, J=1-4: ALIGHT values determining the effect of available light on diameter growth; x coordinates for Fig. 4. line segments; by shade-tolerance class, I (across), and x coordinate, J (down).	$0.0 \le x \le 1.0$
SHY(I,J)	I=1-6, J=1-4: shade index values for effect of light on diameter growth; y coordinates for Fig. 4. line segments; by shade-tolerance class, I (across), and y coordinate, J (down).	$0.0 \le x \le 1.0$
PLOTSZ	Size of the area to be used in calculating the influence of surrounding trees on shading of a given tree (acres or hectares).	$x>0.0$ (0.2000)
SHADMN	Minimum value for SHADE in eqn. 16.	$0.0 \le x \le 1.0$, (0.05)
TEMPMN	Minimum value for temperature effect on diameter growth. See eqn. 16 and Fig. 4.	$0.0 \le x \le 1.0$, (0.05)
CRWDMN	Minimum value for CROWD in eqn. 12.	$0.0 \le x \le 1.0$, (0.75)
DFOLDE	Slope of the defoliation effect curve and the maximum proportional decrease in this year's foliage production (at 100% defoliation) due to last year's defoliation (DEFL(IH,IS)) in TREE1.	$0.0 \le x \le 1.0$, (0.15)
DFLC(I,J)	J=1,2;I=1,2: Coefficients for eqn. 13 (light) and eqn. 14 (heavy) for predicting DEFIND (eqn. 16), the effect of current defoliation on diameter growth.	A. intercept: $0.8 \le x \le 1.0$ A. slope: $-0.008 \le x \le 0.0$ B. intercept: $1.0 \le x \le 5.0$ B. slope: $0.0 \le x \le 1.0$
STOCKS(I,J)	J=1,2,3;I=1,2,3: stocking-class parameters, 3 per quadratic (J), 3 stocking classes (I), species specific (J= ISTOKG(IH)).	
RSMULT	Effect of relative stocking on tree crowding index, see eqn. 12.	$0.0 \le x \le 1.0$ (0.0025)
STOKX(I,J)	I=ISHADE(IH,2), shade-tolerance class for recruitment; I = 1,...,6; J = interpolation points (see STOKY), J = 1,...,4; x coordinate for relative stocking effect on recruitment. See Figure 10 and Table 2.	$0.0 \le x \le 120.0$
STOKY(I,J)	I=ISHADE(IH,2), shade-tolerance class for recruitment; I = 1,...,6. J=interpolation points (see STOKX) J=1,...,4; y coordinate for relative stocking effect on recruitment. See Figure 10 and Table 2.	$0.0 \le x \le 1.0$
EPSIGR	Test parameter to skip diameter growth. When stem count for a cell is less than EPSIGR, growth calculation is not performed. See subroutine TREE22.FOR.	$0.0 \le x \le 0.01$ (0.0)

Continued

Stand Details Edit Window (Con't)

Data field	Description, comments	Range (default value)
EPSITR	Test parameter to skip transfer between diameter class cells when stem count is very small. When stem count for a cell is less than EPSITR, no transfer is made to the next larger cell for that species. See subroutine TREE22.FOR.	$0.0 \le x \le 0.01$ (0.0)
EPSIMG(I)	Parameters for control exclusion of cells with small stem counts in tree removal calculations. I = 1, 2, or 3. See FORTRAN subroutine TREE22.FOR documentation for more detail.	(0.0, 0.0, 0.0)
PRTMIN	Test parameter to suppress including cells with small stem counts in output table (default: all cells are reported).	(0.0)
SGMORT	Effect years of slow growth (NSLOW) will have on tree mortality rate. Exponential rate coefficient for calculating GDIE, eqn. 18.	$-0.5 \le x \le 0.0$ (-0.084)
STRFAC(I)	1: Non-stress mortality factor; 2: Stress-induced mortality factor, see SDIE, eqn. 19.	$0.0 \le x \le 1.0$ (0.0, 0.15)
STRESS(I)	Probability that additional stress will occur by site index, I = 1-3. Note: variable ISITE determines which is active.	(0.0, 0.0, 0.0)
ISOPT	Stress option, 0 for no stress, 1 for random stress, 2 for designated years (see ISTR(I)).	(0), 1, 2

When stress option 2 is chosen (ISOPT), an additional subordinate window opens as you exit this edit window. It contains a list of the years to be simulated, permitting you to select the years in which stress mortality should be applied. Selections are made using the [↑] and [↓] to highlight and the [SPACE] to select or by pointing and clicking with the mouse. The variable STRFAC, in the previous window, sets the rate.

Stress Year Selection Window

Data field	Description, comments	Range (default value)
ISTR(I)	Years selected are shown with a checkmark.	All simulation years (none)

Trees

With the **Trees** option (Fig. 9), one can add, delete, and edit tree-species specific data, including the initial conditions, history, and parameters; describe, edit, or delete strata and species-specific defoliation for individual years.

Add Tree Species

When **Add tree species** is selected, a pick list of the available species is provided for the user to select from. The final entry in this list is a user-defined set of parameters that will allow you to create your own species when none of the other existing choices is suitable. It is possible to have the same species in a stand twice, altering the parameters for each "population" to differentiate their distinct characteristics. Once a species has been selected, the tree species-specific data edit window is automatically opened for that species to allow entry of stocking and history data. This window also contains all the specific parameters for the selected species.

Edit Tree Species

When **Edit tree species** is selected, a selection list is presented to the user so that those species that need review or editing can be selected. Once choices have been made and the selection list window is exited, species-specific edit windows fill the computer monitor sequentially, one for each selected species. All data here are tree species-specific but where data are indexed by more than just tree species (IH), the host tree and other indexes are shown explicitly.

Tree Species-Specific Data Edit Window

Data field	Description, comments	Range (default value)
STEMS(IH,ID)	Stem count by diameter class, the program assumes that ALL stems in the stand are included, ID = 1-20.	(0.0)
IDHIST(IH,J,K)	J=1,2,3;K=1,2; defoliation history classifications; Strata: J = 1, overstory; J = 2, understory; J = 3, shrub/ground. Year: K = 1, last yr; K=2, two yr old. Values correspond to: O = None; 1 = 1-30%; 2 = 31-65%; 3 = 66-100%	(0)
AGEMAX	Maximum age for this species, see eqn. 17 and Table 3.	x>0
HMAX	Maximum height for this species, see eqn. 15 and Table 3.	x>0.0
DMAX	Maximum diameter for this species, see eqn. 15 and Table 3.	x>0.0
GROWR	Base diameter growth rate for eqn. 15 derived from D/D_{max}=2/3 when Age/Age_{max}=1/2.	
SLOWD	Minimal diameter growth to avoid additional mortality, see eqn. 18.	x≥0.0, (0.10)
COLD	Minimum accumulated degree-days expected for the range of this species.	x≥0.0
HOT	Maximum degree-days accumulated expected for the range of this species.	x≥COLD
ISTOKG	Relative stocking class, see Table 2.	1, 2, 3
ISHADE(IH,1)	Recruitment shade-tolerance index, see Table 2 for values.	1≤x≤6
ISHADE(IH,2)	Diameter-growth shade-tolerance index, see Table 2 for values.	1≤x≤6
RECRUT	Maximum number of stems recruited per year, see Table 4.	x≥0
SURFAR	Biomass to surface-area conversion factor, see Table 4.	x>0.0
FDIE(IH,J,K)	J=1,2,3;K=1,2,3; proportion of trees growing on site type K that die following J consecutive years of heavy defoliation (> 65%).	x≥0

Delete Tree Species

When **Delete tree species** is chosen, a numbered list of the currently included species is presented. If the default value (0) is changed to one of the numbers to the left of the code and common name, a confirmation screen is presented showing the common name of the selected species. The default response to the message is "No," requiring you to select "Yes" to activate the delete.

Add Defoliation Year

Requesting **Add defoliation year** (Fig. 11) produces a single-field data entry window and the range for selecting a year to schedule defoliation. Only calendar years within the range of the simulation are permitted as valid entries. If a year is entered for which defoliation already is scheduled, the program provides a warning that the chosen value is a duplicate and returns the user to the pull-down menu.

Defoliation Date Entry Window

Data field	Description, comments	Range (default value)
IDFOLY	Year of defoliation event.	(1979)

When a valid entry is provided, the program opens the defoliation data edit window for that year. See the **Edit defoliation data** section for a description of that window.

Edit Defoliation Data

When **Edit defoliation data** is selected off the **Stand** pull-down menu, the user is presented with a selection screen displaying all the years for which defoliation already has been scheduled. Once choices have been indicated, the defoliation data edit window is opened for selected years. One data-edit field is provided for overstory and another for understory defoliation percentages on each line, one line for each tree species.

Defoliation Data Edit Window

Data field	Description, comments	Range (default value)
DEFL(IH,1)	Overstory defoliation for each tree species.	$0.0 \leq x \leq 100.0$, (0.0)
DEFL(IH,2)	Understory defoliation for each tree species.	$0.0 \leq x \leq 100.0$, (0.0)

Delete Defoliation Year

A list of the calendar years for which defoliation is implemented is displayed. After keying in a year that is in the list, a user is presented with a confirmation prompt. The default setting here is not to delete the defoliation record and the user must confirm the deletion by selecting "Yes." This removes all defoliation data for the corresponding year.

Remove All Defoliation

As with an individual year, removal of all defoliation data records requires both selecting the menu option and confirming the deletion. This removes all data for all years.

Management

The **Management** pull-down menu (Fig. 12) is similar to the **Tree** pull-down menu in that there are add, edit, and delete options. There also is a **Change management year** option.

Add Management Year

Similar to adding defoliation data, the user is provided the current range of simulation years and asked to supply a calendar year (MYEARS). The user also must supply the management tree-selection criteria (MANAGE) to be simulated. The initial value here is "0" and must be actively changed to one of the two valid types.

Management Selection Edit Window

Data field	Description, comments	Range (default value)
MYEARS[1]	Calendar year for a management action.	ISYEAR≤ i ≤ISYEAR+ NYEARS
MANAGE[1]	Management type: 1 = proportion of stems; 2 = target residual stem count.	1,2

Edit Management Data

Similar to editing defoliation data, a selection screen is first presented, permitting users to select any number of currently active years from the list. Once selections are made, the management prescription edit window is open for each year. This provides access to the diameter range (min. and max.) and management parameter (residual tree count or the proportion to be removed, depending on the criteria selected previously) data-edit fields for each species.

Management Prescription Edit Window

Data field	Description, comments	Range (default value)
CUTMIN(IH)	Minimum diameter (inches or cm) of species IH to be removed.	0 ≤ x, (2.0)
CUTMAX(IH)	Maximum diameter (inches or cm) of species IH to be removed.	0 ≤ x, (20.0)
PCUT/ TARGET(IH)	Depending on the value of MANAGE, this is either the proportion to cut, PCUT, or the residual per acre stem count, TARGET, following the removal.	(0.50) 0.0≤ x ≤1.0 (50.0) 0.0 ≤ x

Delete Management Year

A window is presented containing a list of calendar years for which management actions have been defined. When a valid year is entered, a confirmation screen is presented for active confirmation.

Change Management Year

When management already has been defined for some year(s), one can move the prescribed actions to another year by first selecting the desired year to change. Point and click on the desired year or highlight the year using [↑] and [↓]; then press [ENTER] to make the selection. The prescription for that year will then be presented along with a pick list of the open years. Only the scheduled year is changed in this process.

Weather

When **Edit weather data** is selected (Fig. 10), an edit window is presented with the current value of accumulated degree-days for each year. As the simulation start date or the length of the simulation is altered, this window will be re-indexed according to the new start year and shrink or grow depending on the change in the length of the simulation.

Weather Data Edit Window

Data field	Description, comments	Range (default value)
ANNDD(I)	Annual degree-days above 42°F accumulating from the first day of the year. I between 1 and 5 in the default simulation of 5 years; varies with the length of a simulation.	(4570.0)

Output

Under the output pull-down menu (Fig. 7) the user can both design the output that should be produced as a simulation takes place and view the generated output in tabular and graphic format. Information that was generated also can be printed or saved.

Options

Tables, graphic, and simple data files can be designed and requested through the output options edit window. Besides selecting specific output, you choose the frequency with which the annual summary data is written to the table or file.

Output Options Edit Window

Data field	Description, comments	Range (default value)
IPYEAR	Output interval for stand table; a value of zero (0) indicates that IVIEW, described below, will be loaded with desired output years by the user.	$i \geq 0$
STABLE[1]	Yes if stand table is to be produced.	(Yes)/ No
IGYEAR	Interval (years) between printing output to ASCII data files; these data are used for generating graphs and may be saved for external use.	$i > 0$ (2)
ICAT	Output summary category: 1 = overstory only, 2 = understory only, 3 = all trees.	(1), 2, 3
TGSTEM	Yes if stem count file is to be generated.	(No)/Yes
TGBA	Yes if basal area file is to be generated.	(No)/Yes
TGVOL	Yes if volume file is to be generated.	(No)/Yes
TGDBH	Yes if diameter file is to be generated.	(No)/Yes
DEBUG	Yes if debug output is desired.	(No)/Yes

[1] Answers to the 6 Yes/No questions in this window are passed to the model as boolean (True/False) variables.

If tabular output is becoming too voluminous, set output interval (IPYEAR) to zero and specify specific years (IVIEW(I)) to generate output.

Tabular Output Interval Subwindow

Data field	Description, comments	Range (default value)
IVIEW(I)	Specific years that stand summaries are to be produced in the output.	Calendar years within range of simulation

View

A pick list of available output is generated and a selection produces a scrollable view window of the selected output. Use of [ESC] or a mouse click outside such a window exits the window.

Graph

A pick list of available output is generated and a selection produces a screen graph of the generated data. If no temporary output files are present for use in generating a graph, a warning message indicates that the output must be requested prior to running a simulation. The striking of any key or a mouse click exits the graph window.

Print

A pick list of available output is generated and following a selection, the program checks the normal printer port (LPT1). If it detects a printer ready to accept output, it sends the selected document to the printer. If it is not able to detect a ready printer, it allows the user to continue with transmission to LPT1 upon confirmation. Programs such as this often are unable to ascertain the status of laser printers, so do not be alarmed if this confirmation prompt is present and the printer is on line and ready to accept output.

Save

The defaults for printing output files are just the opposite of those for generating output. Only output that always is generated by default is not defaulted for archiving. Upon selection of the Save option, the user is presented with the save-file setting edit window. The contents of this window depend on the outputs generated, one save-file setting for each file that was generated during the simulation. If a Save is attempted before a simulation has been made to generate output, the program prompts the user to first generate the output by running a simulation.

Run Model

This selection turns control over to the model proper for generating the simulation. A pop-up box is activated that contains the simulation length at the top, a status bar that changes shade as the simulation progresses, and a line that chronicles each year being processed. Upon completion of the simulation, click the OK button or press [ENTER] to return control to the menu portion of the model program.

Quit

If no unsaved input or output files are present, the user is returned directly to the DOS prompt; otherwise, warnings are presented that suggest that input data or temporary output files will be lost unless file archive actions are performed. Following responses to the file-save questions, the user is returned to the DOS prompt.

Information Generated

Tables, graphs, or ASCII data files can be generated during a simulation. In the following sections we describe the format of these and provide directions for use in structuring your output.

Tables

The standard output tables are all contained in one compound table (multiple pages in a single temporary file.) Following is a copy of the output file derived from the example input file (EXAMPLE.INP). Output is broken by several end-of-page breaks, inserted by the software, to assist in the review of the material. Part 1 (top page 34) contains a printed copy of the material that was supplied in the **Edit job description** window under the **Setup** main pull-down menu. Part 2 (middle page 34) provides a complete listing of the parameters that were used to generate the simulation so that these data will be available to review along with simulation results. Part 3 (bottom page 34) is a description of the initial stand, as supplied by the user. It is presented in two parts; first is a stand table, a rectangular array of stem counts per acre organized by diameter classes and tree species. The columns are headed by the midpoint diameter of each class. Rows are indexed by the species two-character mnemonic code. Second, defoliation history supplied by the user is classified as none (0), light (1), moderate (2), or heavy (3) for overstory and understory trees of each species.

Next comes the simulation results. Part 4 (page 35) is the summary information that is user controlled. The variable IPYEAR, is set by the user in the **Options** window under the **Output** pull-down off the main menu. It allows you to decide the number of years between writing these outputs; if set to zero (0), an additional edit window appears to provide a means for entering up to 20 specific years to be written during a simulation (Fig. 7). Calendar years can be entered in any order. The list will be sorted into ascending order, automatically. EXAMPLE.INP produces five pages, printing a summary for every other year, 1978-1990 (IPYEAR = 2). Two pages of annual summary data are produced in this example.

For each year of requested output, the year and annual degree-day heat units are used as a banner for the data given by species and strata (overstory or understory) as a single line in the table. First appears the user-supplied percent defoliation. The defoliation one chooses to simulate will alter the growth and mortality and hence be reflected in the regeneration. Next, the trees are summarized by basal area, stem count, quadratic mean diameter, and whole-tree volumes. Next, if the user has chosen to supply a particular management prescription that year, the resulting yields are presented. Management will affect the growth and mortality variables and also cause additional output to be provided. Each time management is requested, a stand table (stem counts by diameter and species) will be produced prior to and following the removal so that users can see the effects of the actions that they prescribe. Next, total foliage biomass (potential food for the gypsy moth) is presented, followed by tree growth statistics. Actual growth is the average of annual diameter increments for all trees in the class while potential growth is the average of maximum possible growth for these trees. The modifiers are the current values of multiplicative factors used to adjust potential growth down to actual growth (gypsy moth, temperature, stand density, and shade). Finally, mortality is presented as a percent of total stems in the class, followed by the subdivision of that total into the four factors composing it (base rate, slow growth, random stress, and gypsy moth).

The final output, another stand table, presents the stand at termination of the simulation, showing the final stem counts for all trees (stem/acre) by species and diameter class. Requesting stand management will also automatically cause this stand table to be placed in the output describing the stand just prior to and just after the tree removal has taken place.

The following two pages of this manual contain the five pages of output generated during the example simulation. Horizontal lines indicate page breaks in printed copy.

*** User supplied input/output information ***

Input Data File Name: EXAMPLE.INP
User Name: Feicht & Fosbroke
Job Name: Block 41 Stand 123
Site Name: Mifflin Co. PA, USA
Date: September 2, 1978

User notes supplied through the Setup-Edit Job Description

Stand Output Table: EXAMPLE.TBL; printed every other year.
Other outputs: printed every year for all trees (category 3), Stem count, Basal area, & Volume; these output files not saved
Parameter changes: Sample Plot area = 0.3 ac.; Stand area = 2.4 ac.
Start year: 1978, Duration = 13 years.
Sampled Basal area: approximately 60% oak and 20% red maple
Defoliation years: 1981, 1986

DAMAGE MODEL VERSION 1.1: PARAMETER VALUES

No. of Years to be Simulated: 13
First Year of Simulation: 1978
Output to be produced Every 2 Years

UNITS: ENGLISH
Stand Area: 2.4 AC
Total Sample Plot area: .3 AC
Site moisture Index: 3

RANDOM NUMBER SEEDS --
Stem Recruitment: 2653
Add. Tree Mort. due to Stress: 3745

Defoliation data will be read from file: DEFOLDAT.D1S

OVERSTORY / UNDERSTORY BOUNDARY (BASED ON DIAMETER): 5.00 (IN)

SHADING PARAMETERS: TLIGHT= 1.0 TKL= .00020 SHADMN= .05 PLOT SIZE FOR SHADING= .0200 AC

EFFECT OF AVAIL. LIGHT ON DIAM. GROWTH, BY TOLERANCE CLASSES (PROP. AVAIL. LIGHT, PROP. OF POT. GROWTH):

TOL. CLASS:	1	2	3	4	5	6
	.00, .10	.00, .20	.00, .30	.00, .40	.00, .40	.00, .20
	.31, .15	.34, .25	.37, .35	.40, .45	.40, .45	.34, .25
	.80, .95	.75, .85	.70, .75	.65, .65	.80, .95	.80, .95
	1.00, 1.00	1.00, .90	1.00, .80	1.00, .70	1.00, 1.00	1.00, 1.00

MULTIPLIER FOR EFFECT OF RELATIVE STOCKING ON DIAMETER GROWTH: .0025
EFFECT OF REL. STOCKING ON RECRUITMENT, BY TOLERANCE CLASSES (REL. STOCKING, PROP. OF POT. RECRUIT.):

TOL. CLASS:	1	2	3	4	5	6
	0., 1.00	0., 1.00	0., 1.00	0., 1.00	0., 1.00	0., .00
	30., 1.00	35., 1.00	40., 1.00	45., 1.00	30., 1.00	0., .00
	50., .05	70., .05	80., .05	90., .05	90., .05	0., .00
	120., .05	120., .05	120., .05	120., .05	120., .05	0., .00

No additional stress included (ISOPT = 0).

ADDITIONAL MORTALITY IN YEARS WITH NO STRESS: .00, IN YEARS WITH STRESS: .15

13 Years of weather summary data, accumulated degree-days for each year in data file: ANNDDSUM.D1S
Tree Threshold Temperature: 42.0 Temperature Multiplier: 1.0 Minimum Value for variable TEMP: .05

PARAMETERS THAT VARY WITH TREE SPECIES --

SPECIES CODE:	RM	RO	CO
Relative Stocking Class	2	2	3
Recruitment Tolerance Class	5	2	2
Diam. Growth Tolerance Class	5	6	2
Maximum Diam. (IN)	24.	36.	24.
Maximum Height (FT)	70.	80.	60.
Maximum Age (Years)	250.	250.	250.
Minimum Annual Day-Deg.s	1810.	731.	3686.
Maximum Annual Day-Deg.s	13395.	8499.	7756.
Diam. Growth Parameter	194.4	121.5	83.3
Height Parameter B1	65.51	50.62	55.51
Height Parameter B2	.5373	.2783	.4553
Foliage Biomass Param. F1	.00812	.02622	.02622
Foliage Biomass Param. F2	2.0150	1.7752	1.7752
Surface Area::Biomass Ratio	205 0	104.0	143.0
Max. Annual Tree Recruitment	50.	30.	30.
Bole Resting Sites / sq. ft.	.0929	.4645	.0929
Crown Resting Sites / sq. ft.	.9290	4.6450	9.2900
Live Crown Ratio Parameters 1:	4.35	4.20	4.49
2:	.0046	.0010	.0020
3:	1.82	2.76	1.21
4:	.274	.025	.065
Add. Mort. When Growth Slowed	.010	.010	.010
Base mortality rate	.01600	.01600	.01600

Tree Mortality Rates Following Heavy Defoliation:

	YEARS OF HEAVY DEFOL.		
SPECIES	1	2	3
RM	.10	.20	.35
RO	.10	.20	.35
CO	.10	.20	.35

No Stand Treatments Scheduled

DAMAGE MODEL VERSION 1.1: INITIAL CONDITIONS

NUMBER OF STEMS PER AC:

	DIAMETER CLASS (IN)																			
SPECIES	1.0	3.0	5.0	7.0	9.0	11.0	13.0	15.0	17.0	19.0	21.0	23.0	25.0	27.0	29.0	31.0	33.0	35.0	37.0	39.0
RM	.00	76.67	10.00	6.67	3.33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
RO	.00	3.33	6.67	10.00	13.33	13.33	3.33	6.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
CO	.00	6.67	10.00	20.00	16.67	3.33	6.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

DEFOLIATION HISTORY:	RM		RO		CO	
	OVER	UNDER	OVER	UNDER	OVER	UNDER
% Defol. 1 Year Ago:	0	0	0	0	0	0
% Defol. 2 Years Ago:	0	0	0	0	0	0

SPEC	STRAT	% DEFOL	BASAL AREA (FT2/AC)	NUMBER STEMS (AC)	MEAN DBH (IN)	VOLUME (FT3/AC)	YIELD (FT3/AC)	FOLIAGE (LB/AC)	ACTUAL GROWTH (IN)	POTEN. GROWTH (IN)	MODIFIERS OF GROWTH: GYPSY MOTH	TEMP	STAND DENS.	SHADE	TOTAL % MORT.	SOURCES OF MORTALITY: BASE % MORT.	SLOW GR. MORT.	RAND. STRESS MORT.	GYPSY MOTH MORT.
End of Year: 1978								Accumulated day-degrees for year: 4570.0											
RM	OVER	0.	6.0	27.8	7.5	73.3	.0	252.2	.232	.368	1.000	.726	.874	.992	1.6	1.6	.0	.0	.0
RM	UNDER	0.	3.4	83.7	2.9	22.2	.0	203.0	.215	.342	1.000	.726	.874	.990	1.6	1.6	.0	.0	.0
RO	OVER	0.	30.7	52.9	10.4	462.2	.0	2365.2	.261	.300	1.000	1.000	.874	.995	1.6	1.6	.0	.0	.0
RO	UNDER	0.	.2	6.4	3.0	.8	.0	17.5	.227	.262	1.000	1.000	.874	.989	1.6	1.6	.0	.0	.0
CO	OVER	0.	22.6	56.1	8.6	298.8	.0	1867.4	.096	.180	1.000	.680	.874	.895	1.6	1.6	.0	.0	.0
CO	UNDER	0.	.4	14.9	3.1	1.9	.0	35.0	.089	.168	1.000	.680	.874	.891	1.6	1.6	.0	.0	.0
End of Year: 1980								Accumulated day-degrees for year: 4570.0											
RM	OVER	0.	8.7	40.2	6.9	107.2	.0	402.5	.229	.367	1.000	.726	.868	.991	1.6	1.6	.0	.0	.0
RM	UNDER	0.	2.8	78.3	2.5	18.3	.0	167.2	.197	.316	1.000	.726	.868	.989	1.6	1.6	.0	.0	.0
RO	OVER	0.	33.0	51.8	10.8	513.9	.0	2523.2	.258	.300	1.000	1.000	.868	.994	1.6	1.6	.0	.0	.0
RO	UNDER	0.	.3	33.0	1.8	1.5	.0	27.2	.169	.197	1.000	1.000	.868	.988	1.6	1.6	.0	.0	.0
CO	OVER	0.	23.0	54.8	8.8	308.3	.0	1892.5	.095	.180	1.000	.680	.868	.894	1.6	1.6	.0	.0	.0
CO	UNDER	0.	.4	23.8	1.9	2.1	.0	43.9	.071	.134	1.000	.680	.868	.891	1.6	1.6	.0	.0	.0
End of Year: 1982								Accumulated day-degrees for year: 4570.0											
RM	OVER	0.	9.4	41.9	6.7	118.4	.0	411.8	.173	.367	.745	.726	.876	.992	1.6	1.6	.0	.0	.0
RM	UNDER	0.	2.4	81.5	2.3	15.0	.0	117.5	.142	.303	.745	.726	.876	.989	1.6	1.6	.0	.0	.0
RO	OVER	0.	30.8	45.7	11.2	490.3	.0	2083.2	.194	.299	.745	1.000	.876	.995	1.6	1.6	.0	.0	.0
RO	UNDER	0.	.5	42.2	1.5	2.2	.0	44.5	.125	.194	.745	1.000	.876	.989	1.6	1.6	.0	.0	.0
CO	OVER	0.	20.7	48.0	8.9	280.0	.0	1502.3	.071	.179	.745	.680	.876	.895	1.6	1.6	.0	.0	.0
CO	UNDER	0.	.5	38.5	1.7	2.3	.0	43.0	.051	.129	.745	.680	.876	.891	1.6	1.6	.0	.0	.0
End of Year: 1984								Accumulated day-degrees for year: 4570.0											
RM	OVER	0.	11.6	48.4	6.9	148.8	.0	563.9	.230	.367	1.000	.726	.871	.991	1.6	1.6	.0	.0	.0
RM	UNDER	0.	2.2	87.1	2.3	13.9	.0	123.1	.187	.300	1.000	.726	.871	.989	1.6	1.6	.0	.0	.0
RO	OVER	0.	32.6	45.6	11.6	531.1	.0	2455.3	.259	.298	1.000	1.000	.871	.995	1.6	1.6	.0	.0	.0
RO	UNDER	0.	.7	52.0	1.8	3.2	.0	65.4	.172	.200	1.000	1.000	.871	.988	1.6	1.6	.0	.0	.0

SPEC	STRAT	% DEFOL	BASAL AREA (FT2/AC)	NUMBER STEMS (AC)	MEAN DBH (IN)	VOLUME (FT3/AC)	YIELD (FT3/AC)	FOLIAGE (LB/AC)	ACTUAL GROWTH (IN)	POTEN. GROWTH (IN)	MODIFIERS OF GROWTH: GYPSY MOTH	TEMP	STAND DENS.	SHADE	TOTAL % MORT.	SOURCES OF MORTALITY: BASE % MORT.	SLOW GR. MORT.	RAND. STRESS MORT.	GYPSY MOTH MORT.
CO	OVER	0.	20.9	47.0	9.1	285.9	.0	1708.0	.095	.179	1.000	.680	.871	.894	1.6	1.6	.0	.0	.0
CO	UNDER	0.	.6	54.6	1.6	2.9	.0	64.9	.067	.127	1.000	.680	.871	.891	1.6	1.6	.0	.0	.0
End of Year: 1986								Accumulated day-degrees for year: 4570.0											
RM	OVER	80.	12.2	48.2	7.0	161.1	.0	71.3	.148	.367	.645	.726	.862	.998	11.6	1.6	.0	.0	10.0
RM	UNDER	80.	2.1	111.5	2.1	12.6	.0	12.2	.117	.290	.645	.726	.862	.998	11.6	1.6	.0	.0	10.0
RO	OVER	80.	30.7	41.3	11.8	511.4	.0	264.9	.165	.297	.645	1.000	.862	.999	11.6	1.6	.0	.0	10.0
RO	UNDER	80.	.7	46.6	1.7	3.6	.0	9.1	.113	.203	.645	1.000	.862	.997	11.6	1.6	.0	.0	10.0
CO	OVER	80.	18.9	41.4	9.2	261.1	.0	175.6	.061	.178	.645	.680	.862	.899	11.6	1.6	.0	.0	10.0
CO	UNDER	80.	.8	73.3	1.5	3.5	.0	9.1	.043	.127	.645	.680	.862	.898	11.6	1.6	.0	.0	10.0
End of Year: 1988								Accumulated day-degrees for year: 4570.0											
RM	OVER	0.	13.9	52.2	7.2	187.9	.0	713.7	.171	.366	.745	.726	.872	.992	1.6	1.6	.0	.0	.0
RM	UNDER	0.	2.4	138.5	1.9	14.0	.0	119.5	.131	.280	.745	.726	.872	.988	1.6	1.6	.0	.0	.0
RO	OVER	0.	32.1	41.9	12.0	542.0	.0	2417.6	.191	.296	.745	1.000	.872	.994	1.6	1.6	.0	.0	.0
RO	UNDER	0.	.8	51.0	1.9	4.1	.0	88.4	.132	.206	.745	1.000	.872	.988	1.6	1.6	.0	.0	.0
CO	OVER	0.	19.0	40.6	9.3	264.3	.0	1549.2	.070	.178	.745	.680	.872	.894	1.6	1.6	.0	.0	.0
CO	UNDER	0.	.9	78.0	1.5	4.1	.0	101.3	.050	.126	.745	.680	.872	.891	1.6	1.6	.0	.0	.0
End of Year: 1990								Accumulated day-degrees for year: 4570.0											
RM	OVER	0.	16.6	58.6	7.5	229.7	.0	832.5	.227	.366	1.000	.726	.864	.991	1.6	1.6	.0	.0	.0
RM	UNDER	0.	2.8	160.5	1.9	16.4	.0	138.8	.173	.279	1.000	.726	.864	.988	1.6	1.6	.0	.0	.0
RO	OVER	0.	34.2	43.5	12.2	589.6	.0	2537.6	.253	.295	1.000	1.000	.864	.994	1.6	1.6	.0	.0	.0
RO	UNDER	0.	1.1	70.6	1.8	5.2	.0	108.7	.174	.204	1.000	1.000	.864	.987	1.6	1.6	.0	.0	.0
CO	OVER	0.	19.3	40.3	9.4	271.3	.0	1560.0	.093	.177	1.000	.680	.864	.894	1.6	1.6	.0	.0	.0
CO	UNDER	0.	1.1	92.1	1.5	5.2	.0	119.6	.067	.127	1.000	.680	.864	.890	1.6	1.6	.0	.0	.0

NUMBER OF STEMS PER AC:

DIAMETER CLASS (IN)

SPECIES	1.0	3.0	5.0	7.0	9.0	11.0	13.0	15.0	17.0	19.0	21.0	23.0	25.0	27.0	29.0	31.0	33.0	35.0	37.0	39.0
RM	116.33	44.14	27.21	16.78	8.83	3.94	1.42	.38	.07	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
RO	54.62	15.98	7.02	4.85	5.71	7.19	6.87	5.51	3.69	1.85	.66	.16	.03	.00	.00	.00	.00	.00	.00	.00
CO	78.38	13.71	6.45	10.03	11.19	6.11	4.47	1.69	.32	.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

ASCII Text File

Contents

There are four ASCII files (sometimes referred to as flat files or text files) that the user may request be written under the **Output** submenu (these are the same files that are used to generate the screen graphic outputs). These files contain one record or line for each year requested. The default is that these be written every other year. The variable IGYEAR, set by the user in the **Options** edit window, allows you to decide the number of years between written output; this variable is constrained to positive integer values. During each year, one of three categories will be accumulated by species on a per-acre basis and written to a disk file. The category is selected according to the user's choice of the variable ICAT: (1) only the overstory trees, (2) only the understory trees, or (3) all the trees. The calendar year always is the first item on each line (the first column), followed by one item (column) for each species. The accumulated totals by species and category can be produced for numbers of stems, basal area, standing volume, or quadratic mean diameter. See Figure 7 for examples of the output control screens.

Formats

Format specifications are detailed in the help screens for each of these output files. The format for outputs of total stem counts or total basal area are the same: a single space is followed by the calendar year in columns 2-5; then the total number of stems or total basal area for each species takes up nine (9) columns, with two digits to the right of the decimal point, leaving up to six digits to the left.

Each line or record for total volumes by species is similar to those for stem counts except that volumes take up 11 columns, again, with two digits to the right of the decimal point. For the quadratic mean diameters, the format again takes a total of nine columns, but this time there are three digits to the right of the decimal point, leaving five to the left.

Examples

Figure 18 shows the form of four output viewing windows generated using the default input data. The output frequency was changed to "1" so that data for each year were produced. Output frequency (IGYEAR) is set in the **Output Options** edit window.

Graphs of Output

The program uses the ASCII data from the files that you choose to generate to produce screen graphs of these data. Figure 14 is one such graph. The lines are labeled using the two-character species codes.

Debug Output

The additional information that is produced by requesting debug output originally was designed to allow analysts to track and test the models while under development. When debug output is requested, additional lines of information are produced. Considerable information is added to the tabular output, and a separate debug data file is produced. In both of these, the information added will help someone interested in tracing the calculations that comprise the normal simulation outputs.

Debug File

Because the request for debug output is transmitted to the simulation portion of the model as a logical variable, DEBUG, the user can locate the places in the source code where this output is produced by looking for the logical syntax:

```
IF (DEBUG) THEN ...
```

which can be seen in each place that debug related actions take place. Following the output of some of the data read into the simulator from temporary files (weather data are read in INITW.FOR while most of the other data are read in TINIT.FOR), stand-basal area and tree-crown ratios are written from TREE1.FOR. Output written to the DEBUG temporary file from other routines follow, allowing the user to see internal calculations and intermediate values of variables. The main loop is traversed once each year of a simulation. Major sections of the model are done through subroutine calls. The format of each line:

```
MAIN 30NN: <subroutine name(s)> done
```

signals the completion of that portion of the simulation code. Here, the four-digit integer 30NN is the numerical label within the code of the main subroutine DAMSR.FOR of the simulator. This and other source code is found in General Technical Report NE- (Colbert and Sheehan 1995).

Debug Table

In addition to the information written to the DEBUG data file, a number of additional entries are placed in the output table: details of tree growth, including the potential and actual increment within each cell (by species and diameter); the movement of tree counts between adjoining diameter cells within each species; and the introduction of new trees to the smallest diameter class, accounting for ingrowth. This additional output will cause the output file to be approximately 4 times as large as without all of the detail, so expect to use this when writing the output data for only several years or be prepared to wade through a large amount of information.

Stem count ASCII file (Use Page-Up, Page-Down, and Arrow keys)

1979	51.72	67.74	252.17
1980	45.95	65.39	228.30
1981	36.12	72.54	228.05
1982	37.86	79.79	235.32
1983	37.59	78.96	238.89

Press Escape

Basal area ASCII file (Use Page-Up, Page-Down, and Arrow keys)

1979	37.03	11.61	39.31
1980	33.49	10.69	35.81
1981	26.86	10.94	36.26
1982	27.08	11.16	36.88
1983	27.29	11.49	37.80

Press Escape

Volume ASCII file (Use Page-Up, Page-Down, and Arrow keys)

1979	633.62	155.81	808.28
1980	576.70	144.88	734.65
1981	465.34	149.36	742.16
1982	472.50	153.46	752.67
1983	479.44	159.80	768.97

Press Escape

Diameter ASCII file (Use Page-Up, Page-Down, and Arrow keys)

1979	25.607	11.761	8.169
1980	25.811	11.170	8.248
1981	26.071	10.364	8.372
1982	24.936	9.686	8.325
1983	25.053	9.889	8.435

Press Escape

Figure 18. Four ASCII file output windows from the default inputs except that the output cycle was reset to one year.

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