A Decision Tree System for Developing Harvest Schedules from User-Defined Silvicultural Guidelines

by

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DTREES, Version 4.2

A Decision Tree System

for

Developing Harvest Schedules from User-Defined Silvicultural Guidelines

User's Manual[1]

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INTRODUCTION TO THE DTREES SIMULATION SYSTEM

This manual is designed to facilitate the use of **DTREES** (Decision **TREE** System) and provide the user with information on the structure and use of various DTREES functions. It is not intended to teach system analysis or timber management planning, and the authors assume that the users of this system have some expertise in these areas, as well as experience in using personal computers running under the DOS operating system environment. The manual is broken down into several distinct sections that the user may consult as needed. Each main menu option is described and brief examples are provided.

Typology Conventions

To help you better understand this manual, we will explain the conventions used to interact with the DTREES system and each of its sub-components. DTREES has been thoroughly tested and extensively error-trapped, and careful use of the system should result in quick and effective runs. However, the system is not capable of defeating all deliberate attempts to crash it, so we advise that you think ahead when changing variables to extreme values.

(1) Whenever a key is bracketed by the greater-than and lesser-than signs < >, this symbolizes a key press. For example:

<4><ENTER>- Symbolizes pressing the 4 key and then the enter key.

<SPACEBAR> - Symbolizes pressing the spacebar once.

<5><5><.><0><ENTER> Pressing 55.0 and then the enter key.

(2) Whenever a numeric key press is requested (i.e. - <4>), it refers to the numeric keys above the alphabetic keys on the keyboard. DTREES uses the numeric keypad for cursor control only.

(3) Unless otherwise noted, DTREES is not case sensitive. In other words, <E> is equivalent to <e>.

(4) Definition of DOS. DOS refers to the Disk Operation System for IBM or IBM compatible personal computers.

(5) Reverse video refers to reversing the basic foreground and background colors of the text. If the majority of the text is light letters on a dark background, reverse video will be dark letters on a light background.

(6) When the message "Press any key to continue..." appears on the screen, DTREES is allowing you to observe the screen contents before continuing. Pressing any of the alpha-numeric keys will then signal DTREES to continue.

(7) When cursor control is used to highlight a menu option in reverse video (as in the **SRP** (SET RUN PARAMETERS) module main menu), the up arrow key on the enhanced 101 key keyboard and the 8 key on the numeric keypad are equivalent. Similarly, the down arrow key is equivalent to the 2 key on the numeric keypad. Use these keys to highlight the menu option of interest, then press <ENTER> to execute that option.

System Requirements and Recommendations

The DTREES system itself can be run from any computer operating DOS 3.1 or higher, and at least 3.5 MB of free disk space for the compiled programs alone. However, to properly use the DTREES system, the following is a description of the minimum operational system. (The system described here is an PC 486. The need for an extra 5 MB of free disk space is due to the fact that DTREES can create up to 6000 bytes of output for each stand processed. Should you process a planning area with 2500 management units, the DTREES output alone is 3-6 Mb! This is due to the detail with which DTREES processes each stand. This is also the cause for recommending a machine which has a processor running at least 33 Mhz. With a PC 486 running at 66 Mhz, DTREES will process one stand completely every 2 seconds. Using the same 2500 stands, that equals about 2 hours of total running time. The minimum recommended system for DTREES would include:

- DOS 3.1 or higher
- VGA graphics
- Computer processor running at 25 Mhz or higher
- At least 20 Mb of free disk space or other peripheral storage device, e.g., Bernoulli box

However, when operating DTREES and other components of the integrated planning package such as **DUALPLAN** (see Rose et al. 1989), even more processing power and memory space is recommended. The optimal system for the total planning system would include these components:

- 486 PC running at 50Mhz or better
- A minimum of 100 Mb of on line disk space
- Backup storage capacity of 200 Mb. Either Bernoulli cartridges, tape storage, optical disks, or mainframe computer storage.
- VGA graphics capacity
- High quality printer
- High quality plotter (support for **GIS**)

The total cost of the hardware for this system has decreased dramatically and would fall in the range of $3-4,000. Many organizations involved in strategic planning already own such computer systems.

What DTREES Does

A major objective of forest planning is to chose among many available stand management options in such a way that management objectives are achieved in the best possible way. The key is to provide a stand management scheduling model called DUALPLAN (see Rose et al. 1989) with a selection of technically sound management alternatives. The development of these alternatives is an important, but potentially very tedious process. **D**ecision **TREE** System **(DTREES)** was developed to facilitate the development of management alternatives and functions as the "front-end" to a harvest scheduling algorithm. It provides a list of alternative management sequences for each forest stand by simulating management activities and responses. DTREES can also be run as a stand-alone program without a scheduling program to project stands and management outputs under predetermined silvicultural management rules. Included in DTREES system objectives are (1) use of a tree-based growth projection system, (2) a modular systems design, (3) an understandable and user accessible silvicultural decision system, (4) avoidance of stand aggregation, and (5) a flexible inventory data base interface.

DTREES can generate and simulate alternative management sequences for forest stands in the Great Lakes Region. DTREES makes no assumptions about economic conditions or values. It simply models the biological aspects of a forest as presented in the inventory files. For a given inventory data base, DTREES will produce an output data base which describes, for each stand in the inventory that was selected by the user for simulation, a series of management actions and their associated product flows by species and the characteristics of the trees remaining in a stand due to a management action over time. DTREES bases its decisions on silvicultural guidelines derived from management handbooks for each covertype in the Great Lakes Region (Brand, 1981a).

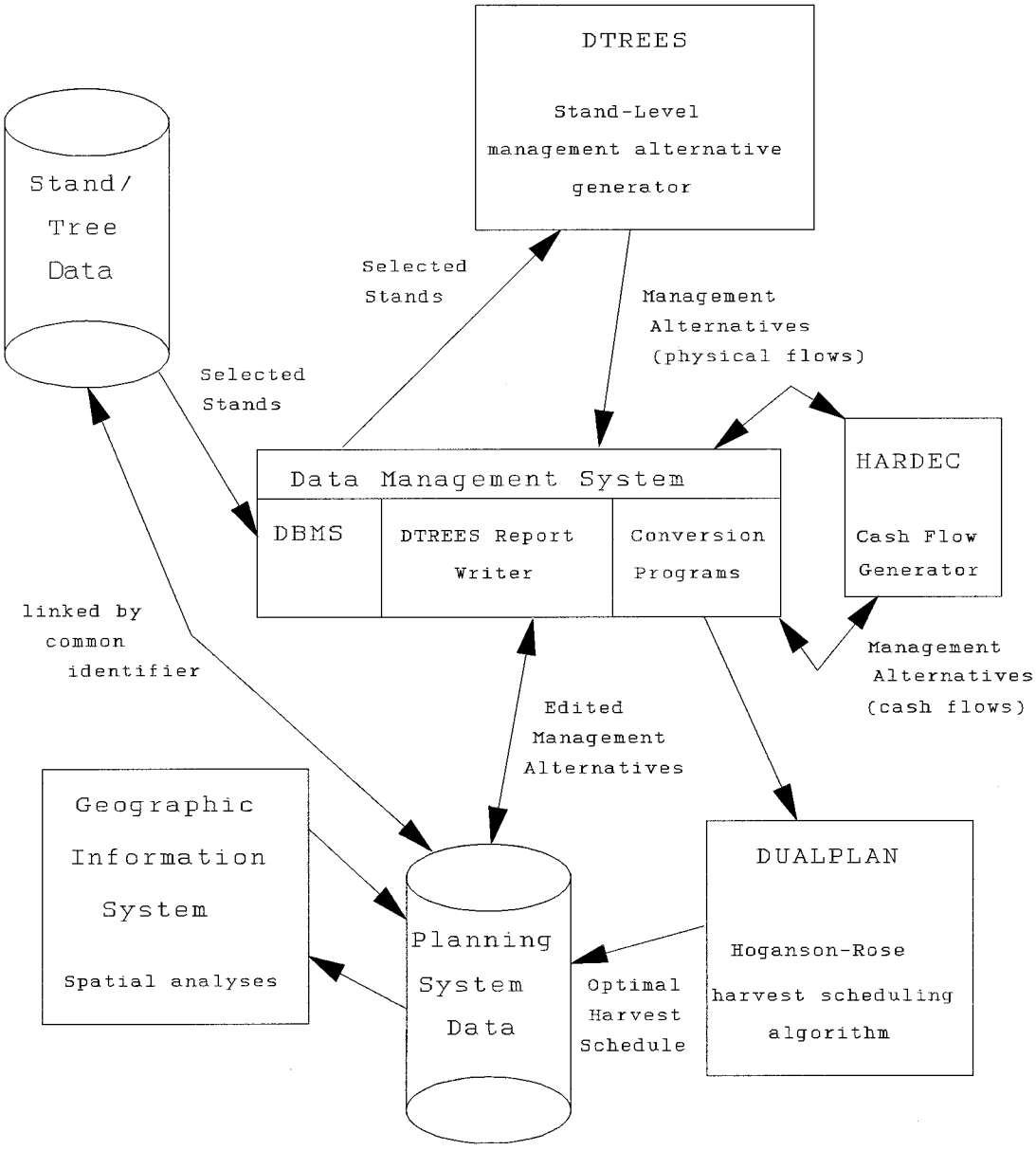
An example of the type of input required by DTREES is given in Appendix I for a few stands from the DNR Sturgeon River State Forest. Following the input example is an example of the type of information DTREES will provide under a Model I formulation assumption. Most timber management scheduling models found in the forestry literature are formulated in either a Model I or Model II format. The best description of these two model formulations can be found in Johnson and Scheurman (1977). The primary difference between Model I and Model II formulations is in the method of defining the variables that relate to the management alternatives. In Model I, the decision variables are the number of acres of an initial age class assigned to a unique management sequence or option over time. In Model II, on the other hand, the decision variables refer to the number of acres in an initial age class that are harvested in a given planning period. The major difference between the two formulations is that in model II stands harvested in a specific planning period are merged to form a new age class while in model I all stands maintain their original identity. This version of DTREES is designed only to project inventories under user-recommended silvicultural actions without development of optimal schedules. The user for this version of DTREES can only use the model I option.

DTREES is designed to support the DUALPLAN harvest scheduling system. However, DTREES can be used to produce a "first-cut" at a harvest management plan. When used in this manner, it is best to use a Model I formulation with only one alternative generated at each decision node. With these settings, DTREES will produce only the silvicultural "optimal" management sequence according to the decision system critical parameters, and the simulation will continue for the entire planning horizon. This output can be used as a base from which to recommend various management options. Use of DTREES in conjunction with DUALPLAN to generate economically optimal management schedules is considerably more complex because for each stand multiple management alternatives and associated product flows need to be generated. The scheduling model selects among those alternatives in order to optimize an objective function such as minimum cost of production or maximum net discounted net revenues. The use of DTREES as a front-end to a scheduling model will be described in a separate user's manual which is currently being prepared.

DTREES uses the **GROW** subroutine (Brand, 1981b) for growth projections, and in the Model I formulation empirical tree lists are used for regenerating stands after final harvests. The harvesting schemes modelled by DTREES include clearcutting, random thinning, selection by species or diameter size class, and shelterwood harvests for natural regeneration. A detailed discussion of the concepts and procedures used by DTREES to produce alternative management sequences is contained in the overview paper by Rose, Hoganson, Pelkki, and Arthaud (1989).

Where DTREES Fits into Forest Management Scheduling System

Figure 1 shows the overall structure of an integrated planning system. While DTREES is fully capable as a stand-alone system, it is designed to work with the other components of the planning system in an integrated fashion. The stand-level inventory database is the most current representation of the real world (forest). From this current state, DTREES models for each stand (or management unit) in the forest several alternative management sequences forward in time. Each of these alternatives are then evaluated by economic criteria using program HARDEC and costs of production are defined for each alternative. This modified prescription list is then evaluated by DUALPLAN, the microcomputer version of the Hoganson-Rose algorithm (Hoganson and Rose, 1984). DUALPLAN finds the lowest cost strategic harvesting plan for the entire forest, for given levels of production. The planning system can take advantage of geographic information systems (GIS) for analysis, display and reporting on the output from DTREES and DUALPLAN if stand data are available in digitized form. The report writer provides a series of management summary and exception reports for the user. Its purpose is to reveal to the user in a concise and readable format all relevant outputs from the simulated management actions.



Forest Planning System Framework

INSTALLING THE DTREES SIMULATION SYSTEM

Back up your DTREES diskettes before any installation procedure! This will minimize the risk of damage to the original diskettes. DTREES has no copy protection, so follow these steps to make working diskette copies:

1. Put first DTREES diskette in drive A.
2. Put a blank formatted working copy disk in drive B.
3. Type <COPY A:*.* B:>
4. Repeat steps 1-3 until you have copied all three DTREES diskettes.

Put the program disk away in a safe place and continue with the installation of the working copies to the computer's hard disk. The user has two options to do this.

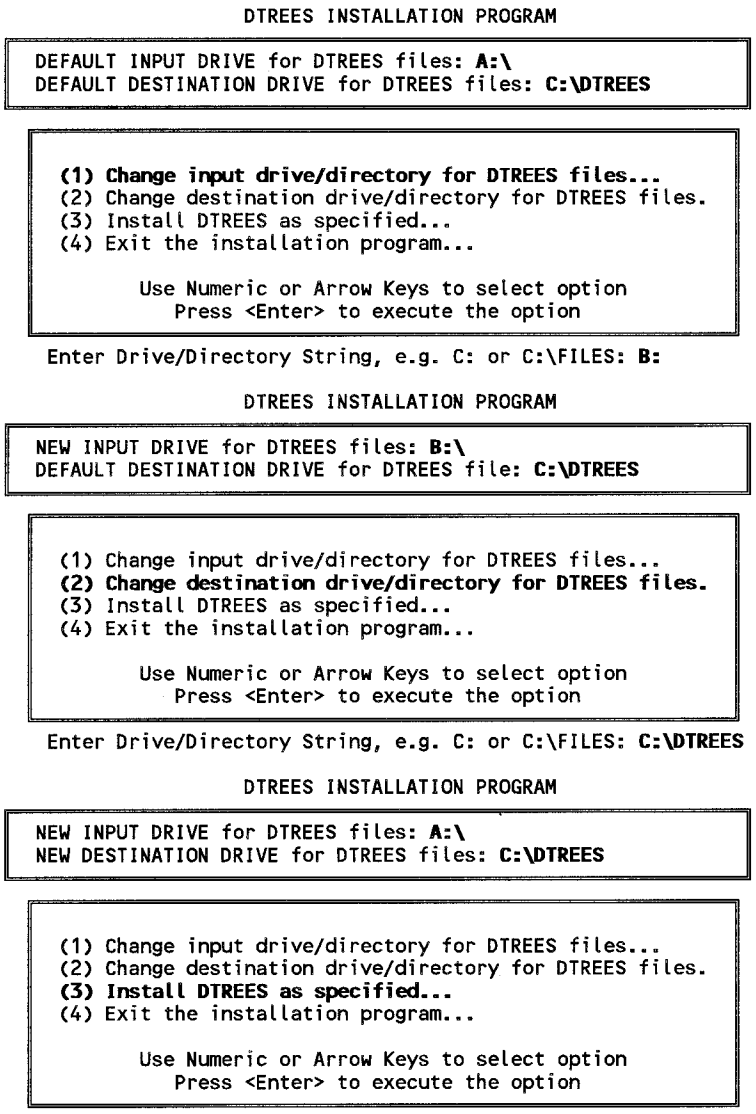
Using DOS

1. Create a directory for the DTREES main files on your computer hard disk, e.g., DTREES by typing <MKDIR DTREES> from the C:\ prompt.
2. Go to that directory by typing <CD DTREES>
3. Insert DTREES diskette 1 into drive A: or B: and type <COPY A:*.*> or <COPY B:*.*>. Repeat process for DTREES diskette 2.
4. Create a data and output subdirectory on the DTREES directory on your hard disk by typing <MKDIR DATA> and <MKDIR OUTPUT>. Be sure that you are at the C:\DTREES prompt if that is the directory you created.
5. Move to the data subdirectory by typing <CD DTREES\DATA>.
6. Insert DTREES diskette 3 into drive A: or B: and type <COPY A:*.*> or <COPY B:*.*>.

These steps will complete the installation process. The output directory was created so that DTREES outputs can be written to a specific subdirectory.

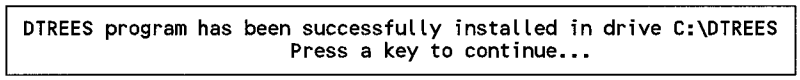
Using DTSETUP Program

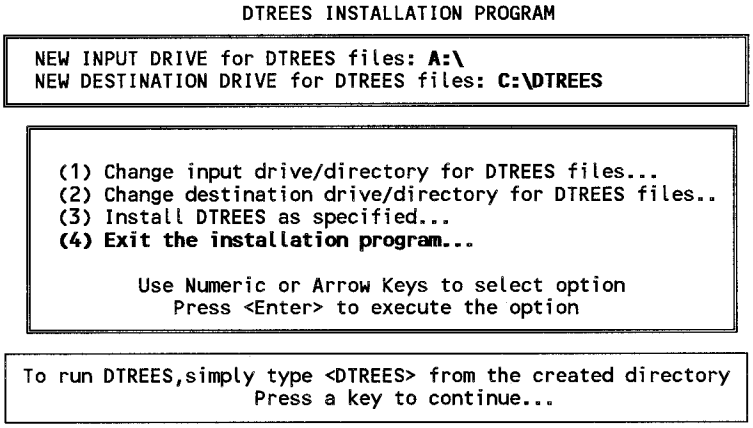
An installation program **DTSETUP** on the program diskette can be used also to install the program and all necessary files to any specified hard disk. Simply insert the program diskette in a drive, type **<DTSETUP>** and follow the simple instructions on the screen. The proper files will be copied to the hard disk. Drive "A" is the default input drive, but the system will determine from which drive the **DTSETUP** program was activated. The default destination drive and directory is C:\DTREES. The **DTSETUP** program itself will not be saved to the hard disk. The following shows the input screens the user will see during installation:



At this point a list of all the files being copied to the hard disk will appear on the screen, e.g.,

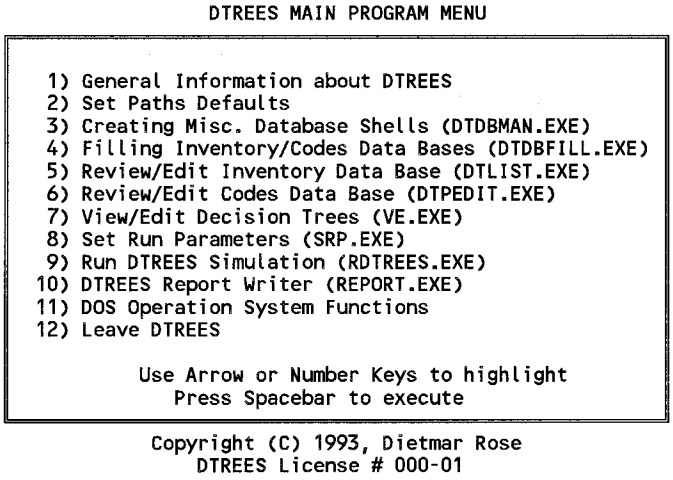
```
C:\DTREES\DTREES.EXE
C:\DTREES\DTSETUP.EXE
etc.
        XX File(s) copied
C:\DTREES\DATA\MISC.PAR
etc.
        XX File(s) copied
```




DTREES INSTALLATION PROGRAM
NEW INPUT DRIVE for DTREES files: A:\
NEW DESTINATION DRIVE for DTREES files: C:\DTREES
(1) Change input drive/directory for DTREES files...
(2) Change destination drive/directory for DTREES files..
(3) Install DTREES as specified...
(4) Exit the installation program...
Use Numeric or Arrow Keys to select option
Press <Enter> to execute the option
To run DTREES,simply type <DTREES> from the created directory
Press a key to continue...

USING THE DECISION TREE SYSTEM: DTREES MAIN MENU

After entering DTREES from the DOS prompt in the appropriate directory, the DTREES initial screen will appear. Pressing any key at this point will place you in the main DTREES menu. From this menu you can access all of the major DTREES subsystems and execute all of DTREES procedures. The DTREES main program menu appears:



A selection is made by using the cursor, number, <Home>, or <End> keys and the <Enter> key for a highlighted choice. The appropriate subsystem is activated, and typically a new menu screen or activity will appear. What follows is a description of the function of each subsystem available from the main menu. Option 11 which activates the simulation should not be selected until the control parameters and decision trees are reviewed and set properly.

DTREES Software Structure

DTREES is coded in Microsoft Professional BASIC version 7.1. It requires an IBM or IBM compatible personal computer which supports DOS 3.1 or higher.

DTREES.EXE controls the main program menu and all functions of DTREES are accessible through it. While other modules may be executed outside of this module's environment, the DTREES is designed to be executed from **DTREES.EXE**! Use of the other modules outside of **DTREES.EXE** may cause unpredictable results, loss of data, or damage to the system software.

DTDBMAN.EXE sets up the data base structures for all data base tables.

DTFILLDB.EXE fills the relational data base structures with data.

DTLIST.EXE permits viewing and editing of inventory data bases.

DTPEDIT.EXE permits viewing and editing of the run codes data base tables.

VE.EXE (View/Edit) controls the display and editing of the decision trees which drive DTREES. There are 12 covertypes which can be displayed, and each critical value displayed can be modified and saved. Up to 4 sets (a set consists of critical values for all 12 covertypes) of these "critical" values can be stored at a time.

SRP.EXE (Set Run Parameters) controls all other DTREES running parameters. When executing this subsystem, the user can observe and modify the following:

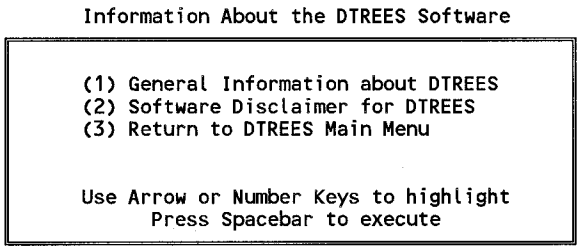
- Inventory source type and file names
- Output file names
- Input and output file paths
- Timber size class codes for all tree species
- Planning horizon length and number of periods
- Modelling formulation (Model 1/Model 2)
- Species and covertype conversion codes
- File start up point
- Update of inventory to current year
- Generation of silvicultural optimal sequence only

The **RDTREES.EXE** module actually performs the simulation of management sequences over time. It uses the US Forest Service NC Experiment Station RunGrow routine to make growth projections.

REPORT.EXE permits generating a number of reports on the simulated stand schedules.

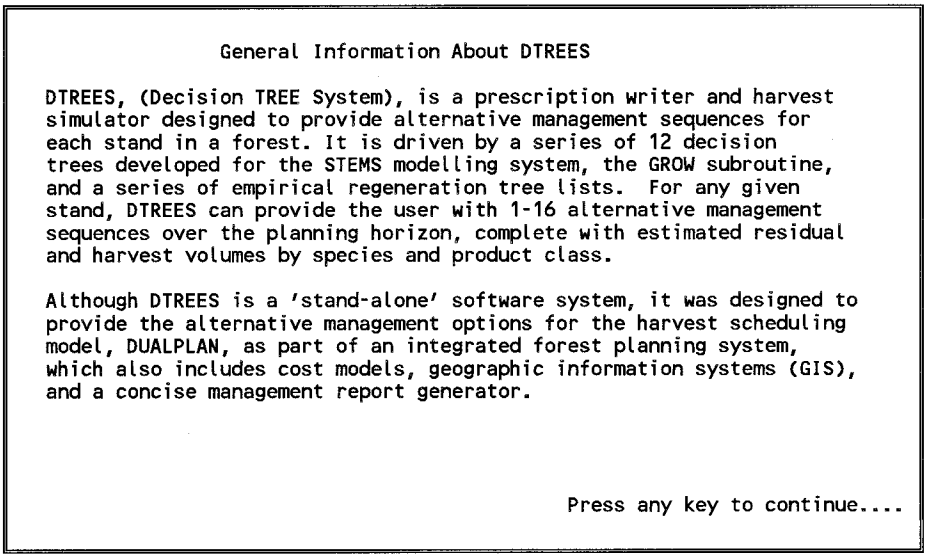
MAIN MENU OPTION 1: GENERAL INFORMATION ABOUT DTREES

This option of the **DTREES** main menu generates the following screen:



Suboption 1: General Information about DTREES

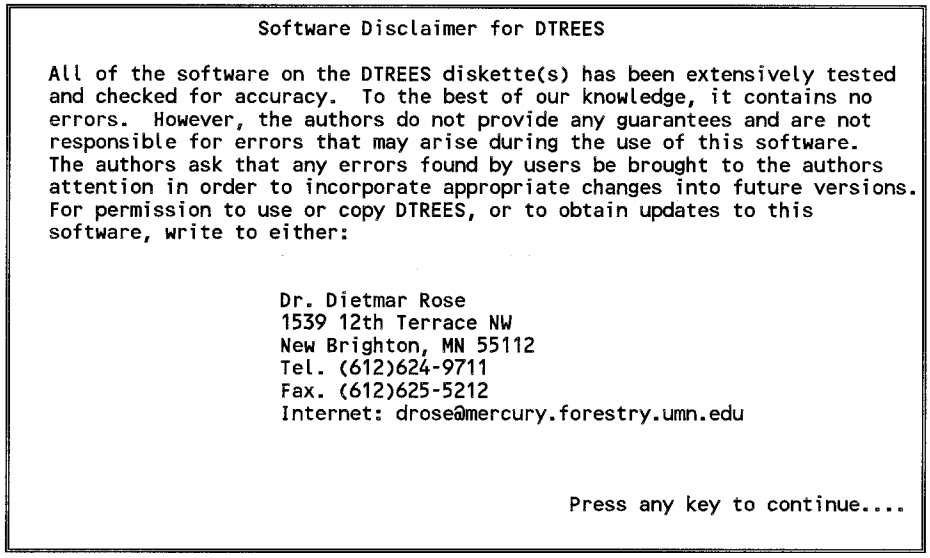
By pressing <1>,the user can read a general description of DTREES, how it fits into the overall planning system, its general structure, and possible uses. By pressing <2>DTREES displays the software disclaimer, which outlines the agreement between authorized users and the authors. Pressing <3>returns the system to the main DTREES menu.



```
          The DTREES system consists of 8 main sub-systems:

 (1) General Information about DTREES
 (2) Set Paths Defaults
 (3) DTDBMAN: Create Misc. Data Base Shells
 (4) DTDBFILL: Filling Inventory/Codes Data Bases
 (5) DTLIST: Review/Edit Inventory Data Base
 (6) DTPEDIT: Review/Edit Codes Data Base
 (7) VE: View/Edit Decision Trees
 (8) SRP: Set Run Parameters
 (9) RDTREES: The DTREES Simulation Module
(10) REPORT: A Collection of DTREES Output Summary Routines
     DTSIMLST: Review Simulation Output Data Base
     A module called by REPORT.

The DTMAKDB module lets user read raw inventory data into a predefined
relational DATA base structure.  It also lets user view and modify the
inventory data base.

The DTDBFILL module allows the user to read inventory flat files and
create a relational data base of inventory records.
                                          Press any key to continue....
```

```
DTLIST allows the user to view/edit stand inventory data bases.

DTPEDIT allows the user to view/edit the codes data bases. The data base
contains 4 tables: a covertype conversion table, a species conversion
table, a merchantability limits table, and a regeneration table.

The VE module allows the user to observe and modify the decision system
used by DTREES.

SRP allows the user to modify DTREES running parameters, set file paths,
and specify input file formats.

RDTREES is the module that actually carries out the simulation of
alternative management sequences.

REPORT allows the user to summarize DTREES simulation results as well
as original stand inventories which were inputted to DTREES. The submodule
DTSIMLST allows review of stand-level detail of the management schedule.

For a detailed description of DTREES, and complete explanations
of various DTREES' functions, see the user's manual.
                                          Press any key to continue....
```

Suboption 2: Software Disclaimer

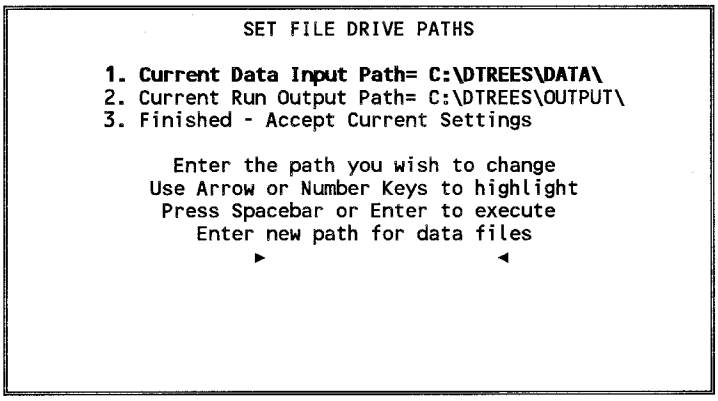


Suboption 3: Return to DTREES Main Menu

This option returns the user to the Main Menu.

MAIN MENU OPTION 2: SET PATHS DEFAULTS

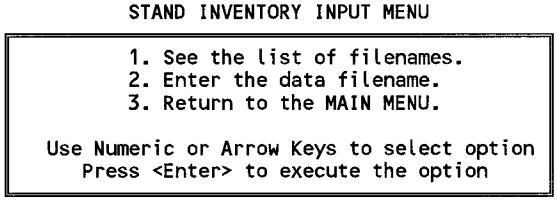
Many of the individual DTREES programs and modules provide the user with an option to set data input and output path parameters. Once input and output paths have been set within a module, they do not have to be reset in a new module, unless new path parameters are desired. Whenever the "Set Paths Default" option is selected, the screen will display the current default values. The user by selecting (highlighting) one of the first 2 options has a chance to change the default values. Any changes are written to a "DTREES.PTH" file. This file is loaded by all DTREES modules and sets the default values for the next time DTREES is executed.



Selecting Input Files

Many of the individual DTREES modules require the user to select a codes and/or inventory data base file. The requests for files are of two basic types. First, raw data files with extension ".DAT" are requested when inventory raw data are to be stored in a relational data base using program "DTFILLDB.EXE". Secondly, files with extension ".MDB" are requested to either select a stand inventory or codes data base. The latter contains four relational tables describing covertype conversion, species conversion, and species merchantability parameters, and regeneration tree lists. As will be explained below, all of these data bases can be expanded and/or edited.

Whenever a request for a file input occurs, the screens shown below will appear. The user may request to see a list of data file names, enter the file name for a specific data file to be recalled or return to the MAIN MENU.



File Entry Choice 1 - See the list of filenames

This option will retrieve an existing data file that was previously created. All of these files have either a ".MDB" (data base) or ".DAT" (raw data) extension as a part of their file name. For the current data base creation option, the user will see the default data path which can be changed, followed by a list of files with extension ".DAT" for a user specified disk drive). The user can select a file by hitting the <Enter> key on a highlighted file or by entering the file number. If there are more than 10 files with extension ".DAT" then the program will let the user scroll through additional lists.

Enter path or <ENTER> for default path: **c:\dtrees\data**
▶ ◀

Once the path is entered or the default path has been accepted, the program displays a list of all files with extension ".DAT":

```
(1) CONVERT.DAT
(2) TIMEINFO.DAT
(3) FIASU1.DAT
(4) STURGEON.DAT

Select by entering a number or highlight
using cursor and pressing <Enter> or Spacebar
```

File Entry Choice 2 - Enter the data filename

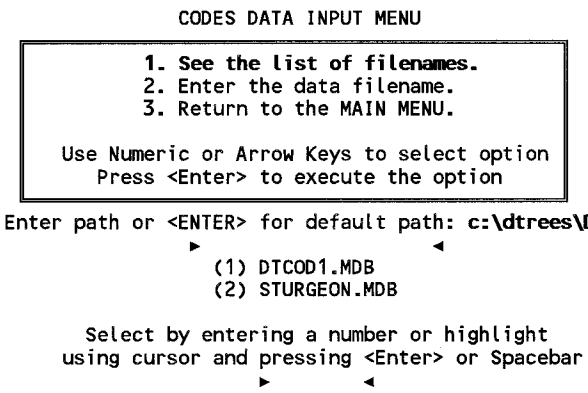
This option will retrieve an existing data file with extension ".DAT" as a part of their file names. Therefore, to recall the data file called FILE1.MDB, the user would simply enter **FILE1** when prompted for the file name. Press <ENTER>, instead of entering a file name, if you are unsure of the data file name to be retrieved or <Esc> to return to the DATA INPUT MENU. For this option, the user will see the default data path which then can be changed. Then the user is prompted for the name of an input file, up to 8 characters long without any extension:

```
Enter path or <ENTER> for default path: C:\DTREES\DATA
                ▶                       ◀
Enter data filename, or press only <ENTER> to return
```

Later, when a created inventory data base is to be retrieved, the list of files might look like follows (note file extension ".MDB").

```
(1) REGSTURG.MDB
(2) DTCOD1.MDB
(3) STURGEON.MDB

Select by entering a number or highlight
using cursor and pressing <Enter> or Spacebar
```

After inputting a requested name for an inventory raw data file, input of a codes data base is requested from the user:

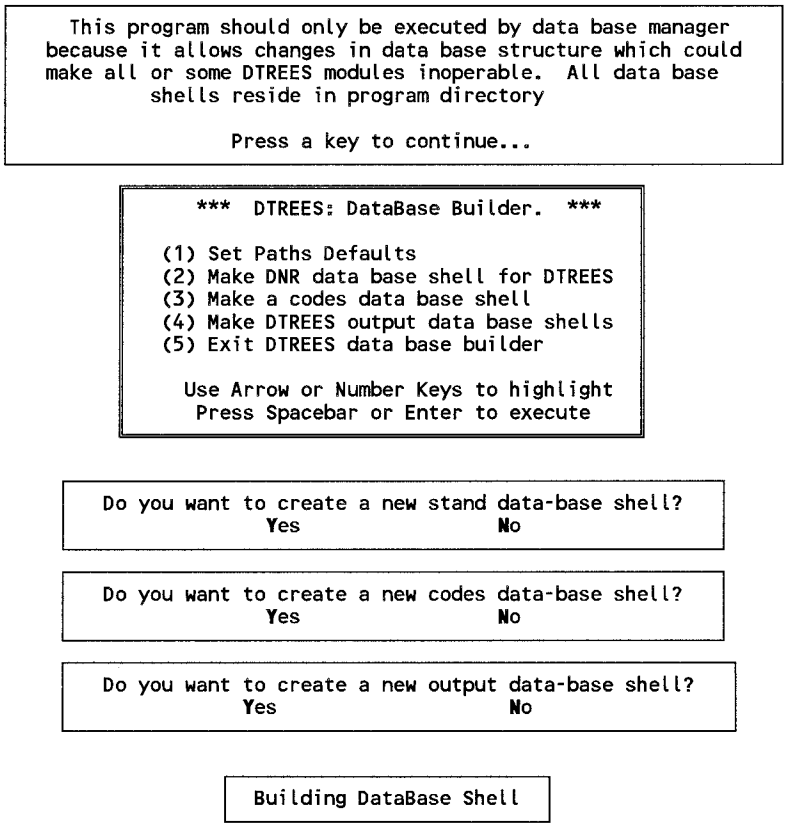


File Entry Choice 3 -Return to the MAIN MENU

With this option the user can return to the Main Menu of the current DTREES module being executed.

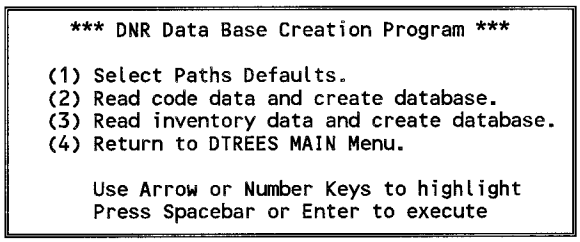
MAIN MENU OPTION 3: CREATE MISCELLANEOUS DATA BASE SHELLS

This option should only be used by the author of the program. With this option, the basic structure of all relational data base tables is established. Any changes made to the data base structure will make all program modules inoperable. All programs would have to be recompiled to become fully functional again. There is one scenario under which the user should execute this program. If any of the data base shells on the data subdirectory were accidentally lost or erased, the empty data base shells could be recreated using this program. This not the same as making actual changes in the data base structures. There are three data base shells corresponding to inventory data, codes data, and DTREES output data. They are named "STAND.MDB", "DTCOD.MDB", and "DTOUT.MDB" and should always be present in the DTREES data subdirectory, e.g., C:\DTREES\DATA.



MAIN MENU OPTION 4: FILLING INVENTORY/CODES DATA BASES

This option is utilized to read two types of information into relational data bases: 1) coding information for covertype, species, and merchantability limits, and regeneration tree lists from ASCII files into the codes data base and 2) DNR CSA (phase II) inventory data from DNR ASCII files into the stand data base. The stand data base uses an hierarchial design with general plot or stand information at the top level and tree-level information on the lower level. The data base structure also contains two aggregate inventory tables for covertype and covertype/age class combinations. Use of relational data bases speeds access to relevant data during the simulation and facilitates data base maintenance and updates.

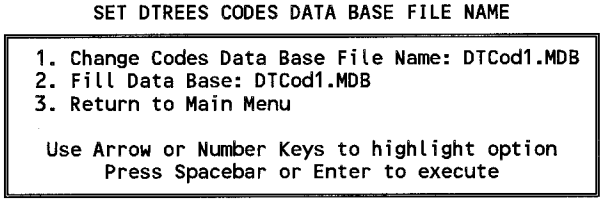


Suboption 1: Select Paths Defaults

This general option was described above.

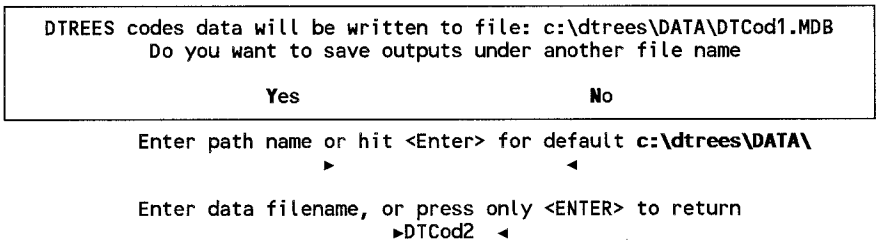
Suboption 2: Read Code Data and Create Data Base

The menu below will appear with options that allow the user to change the name of the current codes data base and to fill that new data base with codes data.



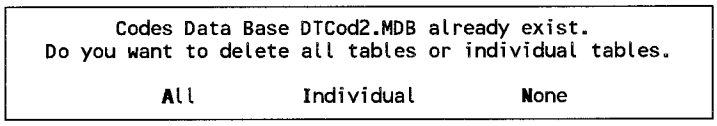
This suboption will provide the user an opportunity to change the default codes data base name. If the data base name to be filled with data already exists, the user will have a chance to fill either individual tables or to rewrite all tables. The codes data base tables are filled from ASCII files, "COVER.PAR", "SPECIES.PAR", "MERCHDBH.PAR", and "REGEN.PAR" residing in the data subdirectory. The appropriate ASCII file is updated by program DTPEDIT.EXE every time any changes are made by the user in an associated codes data base table.

1. Changing Codes Data Base File Name

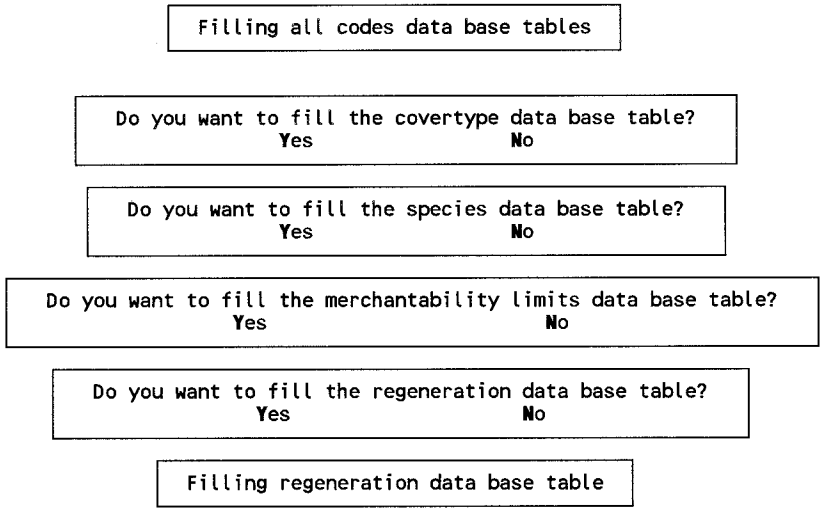


2. Fill Data Base

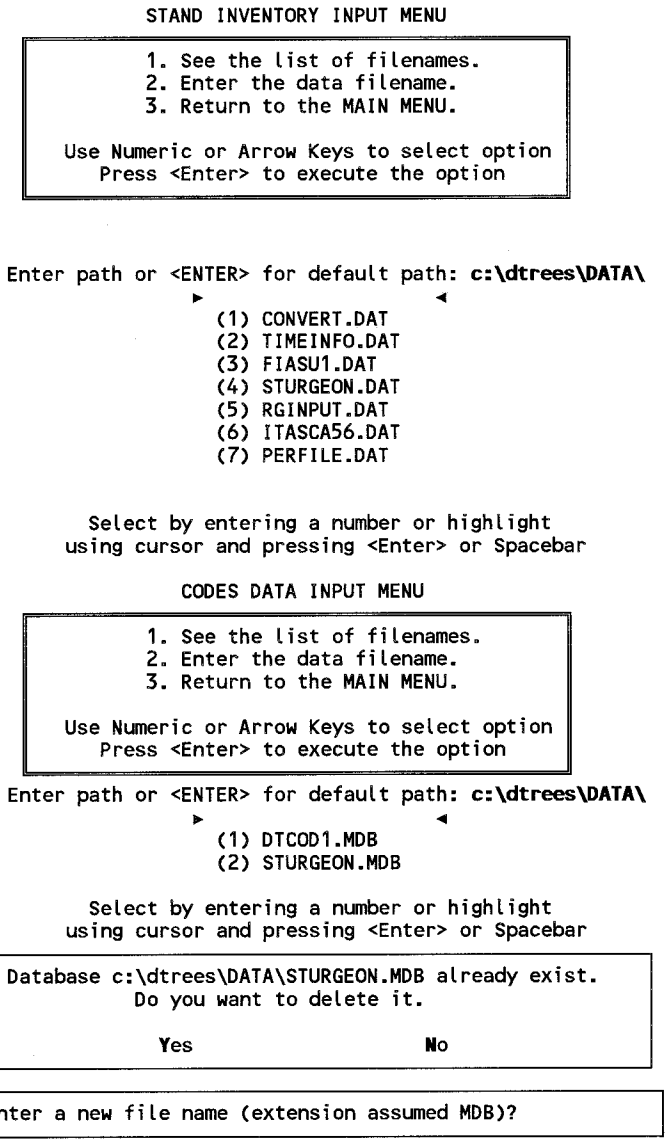
For suboption 2, the program will read the data from four ASCII files, COVER.PAR, SPECIES.PAR, MERCHDBH.PAR, and REGEN.PAR on the data input directory. These four ASCII files are rewritten any time one of the corresponding codes data base tables has been modified.



If <A>llis selected all four codes data base tables will be filled with the data read from the appropriate ASCII files. If <I>ndividual is selected, the program will prompt the user for each individual table that is to be filled. In that case the previous content of the specific table is deleted first. A message will appear while a specific table is being loaded.



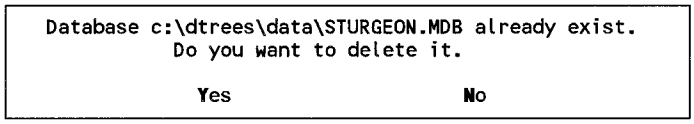
Suboption 3: Read Inventory Data and Create Data Base



At that point the program will begin to read the inventory flat file while displaying information about the stand being processed on the screen:

```
Forest Record No.:  11
Covertype: Ash
Covertype code:  1
Tree No.:  4
Species: Yellow Birch
Species Code:  24
Tree SID:  11 Plot SID:  11

      Stand Data Base: c:\dtrees\DATA\test.MDB
     Codes Data Base: c:\dtrees\DATA\DTCOD1.MDB
```

The program will proceed with creating a relational data base of the inventory raw data using a default file name that is the same as the input file name, except with the extension ".MDB". If a relational data base with that name already exists, a new file name can be entered by the user or the old file can be deleted, i.e, being overwritten by the new data.



Suboption 4: Return to DTREES Main Menu

The user will be returned to the DTREES Main Menu.

MAIN MENU OPTION 5: REVIEW/EDIT INVENTORY DATA BASE

```
*** DTREES Stand Lister ***

(1) Select Paths Defaults
(2) Select Inventory and Codes Data Base
(3) Run Data Base Utilities
(4) View Selected Data Base
(5) Quit DTREES Stand Lister Program

  Use Arrow or Number Keys to highlight
    Press Spacebar or Enter to execute
```

General Comments On Data Base Selection

Many DTREES modules like this **REVIEW/EDIT INVENTORY DATA BASE** option give the user an opportunity to select an inventory and a codes data base. The user by selecting (2) will receive default names for data bases that are stored on the "MISC.PAR" file which is changed only when these default values are not accepted:

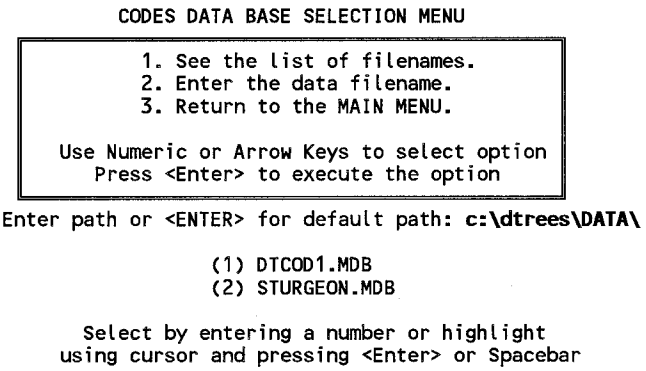
```
Current default inventory data base = c:\dtrees\data\STURGEON.MDB
       Do you want to select another inventory data base

                  Yes                        No
```

For <N>o the user can select from the following menu to retrieve any available other data base. Here option (1) provides a default path and data bases in that directory from which the user can chose. As described before, option (2) requires the user to directly enter a file name.

```
STAND INVENTORY DATA BASE SELECTION MENU

        1. See the list of filenames.
        2. Enter the data filename.
        3. Return to the MAIN MENU.

   Use Numeric or Arrow Keys to select option
      Press <Enter> to execute the option

Enter path or <ENTER> for default path: c:\dtrees\DATA\

                (1) DTCOD1.MDB
                (2) STURGEON.MDB

     Select by entering a number or highlight
   using cursor and pressing <Enter> or Spacebar
```

After anAfter an inventory data base has been selected or the default has been accepted, the user can accept the default codes data base or proceed with selecting a different data base:

```
Current default codes data base = c:\dtrees\data\dtcod1.mdb
    Do you want to select another inventory data base

                Yes                    No
```



Since default data base names are always stored on the "MISC.PAR" file, the user can skip option "(2) Select Inventory and Codes Data Base" and proceed directly to any other option. The program will display the default data base names for these options as above and the user either accepts these defaults or proceeds by entering different data base names. Anytime, a new data base name is selected, the program module will modify the "MISC.PAR" file so that this new default is displayed the next time the program module is activated.

Suboption 1: Select Paths Defaults

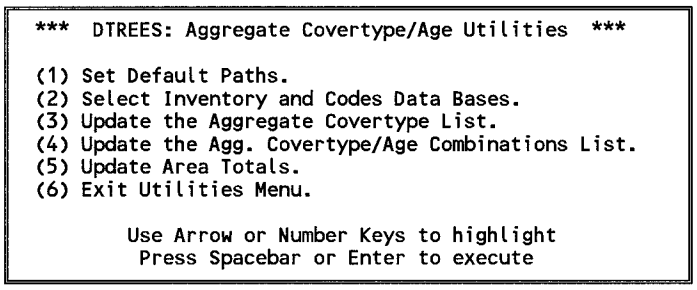
This general option was described above.

Suboption 2: Select Inventory and Codes Data Base

This general option was described above.

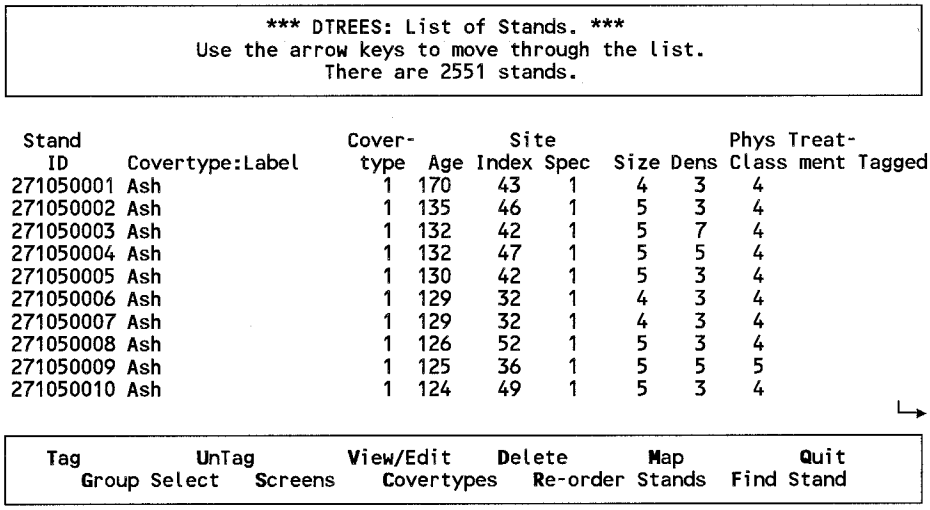
Suboption 3: Run Data Base Utilities

The first time a new inventory data base has been created from raw data, the inventory data base should be aggregated using the data base utility suboption 3. This utility will create aggregate inventory data base records summarizing stand-level data by covertype and covertype/age classes. These aggregate data records provide useful overviews of the inventory. Note that the program suboption again permits the user to make paths parameters and input file selections. Running suboptions 3 or 4 which update the aggregate covertype and covertype/age combinations also perform automatically suboption 5, i.e., the updating of area totals.



Suboption 4: View Selected Data Base

When suboption 4 is selected, the user can view the stand-level inventory data generated by the program. One can scroll through the list using any of the keypad keys. Additionally, the user can find specific stand records, reorder the inventory list using various sorting options, and can review aggregate data records by entering a <C>overtype. In this case, the user will be prompted for selecting either a covertype or covertype/age classification list.



```
*** DTREES: List of Stands. ***
Use the arrow keys to move through the list.
There are 2551 stands.

 Stand                          Cover-        Site                    Phys Treat-
   ID      Covertype:Label       type  Age Index Spec  Size Dens Class ment Tagged
271050001 Ash                      1  170    43    1     4    3     4
271050002 Ash                      1  135    46    1     5    3     4
271050003 Ash                      1  132    42    1     5    7     4
271050004 Ash                      1  132    47    1     5    5     4
271050005 Ash                      1  130    42    1     5    3     4
271050006 Ash                      1  129    32    1     4    3     4
271050007 Ash                      1  129    32    1     4    3     4
271050008 Ash                      1  126    52    1     5    3     4
271050009 Ash                      1  125    36    1     5    5     5
271050010 Ash                      1  124    49    1     5    3     4

  Tag          UnTag        View/Edit    Delete       Map          Quit
    Group Select   Screens     Covertypes   Re-order Stands  Find Stand

Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\dtcod1.mdb
```

The ⌐▸ or ◂⌐ arrow indicate whether more information can be found to the right or left of the current screen. These additional screens can be reviewed by using the right or left arrow keys. Various options are highlighted at the bottom of the screen. The <T>agoption is used to tag stands for a simulation run. Only tagged stands will be simulated by program. With this option, the user can control which stands or covertypes should be simulated. The tagging and untagging is done faster and more efficiently for whole covertypes at the aggregate level which is reached by using the <C> key. The <U>ntag option is used to untag previously tagged stands.

The <D>elete option permits the user to delete a whole data base record.

The <M>ap option allows the user to display a map of the currently highlighted or tagged stands.

The <G>roup Select option can be used to select certain stand groups according to a number of selection criteria options for tagging.

The <S>creens option lets the user go to one of four stand-level data screens directly. Other data screens can also be opened by repeatedly using the right or left arrow cursor keys.

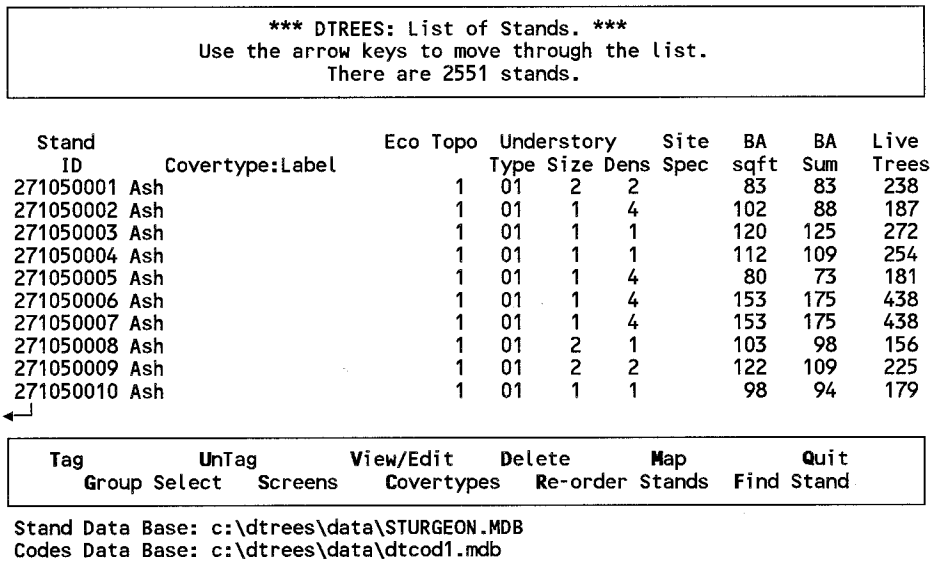
The <R>eorder option lets the user reorder the inventory according to several sorting options.

The <F>indoption lets the user specify data to find specific stands very quickly.

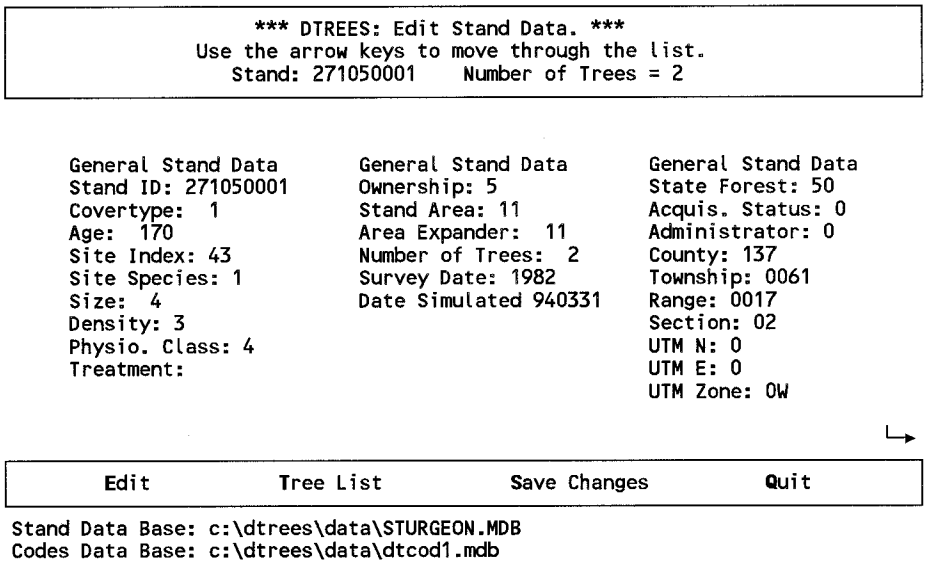
The following screens display the stand-level information on subsequent right screens opened by using the right arrow key:

```
                    *** DTREES: List of Stands. ***
                Use the arrow keys to move through the list.
                          There are 2551 stands.

 Stand                          Owner  Stand    Area    No. of   Survey     Date
   ID    Covertype:Label               Area  Expander   Trees    Date   Simulate
271050001 Ash                    5    11.0     11.0       2    1982  03-31-94
271050002 Ash                    5    26.0     26.0       5    1984  03-31-94
271050003 Ash                    5    12.0     12.0       4    1984  03-31-94
271050004 Ash                    5    53.0     53.0       5    1984  03-31-94
271050005 Ash                    5     9.0      9.0       5    1984  03-31-94
271050006 Ash                    5    27.0     27.0       4    1984  03-31-94
271050007 Ash                    5    10.0     10.0       4    1984  03-31-94
271050008 Ash                    5    18.0     18.0       2    1983  03-31-94
271050009 Ash                    5    61.0     61.0       5    1977  03-31-94
271050010 Ash                    5     7.0      7.0       4    1990  03-31-94
<┘                                                                      └>

   Tag          UnTag        View/Edit    Delete       Map          Quit
     Group Select   Screens    Covertypes   Re-order Stands  Find Stand

Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\dtcod1.mdb
```

```
                    *** DTREES: List of Stands. ***
                Use the arrow keys to move through the list.
                          There are 2551 stands.

 Stand                          Stat  Acq Admin                              UTM   Zone
   ID      Covertype:Label      For Stat      Cnty Twnshp Rnge Sec            N     E
271050001 Ash                   50    0     0  137   0061  0017  02               0W
271050002 Ash                   50    0     0  137   0062  0017  26               0W
271050003 Ash                   50    0     0  137   0059  0021  03               0W
271050004 Ash                   50    0     0  137   0059  0021  05               0W
271050005 Ash                   50    0     0  137   0062  0017  16               0W
271050006 Ash                   50    0     0  137   0062  0017  14               0W
271050007 Ash                   50    0     0  137   0062  0017  14               0W
271050008 Ash                   50    0     0  137   0061  0017  06               0W
271050009 Ash                   50    0     0  137   0061  0017  04               0W
271050010 Ash                   50    0     0  137   0060  0021  34               0W
<┘                                                                              └>

   Tag          UnTag        View/Edit    Delete       Map          Quit
     Group Select   Screens    Covertypes   Re-order Stands  Find Stand

Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\dtcod1.mdb
```



The <V>iew/Edit option opens a screen of plot level data which can be then be edited.



Using the right arrow key, the user can see the rest of the stand data:

```
                *** DTREES: Edit Stand Data. ***
              Use the arrow keys to move through the list.
                 Stand: 271050001    Number of Trees = 2

General Stand Data      General Stand Data      General Stand Data
Ownership: 5            State Forest: 50        Ecoregion:
Stand Area: 11          Acquis. Status: 0       Topography: 1
Area Expander:  11      Administrator: 0        Understory Type: 01
Number of Trees:  2     County: 137             Understory Size: 2
Survey Date: 1982       Township: 0061          Understory Dens: 2
Date Simulated 940331   Range: 0017             Basal Area:  83
                        Section: 02             Basal Area Sum:  83
                        UTM N: 0                Live Trees: 238
                        UTM E: 0
                        UTM Zone: 0W
```

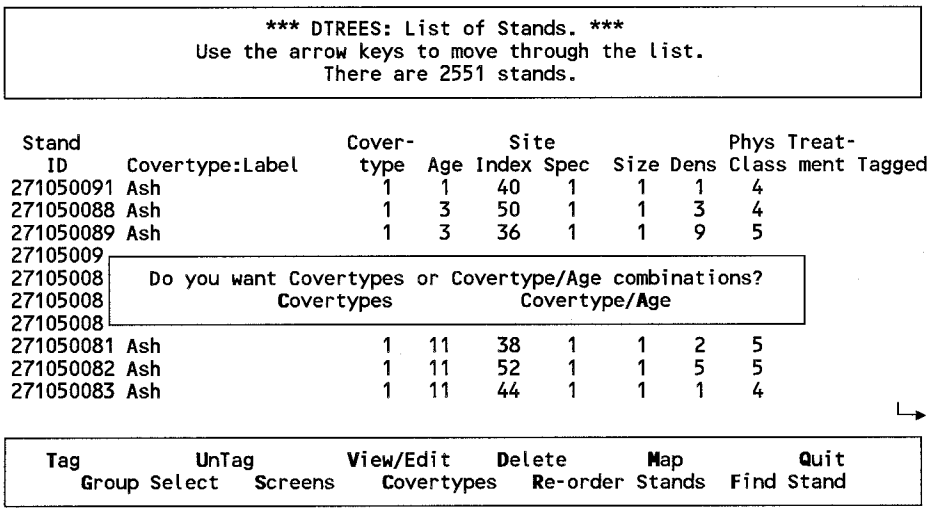
```
     Edit          Tree List          Save Changes          Quit

Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\dtcod1.mdb
```

The <E>ditoption permits editing of the stand-level data. After editing of any stand data, the <S>aveChanges option updates the current stand record. The <T>reeList option will open a screen with tree-level data.

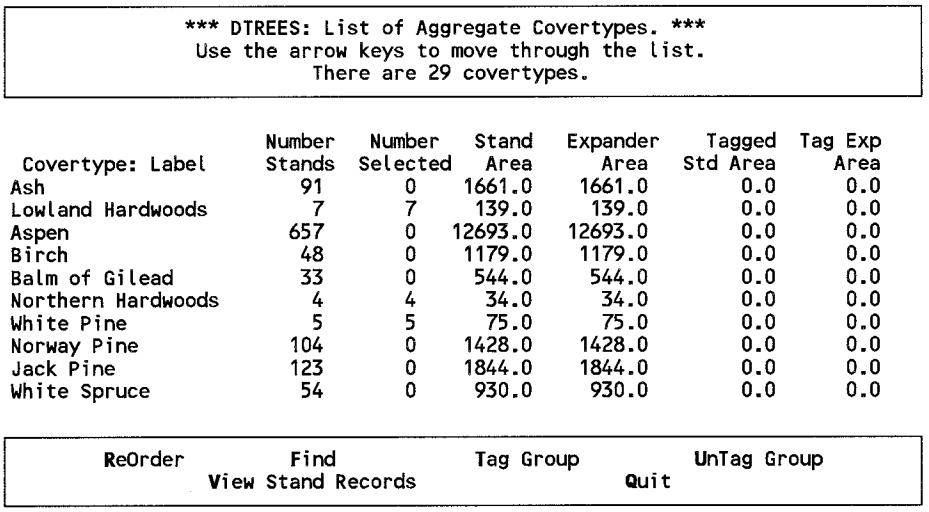
```
                *** DTREES: Edit Tree List. ***
              Use the arrow keys to move through the list.
                 Stand: 271050001    Number of Trees = 2

                          Species                    No. Trees     Crown
Tree #    Species         Label          Diameter    per Acre      Ratio
   1          1      Black Ash             8.0        216.0         -1
   2         73      N White Cedar         8.0         22.0         -1
```

```
   Edit    Add    Delete    ReOrder    Stand-Level    Save Changes    Quit

Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\DTCOD1.MDB
```

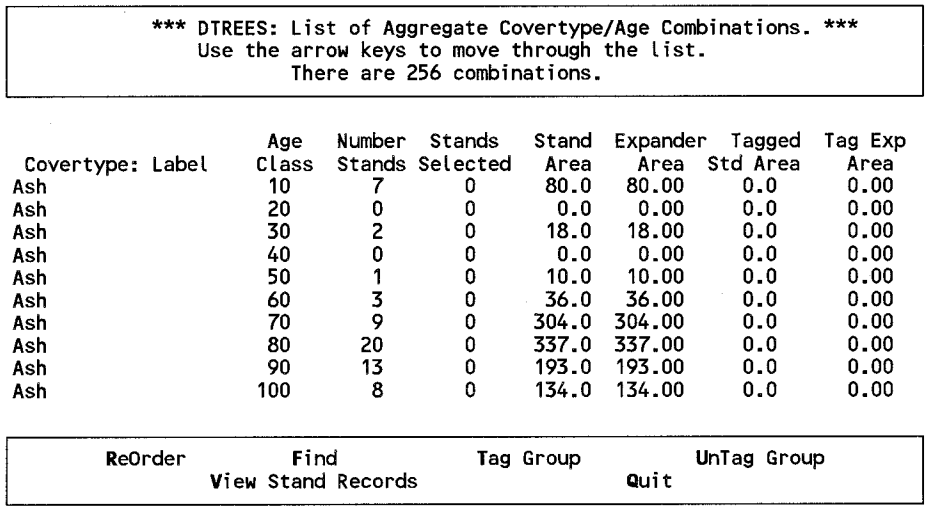
These tree data records can be deleted, edited, reordered, and be saved using the associated letters at the bottom of the screen. Tree records can also be added. <L>,<Esc>,or <Q> will return the user to the stand-level data. The <C>overtypeoption at the stand level provides the user with aggregate data records by covertype or covertype/age classes.



Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\DTCOD1.MDB



Stand Data Base: c:\dtrees\data\STURGEON.MDB
Codes Data Base: c:\dtrees\data\DTCOD1.MDB

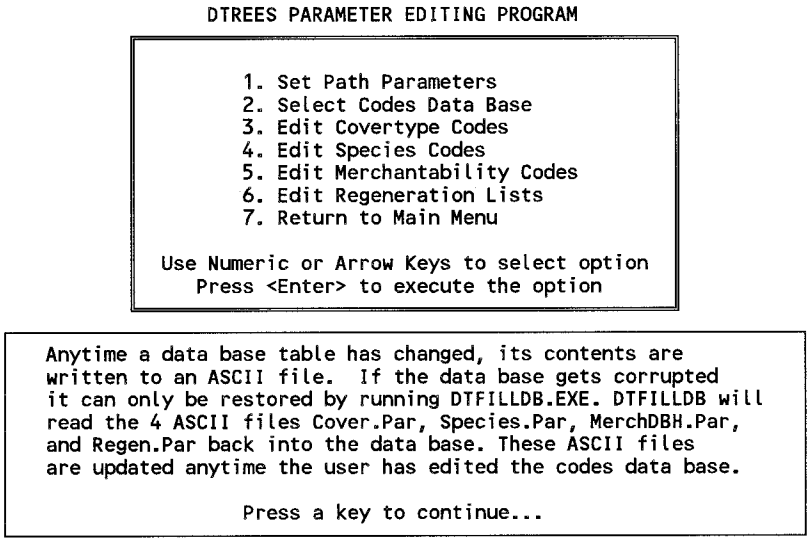


Suboption 5: Quit DTREES Stand Lister Program

The user will be returned to the DTREES Main Menu.

MAIN MENU OPTION 6: REVIEW/EDIT CODES DATA BASE (DTPEDIT.EXE)

This option permits the user to review and/or edit any of the four data base tables specifying various conversion parameters. All four tables can be expanded by adding records, or records can be edited or deleted.



Suboption 1: Select Paths Defaults

This general option was described above.

Suboption 2: Select Codes Data Base

This general option was described above.

Suboption 3: Edit Covertype Codes

This option permits the user to assign DNR covertype codes to one of 12 covertype codes used by the USDA Forest Service RunGrow routine. Setting the covertype conversion files assigns each and every possible commercial forest inventory code to one of the 12 DTREES decision trees. While it is recommended that each inventory covertype is simulated under the decision tree that most closely corresponds to the inventory type it is not required. Therefore, the user may find it advantageous to simulate the bulk of the aspen stands under the aspen decision tree, but for some aspen stands, the user may choose to use the birch decision tree, or even the red pine decision tree. DTREES will not convert the covertype, the conversion codes simply instruct DTREES as to which decision tree structure and critical parameter set to use to make a management decision at a particular point in time. This provides added modelling flexibility.

When editing covertype conversion codes, the user is presented with an editing screen with 4 columns: inventory covertype code, inventory covertype name, decision tree code and decision tree name. Of these 4 columns, the user may edit any value in the last (most right) three columns. DTREES is set up to allow up to 100 unique inventory covertypes, and each of these

may be paired with one decision tree. When this screen appears, the user may use PgUp or PgDn keys to page between screens. The arrow keys are then used to select a column and field for editing. When the desired field is highlighted, pressing the "E" key will allow the user to edit that field. If the user has selected a field in the Covertype Name column, by continuously pressing the F1 key the user can cycle through all currently available covertype names. At any point the backspace key and other keys can be used to edit that field. Pressing the enter key saves the new name. If the field is in the decision tree name column, the F2 key will similarly cycle through the 12 available DTREES decision trees and a "Not Used" option. Or the user may simply type in the decision tree name. Or the user may simply enter the decision tree code value (1-12, 13 for "Not Used") and the name column will be updated automatically. Pressing the escape key exits this function.

```
                DTREES PARAMETERS INPUT AND EDITING SECTION
                Use the arrow keys to move through the list.
There are 100 covertype records in data base: c:\dtrees\data\DTCOD1.MDB
```

DNRCovTyp	Label	RGrowCovTyp	Label
1	Ash	12	Lowland Hardwood
2	Not Used	13	Not Used
3	Not Used	13	Not Used
4	Not Used	13	Not Used
5	Not Used	13	Not Used
6	Willow	12	Lowland Hardwood
7	Not Used	13	Not Used
8	Not Used	13	Not Used
9	Lowland Hardwoods	12	Lowland Hardwood
10	Not Used	13	Not Used

```
Edit Record        Add Record        Delete Record        Quit
```

If any changes were made in the data base table, the program will save these changes in the data base as well as write an ASCII backup files with the data base contents. This is a precaution for the case that the data base table is corrupted and needs to be generated again. This is done by the program "DTPEDIT.EXE" which will read data from these ASCII files back into a relational data base structure. The user is prompted for a file name or can write to the default file name. This latter procedure is recommended to avoid cluttering the disk with unnecessary data files.

```
Covertype conversion codes table will be saved to file:
                c:\dtrees\DATA\COVER.PAR
  Do you want to save outputs under another file name

                Yes                    No

  Enter path name or hit <Enter> for default C:\DTREES\DATA\
                ►                      ◄

  Enter data filename, or press only <ENTER> to return
                ►      ◄
```

The same type of saving option will be given if edits have been performed in any of the following three relational data base tables and will not be repeated below.

Suboption 4: Edit Species Codes

This option permits the user to assign DNR species codes to one of 31 GROW species codes used by the USDA Forest Service RunGrow routine (Brand, 1981b). The original species code is always retained in all projections and in the final output. It is recommended that the user pair inventory species groups with the GROW species group that most closely corresponds to the inventory species group's growth and mortality characteristics.

The editing and pairing procedure for the species conversion codes is identical to that described above for the covertype conversion codes. If a new species group is added to the original species list, DTREES automatically gives that species default timber size class codes which the user may wish to edit.

```
              DTREES PARAMETERS INPUT AND EDITING SECTION
              Use the arrow keys to move through the list.
 There are 100 species records in data base: c:\dtrees\data\DTCOD1.MDB

 DNRSpec      Label              RGrowSpec        Label

    1         Black Ash             11          Black Ash
    2         American Elm          15          Elm
    3         Silver Maple          13          Silver Maple
    4         Red Elm               15          Elm
    5         Rock Elm              15          Elm
    6         Willow                12          Cottonwood
    7         Not Used              28          Not Used
    8         Not Used              28          Not Used
    9         Not Used              28          Not Used
   10         Not Used              28          Not Used

 Edit Record        Add Record        Delete Record        Quit
```

Hints about DTREES Species/Covertypes Conversion Files

The species conversion codes in the corresponding codes data base table and backup ASCII file **SPECIES.PAR** pairs each species code in your inventory with one of 31 RGROW species for individual tree projection. If DTREES encounters a species that it cannot recognize, the procedure will fail and a systems "crash" will occur and an error message will appear. **Make sure that any species code DTREES may encounter is paired with a RGROW code in the data base and SPECIES.PAR file!** You have the option of pairing any species in your inventory with the RGROW species that most accurately reflects the growth and mortality characteristics of that species. The growth projection parameters used are the same set used by **STEMS** (Belcher et. al., 1982).

As with the species conversion procedure, the covertype conversion codes in the corresponding codes data base table and backup ASCII file **COVERTYP.PAR** pairs each covertype in the inventory with one of the 12 DTREES decision tree simulation systems. If DTREES encounters a covertype in an input file with a code not found in the **COVERTYP.PAR** file, DTREES will "crash" and produce an error message. **Make sure that any covertype code DTREES may**

encounter is paired with a DTREES decision system in the data base table and COVERTYP.PAR file!

Also, you may choose to pair a certain covertype in your inventory with any DTREES decision system. You do not need to pair red pine to red pine, you may choose to pair red pine to aspen. DTREES would then use the aspen decision system to simulate the management of red pine stands, but regeneration of the stand (if Model I formulation was used) would still be with the regeneration tree list for the red pine covertype as created with the **DTPEDIT** system.

Suboption 5: Edit Merchantability Codes

DTREES separates trees into three product classes:

Residual wood - any tree with a DBH less than the minimum indicated (Biomass) poletimber DBH and at least equal to 1 inch and all volume in a tree above merchantable pulpwood top diameter outside bark (DOB).

Pulpwood - any tree with a DBH between the minimum pole timber DBH and the minimum sawtimber DBH, and the section of a tree above the minimum sawtimber top DOB but below the minimum pulpwood top DOB.

Sawtimber - any tree with diameter at least the defined minimum sawtimber DBH and below the minimum sawtimber top DOB.

DTREES allows you to change the definition of minimum pulpwood and sawtimber DBH and top DOB for each species in the inventory. In this manner, a user can restrict certain species to certain product classes. If a species is not used for sawtimber, define the minimum sawtimber DBH = 99.99, which would force all volume into the pulpwood and residual wood categories. In a similar manner, you could restrict a species to only biomass production, or relax a sawtimber criteria for a certain high-value species.

This option permits the user to assign for each DNR species code specific utilization parameters in the form of pole or sawtimber dbh and dob limits. These parameters are used by DTREES in the calculation of harvest and residual stand volumes. Editing timber size class codes is done using the same editing style as with the covertype and species conversion files. In this editor, however, new species names cannot be added, and timber size class codes can be edited only for those inventory codes that have a species group name assigned to them. If the code is not used, the editor will skip over these rows. Pressing the "E" key allows the user to edit the values for each of the size classes. There are restrictions on the numeric values that will be accepted by DTREES for any one of the size classes and they are given below.

The restrictions on size class diameters are:

Pole DBH:	Pole DBH $<$ Saw DBH, Pole DBH ≥ 3.50
Saw DBH:	Saw DBH $>$ Pole DBH, $8.00 \leq$ Saw DBH ≤ 99.99
Pole Top DOB:	Pole DOB $<$ Pole DBH, Pole DOB $<$ Saw DOB
Saw Top DOB:	Saw DOB $<$ Saw DBH

Within the editing function, after pressing the "E" key to edit a given field, pressing the F1 key will insert the default value for that field. As mentioned before, by entering a very large value for a minimum DBH, you can prevent that species from ever being utilized for that product. For example, if you know that black locust is never utilized for sawtimber, enter 99.99 for the minimum DBH. All harvested locust volume will then be assigned to residual wood and pulpwood.

DTREES PARAMETERS INPUT AND EDITING SECTION
Use the arrow keys to move through the list.
There are 100 merchantability records in data base: c:\dtrees\data\DTCOD1.MDB

DNRSpec	Label	Pole DBH	Saw DBH	Pole DOB	Saw DOB
1	Black Ash	5.00	12.00	4.00	8.00
2	American Elm	5.00	12.00	4.00	8.00
3	Silver Maple	5.00	12.00	4.00	8.00
4	Red Elm	5.00	12.00	4.00	8.00
5	Rock Elm	5.00	12.00	4.00	8.00
6	Willow	5.00	12.00	4.00	8.00
7	Not Used	5.00	12.00	4.00	8.00
8	Not Used	5.00	12.00	4.00	8.00
9	Not Used	5.00	12.00	4.00	8.00
10	Not Used	5.00	12.00	4.00	8.00

Edit Record Add Record Delete Record Quit

Suboption 6: Edit Regeneration Lists

In order to develop a regeneration system which would cover all major covertypes in Minnesota, the Phase I FIA data for all plots in with average age 10 to 20 were aggregated by covertype and average "regeneration lists" were developed.

This option permits the user to develop/edit customized regeneration lists for any covertype. These lists require input of a species code, a species diameter, and a tree expansion factor (tree per acre represented by the tree).

DTREES PARAMETERS INPUT AND EDITING SECTION
Use the arrow keys to move through the list.
There are 732 regeneration records in data base: c:\dtrees\data\DTCOD1.MDB

DNRCovTyp	Label	TreeNo	DNRSpec	DBH	Tree Expander
1	Ash	1	1	1.50	65
1	Ash	2	1	2.50	26
1	Ash	3	1	3.50	12
1	Ash	4	1	4.50	14
1	Ash	5	1	5.50	6
1	Ash	6	1	6.50	2
1	Ash	7	1	7.50	1
1	Ash	8	1	11.50	3
1	Ash	9	3	1.50	100
1	Ash	10	3	3.50	34

Edit Record Add Record Delete Record Quit

Regeneration Files and DTREES Simulation Dynamics

DTREES volume outputs are aggregated by species groups as defined in the codes data base species table and corresponding SPECIES.PAR conversion file. If the regeneration tree list contains a large number of different species, the output volume files will be larger, in direct proportion to the number of additional species contained in the regeneration files.

The time it takes DTREES to calculate gross cubic foot volumes for a stand is directly proportional to the **number of trees in a given tree list**. Therefore, if a regeneration file contains a large number of trees (whether all one species or not), DTREES will take more time to process that stand.

With the above two comments in mind, editing of the regeneration tree lists and the initial inventory tree lists is important. The objective is to model the total volume by product class as accurately as possible without excessive detail. For example, if your data indicates that in a red pine plantation there exists 20 stems per acre of jack or scotch pine, you may decide to omit these stems or simply include them in the regeneration tree list as red pine stems, especially if these trees will be harvested and used for the same product as the red pine. Likewise, if you are modelling a northern hardwood stand, data may indicate as many as 20 species in a given stand, with only 4 or 5 predominating. In this case you may choose to completely list out the dominant and valuable trees, and lump the rest as miscellaneous hardwoods. However, if DTREES simulation time and disk space is not a concern, DTREES can handle tree lists up to 100 trees per stand.

Suboption 7: Return to Main Menu

The user will be returned to the DTREES Main Menu.

MAIN MENU OPTION 7: VIEW/EDIT DECISION TREES

An Introduction to the DTREES Decision Trees

In order to make silvicultural evaluations, some type of expert knowledge must be encoded into DTREES in a decision subsystem. This decision making system must be automated in order to accommodate the batch processing style of DTREES. Recent work in simplifying the silvicultural decision making process has been done in the form of simple decision trees (Brand, 1981a). These decision trees were developed to be used in a computerized format in the STEMS growth- projection system. They are based on silvicultural guidelines found in manager's handbooks for Lake States' covertypes.

The figure below shows an example of a decision tree for the aspen covertype. The decision tree uses stand-level characteristics to evaluate a stand and determine the appropriate harvest action at a given moment. The decision trees are aptly named. Starting at the far left of the tree (root) the stand is evaluated at each junction of branches until it reaches the far right of the tree, arriving at a harvest action. At each junction a different stand characteristic is compared to the critical values, and one of the paths is taken to the next decision junction. The critical values are the governing factors in the determination of a harvest prescription. It should be pointed out that the decision tree as shown in the figure will only produce one management action for a given stand at a point in time (decision node). The mechanism for arriving at a different ending branch in the decision tree will be discussed later.

Decision trees were selected for DTREES for several reasons. They are easily understood by silviculturalists and foresters, and they have a clear and simple logic. Decision trees are easily implemented in a computer program, and provide a quick evaluation of the stand at a given point in time. Finally, changes in the critical values and simple structural modifications are easy to make. For example, in the aspen decision tree, to prevent the conversion of any aspen stands to red pine, simply alter the critical value at that junction to equal zero. Since no aspen stand will have a site index of zero, the conversion prescription will never be made.

The decision system in DTREES is a set of 12 decision trees developed to simulate timber management in the Lake States (Brand, 1981a). An abbreviated decision tree is shown in the following figure:

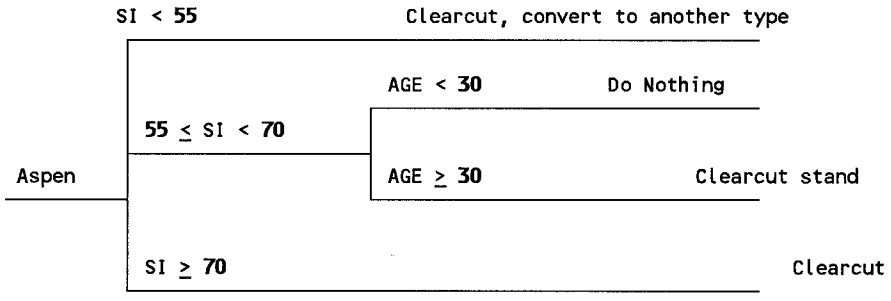


Figure. Structure of a simple decision tree.

At each node of the decision tree, there is an associated critical stand parameter, here site index (SI) and stand age (AGE). Each critical parameter has an associated value (shown

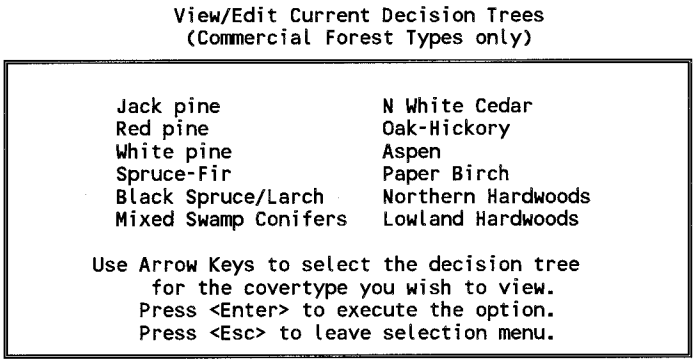
in bold type). The stand's SI value is compared against these values and the appropriate decision path is followed until a management decision is reached. It is important to note that in this unmodified decision tree, there is only one possible management decision for any given state of the stand. For example, an aspen stand with SI = 65 and AGE = 25 would result in a "Do Nothing" recommendation from this decision tree.

By pressing <7>while in the DTREES main menu, the VE module is executed. But prior to the actual execution of the VE system, the user is queried as to whether or not they wish to change the current set of critical parameters used in the DTREES' run. These critical parameter sets are the sets of all the values (remember the numbers shown in bold in the figure above) associated with each of the 12 cover types and their decision trees. DTREES allows you to store and maintain 4 sets of these critical parameters. **The default set (set 1) is a direct adaptation of silvicultural guidelines published by Brand (1981).** These sets allow the user to maintain a base set of parameters while experimenting with different values, or specializing a set of critical parameters for different regions or management objectives.

By pressing <Y>or <y>in answer to the query, the user can then select the set of interest by pressing <1>,<2>,<3>,or <4>.The VE module will execute once this decision is made.

Viewing and Editing Decision Trees

While the **VE** module loads up, a message is flashed on the screen. When the module is loaded and ready to run, a covertype selection menu appears on the screen as shown below. To select a cover type, highlight a choice with the cursor keys and press the <Enter> key.



Once a covertype is selected, you will see part or all of the decision tree on the screen (as the one for aspen in the figure above). Some of the decision trees are rather large and therefore take up 2-4 screens while others are simple enough to all fit on one screen. At the bottom of each screen, in reverse video, you will see a list of the available key presses (command line):

Command Options: E-(Edit) C-(Continue) 1 2 3 4

(This happens to be the screen options for the Northern Hardwoods type). These options will allow you to edit (press <E>)the critical values associated with the stand parameters, return to the main VE menu (press <C>),or switch to another screen which shows you more of the decision tree (press <1>,<2>,<3>,or <4>). If you don't see any numbers on the command line, then all of the decision tree is shown on the current screen. The following is a list of the decision trees and the number of screens for each:

Decision Tree Cover Type	Number of Screens
1. Jack Pine	2
2. Red Pine	3
3. White Pine	2
4. Spruce-Fir	3
5. Black Spruce (Larch)	1
6. Mixed Swamp Conifers	2
7. Northern White Cedar	3
8. Oak-Hickory	4
9. Aspen	1
10. Paper Birch	1
11. Northern Hardwoods	4
12. Lowland Hardwoods	1

When editing critical values, you can only edit those which appear on the screen which is currently displayed, unless that decision parameter also occurs on a prior screen. To begin editing critical values shown on the screen, press <E>. You will notice that the command line will change from

Command Options: E-(Edit) C-(Continue) 1 2 3 4

to

Change this value (Y/N)? (Press E again to escape the editor)

At the same time, a critical value will blink off/on the decision tree. If you press <E> again, the command line will return to its original state and the blinking will stop. If you press <N>,the command line will remain the same, but a new value on the screen will be blinking. You may run through all the critical values on the screen in this manner until the one you wish to edit is blinking. When you have cycled through all the values that can be edited on the screen, the command line will return to its original state (remember, the numbers may not appear on the command line, it depends on which cover type you are currently viewing).

When you find the value you are interested in changing, press <Y>and the command line will change to something like this:

Current critical value (1 9 1) = 40 New value = ##.#

The pound signs (#) will be in reverse video and they represent the format for this critical value. The current critical value should be the same as the value flashing on the screen. The numbers in the parenthesis correspond to critical value set, cover type, and critical value. So in the example above, we are in the first critical parameter set, our cover type is

9 (Aspen), and we are editing the first critical value. To change the critical value, simply press the numbers which will be inserted into the format as you press them, left to right. You do not enter the decimal point as it is assumed. Here are some examples for the above situation:

To change the value from 40 to 60, press:	<6><0><0>
To change the value from 40 to 7.5, press:	<0><7><5>
To change the value from 40 to 80.5, press:	<8><0><5>
To make no changes (40 to 40), press:	<4><0><0>

The editor will only accept numeric keypresses at this point, and when you have made the last accepted keypress, the new value will be displayed on the screen (no blinking) and a new value will be blinking (unless that value was the last to be edited on the screen).

Some of the variables on the decision tree branches need further explanations: BASAP, BAPOLE, and BASAW stand for basal area of sapling, pole, and sawtimber respectively. These classes are defined by the user in the merchantability codes editing program DTPEDIT or main menu option 6. The variable DBAR signifies the average dbh. Two variables, BAMIN and BAROT are defined as regression equations at the bottom of some decision tree. Within these equations, the variables QMDBH stands for quadratic mean diameter, NT stands for number of trees, Age for stand age.

Editing the values associated with the critical parameters is the only editing allowed. Structural alterations of the decision trees themselves, or the harvest actions specified by them (with the exception of thinning intensity) is not possible. However, minor alterations in the tree structure can be accomplished by "pruning" branches of the tree by setting critical values to a minimum or maximum value. The figure below shows how we could modify the simple aspen decision tree shown in the earlier figure so that the simulation would never recommend a clearcut followed by a type conversion. The actual decision tree for the aspen cover type is shown in the next figure. Here, two branches are "pruned" from the decision tree. Type conversion is eliminated as in our previous example, but now, for stands with site index greater than 70, the option to thin stands between the ages of 30 and 40 is eliminated by setting BA too high to be ever selected.

Additional comments on how the decision trees can be made more flexible can be found in section "Setting Covertype/Species Conversion Codes".

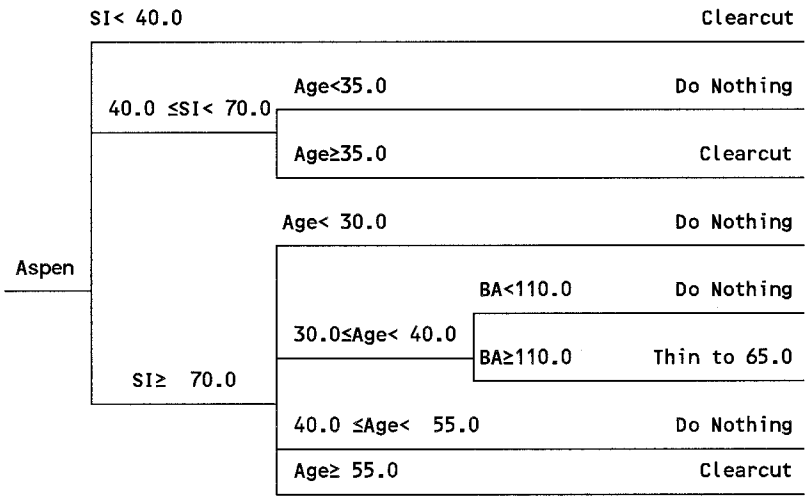
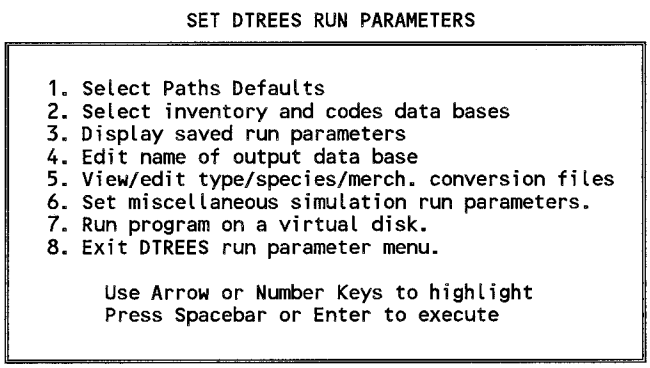


Figure. Example of "pruning" a decision tree so that the simulation will never recommend type conversion.

MAIN MENU OPTION 8: SET RUNNING PARAMETERS

Once all the decision tree parameters have been set, the user uses the **Set Run Parameters** (**SRP**) subsystem to enter in all the other pertinent parameters needed by DTREES to run. This section will explain each component of the **SRP** system and how it is used to control the DTREES simulation module **RDTREES**. To enter into the SRP system, highlight <10> while in the DTREES Main Program menu.

The **SRP** menu will appear on the screen. Use either the arrow keys or the numeric keys to highlight the option of interest and key press <SPACEBAR> to select that option.



Suboption 1: Select Paths Defaults

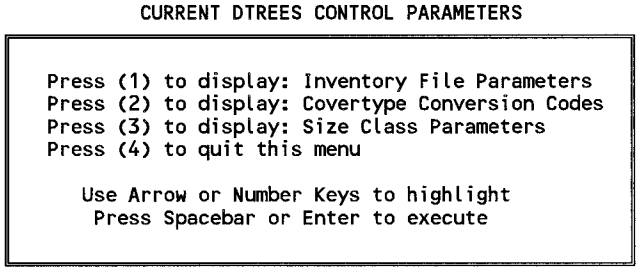
This general option was described above.

Suboption 2: Select Inventory and Codes Data Bases

This general option was described above.

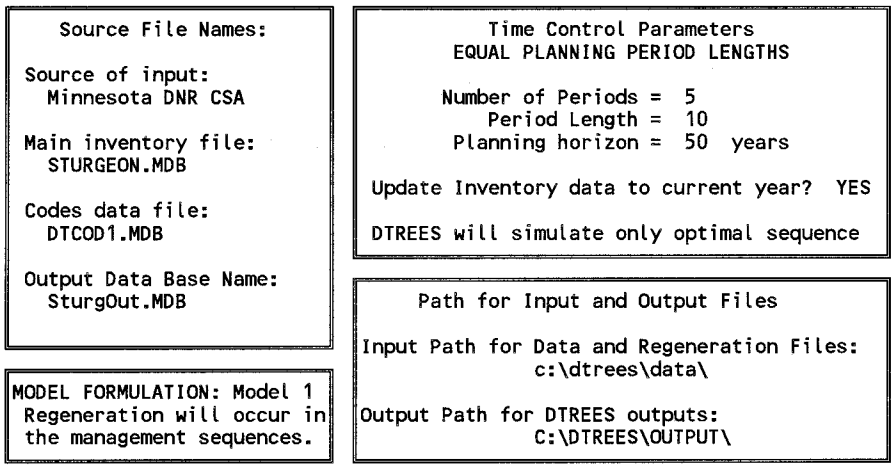
Suboption 3: Display Saved Run Parameters

The following screen will open:



By pressing <1> the user will see the screen below. There are four boxes. The box on the upper left corner contains the source file and output file names. Moving clockwise, the box in the upper right-hand corner shows the time control parameters for each planning period, whether or not DTREES will update inventory data to the current year, and whether or not

DTREES will simulate multiple sequences over the planning horizon. The box on the lower right-hand corner displays the paths where DTREES will search for the input files, where it will place the output files, and where it will search for the regeneration lists. Finally, in the lower left-hand corner the modelling formulation DTREES will use is displayed. This information will stay on the screen until any key press is made, at which point the display control parameters menu will reappear.



Pressing <2> in the display control parameters menu will display the covertype conversion codes and then the species conversion codes currently used by DTREES to convert inventory codes for covertypes and species to those recognized by DTREES and the RGROW growth projection system. The codes are displayed sequentially, when the screen is filled, DTREES will wait for a key press before continuing to display more codes. These codes can be edited using the DTPEDIT.EXE module.

CURRENT COVERTYPE CONVERSION CODES

Inventory Code	Inventory Type	Dtrees Code	Decision Tree Used
1	Ash	12	Lowland Hardwood
2	Not Used	13	Not Used
3	Not Used	13	Not Used
4	Not Used	13	Not Used
5	Not Used	13	Not Used
6	Willow	12	Lowland Hardwood
7	Not Used	13	Not Used
8	Not Used	13	Not Used
9	Lowland Hardwoods	12	Lowland Hardwood
10	Not Used	13	Not Used
11	Not Used	13	Not Used
12	Aspen	9	Aspen
13	Birch	10	Paper Birch
14	Balm of Gilead	9	Aspen
15	Cottonwood	12	Lowland Hardwood
16	Not Used	13	Not Used
17	Not Used	13	Not Used

Press any key to continue....

SPECIES CONVERSION CODES

Inventory Code	Inventory Species Group	GROW Species Code	GROW Species Group
1	Black Ash	11	Black Ash
2	American Elm	15	Elm
3	Silver Maple	13	Silver Maple
4	Red Elm	15	Elm
5	Rock Elm	15	Elm
6	Willow	12	Cottonwood
7	Not Used	28	Not Used
8	Not Used	28	Not Used
9	Not Used	28	Not Used
10	Not Used	28	Not Used
11	Not Used	28	Not Used
12	Quaking Aspen	25	Quaking Aspen
13	Paper Birch	26	Paper Birch
14	Balm of Gilead	30	Other Hardwoods
15	Cottonwood	12	Cottonwood
16	Bigtooth Aspen	24	Bigtooth Aspen
17	Hybrid Poplar	12	Cottonwood

Press any key to continue....

By pressing <3>in the display control parameters menu, the user will be able to observe the current timber size class codes used for each species group in the inventory. These codes determine, how each tree is assigned to a product class group, either sawtimber or pulpwood. They can be used to restrict certain species groups from a product class by setting the minimum DBH to a very large number (i.e. - 99.99). The minimum top diameters outside bark (DOB) are the smallest top diameters allowed for that species group. These codes can be edited using the DTPEDIT.EXE module.

TIMBER SIZE CLASS CODES

Species Code	Species Group Name	Sawtimber Min DBH	Sawtimber Min Top DOB	Poletimber Min DBH	Poletimber Min Top DOB
1	Black Ash	12.00	8.00	5.00	4.00
2	American Elm	12.00	8.00	5.00	4.00
3	Silver Maple	12.00	8.00	5.00	4.00
4	Red Elm	12.00	8.00	5.00	4.00
5	Rock Elm	12.00	8.00	5.00	4.00
6	Willow	12.00	8.00	5.00	4.00
7	Not Used	12.00	8.00	5.00	4.00
8	Not Used	12.00	8.00	5.00	4.00
9	Not Used	12.00	8.00	5.00	4.00
10	Not Used	12.00	8.00	5.00	4.00
11	Not Used	12.00	8.00	5.00	4.00
12	Quaking Aspen	12.00	7.00	5.00	3.00
13	Paper Birch	12.00	8.00	5.00	4.00
14	Balm of Gilead	12.00	8.00	5.00	4.00
15	Cottonwood	12.00	8.00	5.00	4.00
16	Bigtooth Aspen	9.00	7.00	4.00	3.00

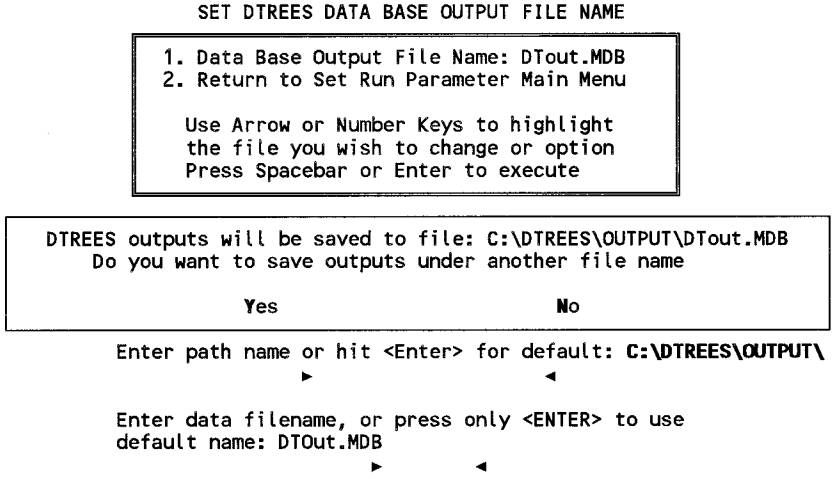
Press any key to continue....

Suboption 4: Edit Name of Output Data Base

By pressing <4>in the main Set DTREES Run Parameters menu, the user can edit the names of the output data base name created by DTREES. The data base contains three types of tables. The PRESCRIPTION table contains the list of alternative management sequences by stand, alternative, and period. It also contains some stand-level summary data such as stand age, stand size, residual and removed basal area.

The HARVEST table contains, for each record in the PRESCRIPTION table, a list of the volumes removed from the stand by species and rough product class. For non-harvest actions recorded in the PRESCRIPTION table, there is no record in the HARVEST table.

The RESIDUAL table is identical to the HARVEST table in structure, but it contains a list of residual volumes by species group for each record in the PRESCRIPTION LIST FILE. For records in the PRESCRIPTION table that have no merchantable volume, there is no record in this file.



Suboption 5. View/Edit Type/Species/Merch. Conversion Files

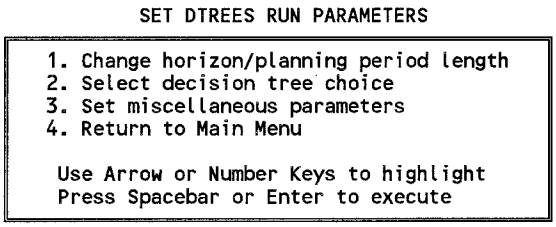
This option can also be directly invoked from the Main Menu option 6 "Review/Edit Codes Data Base" which was described on page 27.

Suboption 6: Setting Miscellaneous Simulation Run Parameters

Pressing <5> while in the main SRP menu allows the user access to the DTREES parameters shown below. When in this menu, the numeric keys 1-4 activate and act as toggles for the first four functions. Pressing <1>will toggle the inventory update function on/off. Pressing <2>will switch the modelling formulation between model I and model II. A special section below explains the important difference between choosing the model I versus model II option. Pressing <3>will toggle the number of alternatives generated at each decision node between 1 and 2. When only one alternative is generated, DTREES will produce only one management sequence per stand, and it will conform to the critical parameters entered in the View/Edit subsystem (see section IV.3).

Pressing <4>will allow you to enter a stand identifier (i.e., columns 1-21 for Phase II data) which corresponds to next identifier in the inventory input files DTREES will execute upon. (For standard ASCII file format the identifier can have any format (characters, spaces, or numbers), but it must be a string type field). In other words, DTREES will search sequentially through the input files until it finds the record with this identifier. DTREES will then start simulation with this stand in the inventory files. If an identifier is listed on

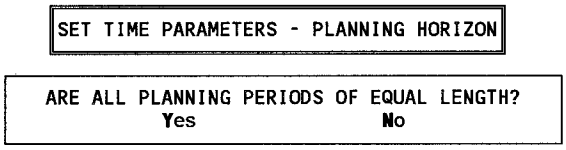
the screen, then pressing <4>will move the start-up point to the top of the current input files. Pressing <5>will escape this function and return control to the main SRP menu.



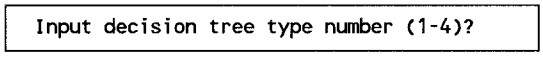
Change horizon/planning period length

By pressing <1>in the main Set DTREES Run Parameters menu, access to changing the length of each planning period and the total planning horizon is possible. DTREES will allow for a maximum of 10 planning periods, each may be from 1 to 50 years in length. First the user will be asked if all the planning periods are of equal length. If the response is yes (use Y or y), then DTREES will ask for the length of each planning period, then the number of each planning period. These values are inputted by typing the numeric value (integers only, please) and then pressing <ENTER> DTREES will then display what you have entered and ask for confirmation. Pressing n or N will allow you to re-enter your values, pressing y or Y confirms your input and DTREES will store it in the time parameter file.

If all planning periods are not of equal length, the user must enter first the number of planning periods (1-10), then for each planning period, the user must enter its length in years (integer only). Again, to enter a value at the prompt, type in the numeric value and press the <ENTER> key to input the data. DTREES will then display what was entered and ask for confirmation from the user as described above. Upon confirmation the data is stored in the time parameter file (TIME.PAR) on the data subdirectory.



Select decision tree choice



Set miscellaneous parameters

```
            CURRENT SETTINGS
Update Inventory to current year: YES
Current DTREES modelling formulation: Model 1
Number of alternatives generated at each decision node:  1

   1. Turn off inventory update function
   2. Change to model 2 formulation
   3. Generate alternative management sequences
   4. Escape this menu

      Use Arrow or Number Keys to highlight
      Press Spacebar or Enter to execute
```

Suboption 7: Run Program on a Virtual Disk

```
This option will transfer all necessary files to a
virtual or RAM drive.  This will speed program
execution considerably.  You will need a RAM drive
with at least 15 MB to run the whole DTREES package.

            Press a key to continue...
```

```
Are you sure that you want to run DTREES on virtual disk?
          Yes                    No
```

```
Enter letter for virtual drive?
```

```
Program will create appropriate directory and subdirectory on drive
  After finishing a run on virtual drive, relevant output will be
            redirected to a user specified drive.

                Press a key to continue...
```

Suboption 8: Exit DTREES Run Parameter Menu

The user will be returned to the DTREES Main Menu.

MAIN MENU OPTION 9: THE DTREES SIMULATION MODULE

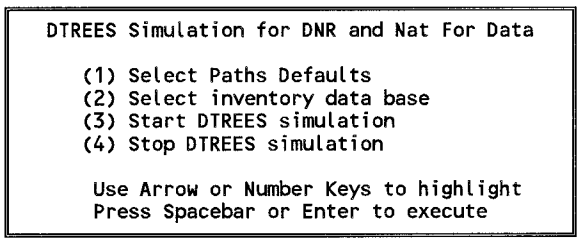
RDTREES.EXE is the run time simulator of the DTREES system. RDTREES performs the actual simulation of multiple harvesting sequences over time and creates the output files which are then used to create economic alternatives and then fed into the harvest simulator, DUALPLAN. RDTREES is activated by pressing <11>in the main DTREES menu. This should be done only after all decision tree and control parameters are set correctly for the DTREES run. When key <11>is pressed, the RDTREES module will load and begin its run.

Suboption 1: Select Paths Defaults

This general option was described above.

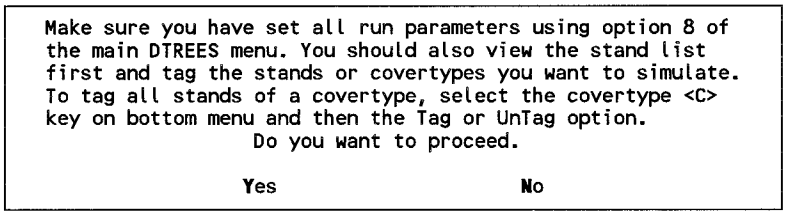
Suboption 2: Select Inventory Data Base

This general option was described above.



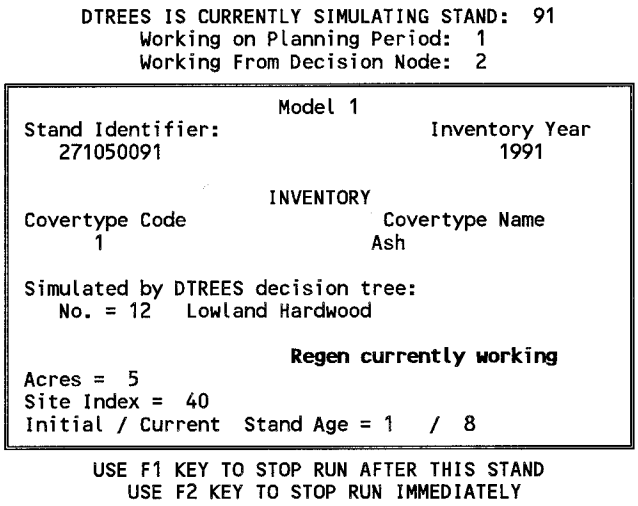
Suboption 3: Start DTREES Simulation

RDTREES will begin simulation of the stands that were tagged in the MAIN MENU OPTION 5: REVIEW/EDIT INVENTORY DATA BASE. The RDTREES screen will appear with certain information about the current state of the simulation.



The RDTREES screen displays some information about the stand currently being simulated and the state of that simulation process such as "Regen currently working." Stand information includes the original inventory stand identifier, the inventory covertype code, the date of the inventory data, the stand size in acres, the stand site index, and the stand's initial age (not current simulation stand age). Facts about the simulation include the DTREES decision tree under which the stand is being simulated, the current planning period which DTREES is simulating, and the decision node DTREES is working from. For a detailed explanation of these decision nodes, see

Pelkki, (1988). DTREES also displays how many stands it has simulated already in the current run of the RDTREES module. After the successful simulation of a stand, the stand is untagged in the stand data base.



There are two more important keys to remember while the RDTREES system is executing. The F1 key (one of 10 or twelve function keys on your keyboard) will, when pressed, stop the execution of the RDTREES module when the current stand is finished processing. The F2 key, on the other hand, will terminate the running of the RDTREES module immediately, without updating any work done to the current stand. For example, if you press the F1 key, RDTREES will finish processing the current stand, update the output files and return to the main menu. If F2 is pressed, RDTREES erases all work done on the current stand and returns you immediately to the DTREES main program menu. In either case, the processing completed on previous stands is already saved and RDTREES, when reactivated, will resume processing with the first unprocessed stand. The F1 and F2 keys are designed to allow the user to escape RDTREES and process large input files in a piecemeal fashion and allow the computer on which DTREES is installed to be used for other purposes when necessary.

MAIN MENU OPTION 10: DTREES REPORT WRITER

This program module is fully integrated within the DTREES system. As soon as a simulation of an inventory or part of an inventory has been terminated, the user has immediate access to a number of useful report writers.

```
        ***  Program options.  ***

   (1) Set Program Path Parameters
   (2) Report on Inventory Data
   (3) Report on DTREES Output
   (4) Review DTREES Stand-Level Output
   (5) Exit DTREES Report Writer Program

     Use Arrow or Number Keys to highlight
     Press Spacebar or Enter to execute
            Press Escape to end
```

Suboption 1: Select Paths Defaults

This general option was described above.

Suboption 2: Report on Inventory Data Base

This option generates 4 types of summary reports for the inventory data base as displayed below:

```
          ***  Inventory report options.  ***

(1) Report on one covertype area, basal area and volume.
(2) Report on covertypes area, basal area and volume.
(3) Report on covertypes area per age class.
(4) Report on stand data, per covertype.

           Use Arrow or Number Keys to highlight
           Press Spacebar or Enter to execute
           Press Escape to end
```

```
      ***          Inventory Report          ***


  This report will have the following information:
        - Total Area,
        - Basal area per acre,
        - Volume per acre,
  for the covertype chosen.


         Press a key to view covertype options.
```

```
    ***          Inventory Report          ***

This report will have the following information:
      - Total Area,
      - Basal area per acre,
      - Volume per acre,
for all covertypes.

       Press a key to continue or ESC to end.
```

```
    ***          Inventory Report          ***

This report will have the following information:
      - Total area per age class,
for all covertypes.

       Press a key to continue or ESC to end.
```

```
    ***          Inventory Report          ***

This report will have the following information:
- Area,
- Age,
- Volume per acre,
- Site index,
for all stands in the covertype chosen.

       Press a key to view covertype options.
```

Covertype Selection Menu

```
  ***  DNR CSA/Phase II covertype labels ***

Ash                     White Spruce
Willow                  Balsam Fir
Lowland Hardwoods       Lowland Black Spruce
Aspen                   Tamarack
Birch                   Northern White Cedar
Balm of Gilead          Upland Black Spruce
Cottonwood              Stagnant Spruce
Northern Hardwoods      Stagnant Tamarack
Walnut                  Stagnant Cedar
Oak                     Offsite Aspen
Central Hardwoods       Offsite Oak
White Pine              Red Cedar
Norway Pine             Cutover Area
Jack Pine               Lowland Grass
Scotch Pine             Upland Grass

     Use Arrow Keys to highlight choice
    Press <Enter> to select covertype
       Press <Esc> to select none
```

Suboption 3: Report on DTREES Output

This option generates 7 types of summary reports for the simulated stand management outputs as displayed below. Reports 1 and 2 are reports for all or selected covertypes as shown in the previous screen while reports 3-6 report for individual selected species:

```
          ***  DTREES Report options.  ***

  (1) Report on covertype areas.
  (2) Report on covertype volumes.
  (3) Report on species volume harvested data.
  (4) Report on species volume remaining data.
  (5) Report on species dbh distribution.
  (6) Report on species volume harvested by covertype.

       Use Arrow or Number Keys to highlight
         Press Spacebar or Enter to execute
              Press Escape to end
```

```
          ***          Covertype Report          ***


       This report will have the following information:
             - Total Area,
             - Area clearcutted,
             - Area thinned,
             - Area idle,
 for each planning period, age class and for the covertype chosen.


            Press a key to view covertype options.
```

```
          ***          Covertype Report          ***


       This report will have the following information:
             - Total Area,
             - Basal Area per acre,
             - Volume Remaining,
             - Volume Harvested,
 for each age class, planning period and for the covertype chosen.

              Press a key to view covertype options.
```

An example of this report is shown below:

Covertype: Aspen Planning period: 1

Age Class	Total Area (acres)	Basal Area (sq.ft./acre)	Vol. Harvested (10^3 cu.ft.)	Vol. Remaining (10^3 cu.ft.)
[0 10]	2,273	0.0	0.00	0.00
[10 20]	1,692	53.3	0.00	42.37
[20 30]	919	87.6	0.00	82.93
[30 40]	474	174.6	50.01	48.81
[40 50]	871	207.0	139.01	92.99
[50 60]	1,911	218.3	195.30	454.66
[60 70]	3,215	217.9	460.76	503.76
[70 80]	1,075	205.8	343.52	0.00
[80 90]	168	210.8	84.21	0.00
[90 100]	80	195.8	23.85	0.00
[100 110]	15	138.0	4.07	0.00
[110 120]	0	0.0	0.00	0.00

Press a key to see table for next age class or ESC to end.

Covertype: Aspen Planning period: 1

Age Class	Total Area (acres)	Basal Area (sq.ft./acre)	Vol. Harvested (10^3 cu.ft.)	Vol. Remaining (10^3 cu.ft.)
[120 130]	0	0.0	0.00	0.00
[130 140]	0	0.0	0.00	0.00
[140 150]	0	0.0	0.00	0.00
[150 160]	0	0.0	0.00	0.00
[160 170]	0	0.0	0.00	0.00
[170 180]	0	0.0	0.00	0.00
[180 190]	0	0.0	0.00	0.00
[190 200]	0	0.0	0.00	0.00
[200 210]	0	0.0	0.00	0.00
[210 220]	0	0.0	0.00	0.00
[220 230]	0	0.0	0.00	0.00
[230 240]	0	0.0	0.00	0.00
All	12,693		1,300.73	1,225.51

Press a key to see table for next planning period or ESC to end.

Reports 3-6 are for specific species. The user selects one from the following selection screen by moving the cursor to a species and by hitting the <Enter> key. Examples of these reports are displayed below.

Species Selection Menu

*** DNR CSA/Phase II species labels ***

Black Ash	Yellow Birch	Hackberry	Northern White Ce
American Elm	Walnut	Boxelder	Eastern Red Cedar
Silver Maple	Butternut	White Pine	Hemlock
Red Elm	Cherry	Norway Pine	Douglas Fir
Rock Elm	Buckeye	Jack Pine	European Larch
Willow	Red Oak	Scotch Pine	Japanese Larch
Quaking Aspen	Black Oak	Ponderosa Pine	Siberian Larch
Paper Birch	English Oak	Austrian Pine	Locust
Balm of Gilead	White Oak	White Spruce	Ironwood
Cottonwood	Burr Oak	Balsam Fir	River Birch
Bigtooth Aspen	Scarlet Oak	Colorado Spruce	Blue Beech
Hybrid Poplar	White Ash	Norway Spruce	Miscellaneous
Red Maple	Green Ash	Black Hills Spruc	
Sugar Maple	Bitternut Hickory	Black Spruce	
Basswood	Shagbark Hickory	Tamarack	

Use Arrow Keys to highlight choice
Press <Enter> to select covertype
Press <Esc> to select none

*** Species Report ***

This report will have the following information:
- Total volume,
- Total volume harvested,
- Residual volume harvested,
- Pulpwood volume harvested,
- Sawtimber volume harvested,

for each planning period and for the species chosen.

Press a key to view species options.

Species: Quaking Aspen

Unit: 10^3 cu.ft.

Pl.Period	Total Vol.	Tot.Vol.Harv.	Res.Vol.Harv.	Pul.Vol.Harv.	Saw.Vol.Harv.
1	2,388.1	1,274.0	194.7	737.1	342.2
2	1,505.1	943.9	147.8	548.6	247.5
3	1,010.0	329.9	50.0	127.4	152.5
4	1,215.3	427.3	68.6	208.3	150.4
5	1,349.8	435.0	74.5	262.6	97.9

Press a key to choose another species.

```
         ***          Species Report          ***


    This report will have the following information:
          - Total volume,
          - Total volume remaining,
          - Residual volume remaining,
          - Pulpwood volume remaining,
          - Sawtimber volume remaining,
    for each planning period and for the species chosen.

            Press a key to view species options.
```

Species: Quaking Aspen

Unit: 10^3 cu.ft.

Pl.Period	Total Vol.	Tot.Vol.Rem.	Res.Vol.Rem.	Pul.Vol.Rem.	Saw.Vol.Rem.
1	2,388.1	1,114.2	199.5	738.3	176.4
2	1,505.1	561.3	131.8	300.2	129.3
3	1,010.0	680.2	177.0	369.5	133.8
4	1,215.3	788.0	190.1	458.8	139.0
5	1,349.8	914.8	195.6	514.6	204.6

Press a key to choose another species.

```
         ***          Species Report          ***


    This report will have the following information:
          - Total volume,
          - Volume harvested,
          - Volume remaining,
    for each plan.period and average dbh class of the species chosen.
            Press a key to view species options.
```

Species: Quaking Aspen Planning period: 1 Unit: 10^3 cu.ft.

Dbh Class	Total Volume	Vol. Harvested	Vol. Remaining
[0 2]	2.1	0.0	2.1
]2 4]	104.1	1.3	102.8
]4 6]	42.4	18.2	24.2
]6 8]	139.9	76.0	63.9
]8 10]	519.5	256.4	263.2
]10 12]	1,023.0	537.6	485.4
]12 14]	421.1	257.2	163.9
]14 16]	126.7	119.4	7.3
]16 18]	8.9	7.6	1.3
]18 20]	0.3	0.3	0.0

Press a key to see table for next dbh class.
Press ESC to end.

Species: Quaking Aspen Planning period: 1 Unit: 10^3 cu.ft.

Dbh Class	Total Volume	Vol. Harvested	Vol. Remaining
]18 20]	0.3	0.3	0.0
]20 22]	0.0	0.0	0.0
]22 24]	0.0	0.0	0.0
]24 26]	0.0	0.0	0.0
]26 28]	0.0	0.0	0.0
]28 30]	0.0	0.0	0.0
All	2,388.1	1,274.0	1,114.2

Press a key to see table for next planning period.
Press ESC to end.

*** DTREES Report ***

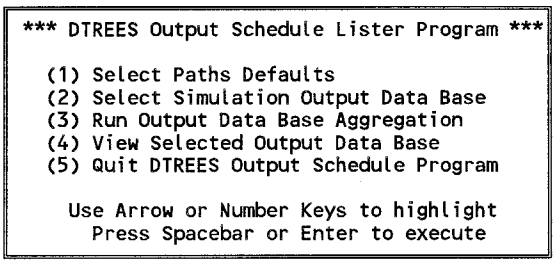
This report will have the following information:
- Total Area of Covertype Classes,
- Volume Harvested per Species and Covertype Classes,

Press a key to continue or ESC to end.

Appendix II shows an example of this output file for the Sturgeon River State Forest.

Suboption 4: Review DTREES Stand-Level Output

This suboption gives the manager ready access to the stand-level specific management options and associated harvest and residual stand data simulated by the DTREES program. Appendix III shows the DTREES output file structure.

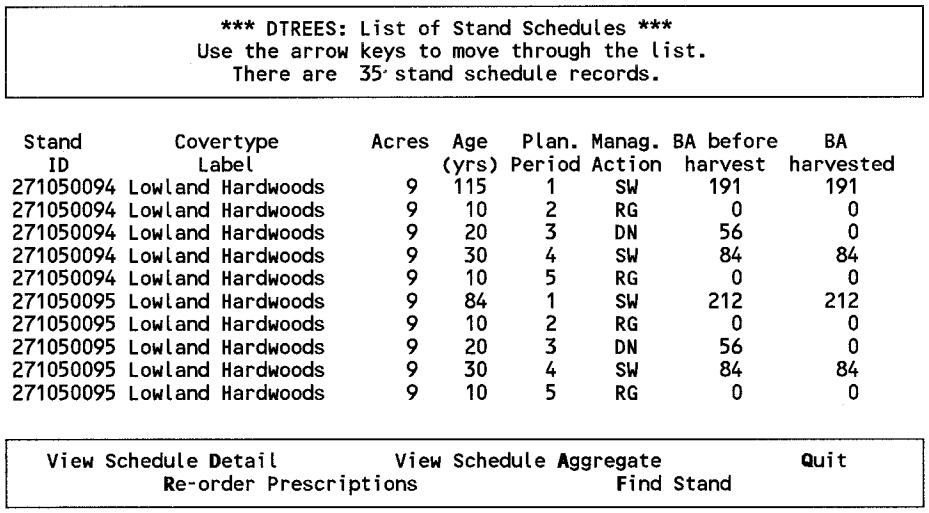


Run Output Data Base Aggregation

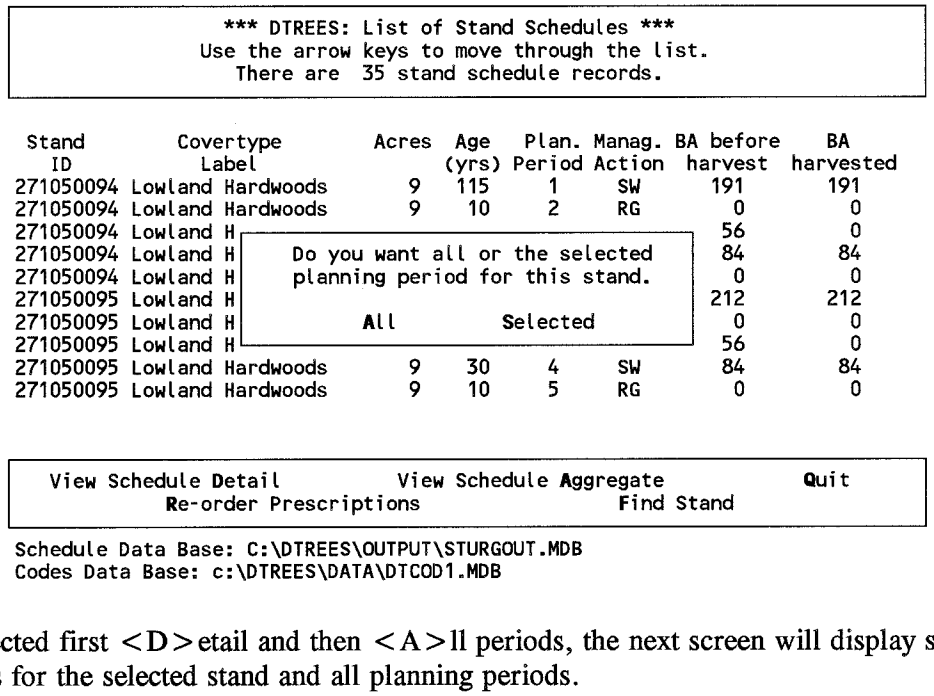
The first time a new simulation run has been done, the output data base should be aggregated using the data base utility option 3. This utility will create aggregate tree data base records for both harvest and residual volumes. The user is prompted for an output data base and the associated codes data abse that was used in the simulation.

View Selected Output Data Base

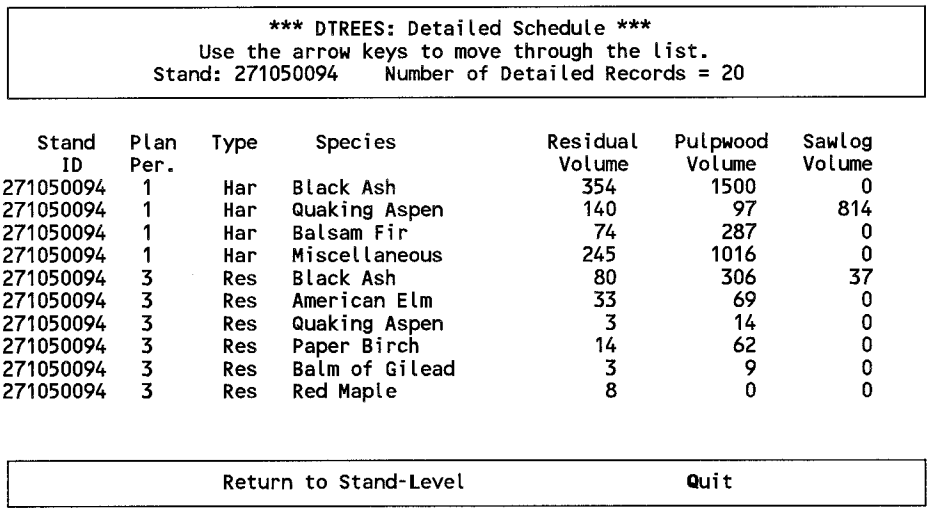
When option 4 is selected, the user can view all stand-level schedules generated by the program. One can scroll through the list using any of the keypad keys. Additionally, the user can find specific stand records, reorder schedule lists using various sorting options, and can review detailed or aggregate data records by entering a <D>or <A>. In both these cases, the user will be prompted for selecting either list for all planning periods for the selected stand or only the currently selected (highlighted) planning period.



By selecting <A>ggregate or <D>etail the program will ask for whether <A>ll planning periods or only the <S>elected planning period are(is) to be displayed.



Having selected first <D>etail and then <A>ll periods, the next screen will display species-level details for the selected stand and all planning periods.



The "type" field indicates whether the volumes shown are harvest or residual volumes where residual volumes refer to volumes remaining in a stand in a given planning period. The volumes themselves are gross cubic foot volumes per acre. For residual volumes it is the volume above the defined top DOB, for pulpwood volumes it is the volume between the defined sawtimber

top DOB and the pulpwood top DOB, and for sawtimber it is the volume above a one-foot stump and below the defined sawtimber top DOB.

Hitting <Esc>,<Q>uit or Stand-<L>evel will return the user to the stand level data screen.

Selecting first <D>etail and then <S>elected period, the next screen would display species-level details for the selected stand and only the selected planning period.

Having selected first <A>ggregate and then <A>ll periods, the next screen will display aggregate data for the selected stand and all planning periods. The selection of the aggregate data for a stand schedule provides a list of the harvest and residual volumes summed across the individual species.

*** DTREES: Aggregate Schedule List ***
Use the arrow keys to move through the list.
Stand: 271050094 Number of Aggregate Records = 5

				Harvest			Residual		
Stand ID	Plan Per.	Stand Area	Age	Residual Volume	Pulpwood Volume	Sawlog Volume	Residual Volume	Pulpwood Volume	Sawlog Volume
271050094	1	9.00	115	813	2900	814	0	0	0
271050094	2	9.00	10	0	0	0	0	0	0
271050094	3	9.00	20	0	0	0	216	625	37
271050094	4	9.00	30	405	946	162	0	0	0
271050094	5	9.00	10	0	0	0	0	0	0

Return to Stand-Level Quit

Schedule Data Base: C:\DTREES\OUTPUT\STURGOUT.MDB
Codes Data Base: c:\DTREES\DATA\DTCOD1.MDB

Both harvest volumes and volumes remaining in the stand are shown side by side for each planning period. The volumes again are gross cubic foot volumes per acre. For residual volumes it is the volume above the defined top DOB, for pulpwood volumes it is the volume between the defined sawtimber top DOB and the pulpwood top DOB, and for sawtimber it is the volume above a one-foot stump and below the defined sawtimber top DOB.

Selecting first <A>ggregate and then <S>elected period, the next screen would display the aggregate data for the selected stand and only the selected planning period.

DTREES MODELLING SYSTEM COMPONENTS

The following is a more detailed description of the models and assumptions used by RDTREES in simulating the alternative harvest sequences. More details can be found in a Master's thesis by Pelkki (1988).

Growth Projection System

Since the decision trees can only evaluate a stand at a given point in time, DTREES must have some method of projecting stands forward in time to the next planning period. For this purpose, a microcomputer growth-projection system **(RGROW)** based on the GROW subroutine (Brand, 1981b) has been adapted from **RUNGROW** (Eriksson, Ek and Weber, 1986).

Although obtaining the necessary tree-list data may require some extra data manipulation, several factors made the use of such an interface indispensable. The current trend is towards distance-independent growth models which provide the best projections and unfortunately have more demanding input data requirements than stand growth models. The use of tree lists allows easy simulation of harvest activities and permits more sophisticated selection harvest methods to be simulated as well. The use of the GROW subroutine meant that any combination of species and stand structure could be modelled (Brand, 1981b). This growth-projection system was already adapted for microcomputer use in RUNGROW, and only required minor modifications which allowed it to be integrated into DTREES.

The advantages in using RGROW are numerous. Since the GROW subroutine is part of the STEMS growth-projection system (Belcher, et al., 1982), updates in the growth and mortality coefficients will be easily installed into RGROW and DTREES. Also, the volume yields presented by DTREES should then be reasonably similar to volumes produced by STEMS. Also, this particular growth projection system is widely used and accepted in the Lake States (Ffolliot et al., 1985). Projection times for RGROW are less than two seconds for an abbreviated tree list over a 10-year period on an IBM PC-AT class computer. Performance of several DTREES components will be discussed in a later section. However, the time required to invoke and run the growth simulator does not, at this time, present a major problem in the matrix generating process.

It should be noted that to keep data requirements and processing time to a minimum, the tree lists used by DTREES are aggregated. The entire stand must be represented with 10 or less trees in the tree list. It has been shown that aggregate or "short" tree lists do not result in a great loss of precision (Ek, et al., 1985). More recent work has supported these findings and improved methods of condensing or aggregating tree lists are being developed[3].

However, their are some disadvantages to using this growth projection model. The system is slower than look-up tables (Ek, Hoganson, and Hahn, 1984). Also, in cases similar to that

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[3] Stegemoeller, Katie. Master's thesis. The University of Minnesota College of Natural Resources, St. Paul, MN 55108.

encountered when using the Minnesota DNR Phase II Intensive database, the approximated tree list may not adequately represent the stand. Because this growth system does not deal with trees of less than 1.0" diameter properly, a separate regeneration function is required. Also, Brand (1981b) noted that this growth projection system projects diameter growth well in the lower diameter classes, but overpredicts diameter growth for large diameter classes.

The projection system performs quite well for the most part, but there are some indications that the GROW system does not provide sufficient mortality for the aspen covertype when interfaced with the aspen regeneration system. The projected volumes and stand characteristics shown in the table below are taken from an actual DTREES run, on site classes 60 and 79 aspen stands.

Table. Aspen stand regeneration and growth data.

Site Class	Parent Stand BA	Stand Percent Aspen	Stand Age	Number of Stems per acre	Average DBH	Cubic Foot Volume
The following are DTREES projections:						
60	90	63	2	6634	0.0	0
			10	4073	1.18	0
			20	1859	2.47	0
			30	982	3.87	1202
			40	776	5.20	1518
79	199	70	2	4414	0.0	0
			10	2722	1.73	0
			20	1325	3.45	1375
			30	1041	4.7	1666
			40	814	5.8	2231
The following is from Ek and Brodie (1975):						
60	Not given (N-G)	N-G	2	5000	0.2	0
			10	3221	1.3	0
			20	1605	2.6	147
			30	N-G	N-G	N-G
			40	560	5.4	1411
80	N-G	N-G	2	5000	0.3	0
			10	2870	1.7	1
			20	1304	3.5	532
			30	N-G	N-G	N-G
			40	431	7.4	3074

From this data we can see that for the stand, once projections are made with GROW (from year 20 to end of rotation), mortality falls off and so does diameter growth. This reduces the total volume projected. This disjoint growth curve is to be expected when merging two independently developed models. Hopefully, when regeneration is handled within GROW, this

will be less apparent. The volumes as shown in Table 9.1 are fairly representative of the aspen covertype for those site classes and ages.

Another possible cause of the disjoint growth curves for aspen is the fact that the Ek and Brodie model returns only one diameter average for all trees. The mortality function is known to be nonlinear, with mortality occurring most heavily in the smaller diameter classes. Thus, when all trees are averaged, the mortality function of RGROW cannot properly model the mortality of the lower size classes. This problem may be solved adequately by providing 3 trees per species, each representing a different size class component for that species.

The next table shows the yield data for red pine plantations on site classes 60 and 80 that were regenerated and grown over a 50 year planning horizon. The data assumes a 2-1 planting stock and an initial density of 1210 stems per acre.

Table. Red pine regeneration and growth data.

Site Class	Age	NT/acre	Avg. DBH	Volume/acre
60	3	1210	0	0
	13	918	2.2	0
	23	918	4.7	1103
	33	909	6.1	2012
	43	899	7.0	2729
	53	887	7.6	3250
80	3	1210	0	0
	13	918	2.9	0
	23	918	5.3	1474
	33	911	6.7	2496
	43	901	7.5	3201
	53	883	7.9	3540

All ages end in "3" because seedlings are 3 years old and projection periods are 10 years.

From age 23 on, RGROW handled diameter growth and projection. It should be noted that the DTREES volumes reported are gross cubic foot volume per acre, calculated by Stone's equations (Hahn, 1984). The volume calculation procedure will be discussed in more detail later. Comparison of the volumes given by DTREES with those in empirical yield tables for Minnesota shows that for the red pine covertype, RGROW provides an acceptable model, though perhaps not over predicting the diameter growth of red pine in the older age classes.

Harvesting Systems

Several harvesting systems are currently employed in RDTREES. They include:

1. Do nothing
   - No harvest of any tree on stand
2. Clearcut
   - Cut and remove every tree
3. Random thin
   - Randomly remove to a specified basal area
4. Diameter section cut
   - Randomly thin within certain diameter or product classes. (i.e. - Thin basal area of sawtimber to 70 $ft.^2$ per acre.)
5. Shelterwood regeneration harvest
   - Thin from above to a certain basal area, then remove residual overstory in 10 years.

The basic method of selecting and executing these systems is discussed in Pelkki (1988).

Volume Equations

VOLCALC is a subsystem within RDTREES that calculates gross cubic foot volume given a simple tree list. VOLCALC calculates a per acre volume by species and product class, and passes this information back to an update function which records this information in both residual and harvest data files which is linked to the final decision matrix when that is formulated. All volumes shown in previous tables were calculated with this module unless otherwise noted.

VOLCALC uses Stone's equations for calculating volume (Hahn, 1984). These require the following information: (1) diameter at breast height, (2) merchantable height, and (3) diameter outside bark at merchantable height to estimate gross cubic foot volume from a 1 foot stump to the merchantable top for an individual tree. These are the same equations used by STEMS for its gross volume calculations. The tree list that RGROW uses is well suited for these equations. Diameter at breast height and number of stems per acre is provided by DTREES. The user has inputted merchantable top diameters in the module "Set Run Parameters". Merchantable height is calculated from a height-estimation model (Ek, et al., 1981) which uses the parameters: (1) diameter at breast height, (2) site index, (3) merchantable top diameter outside bark, and (4) stand basal area. All trees with a top diameter greater than the user specified merchantable top diameter for pulpwood have a volume estimate calculated. This assures that all stand volumes are recorded, even though the trees may not be harvestable. Volume per tree is calculated and then multiplied by the number of stems per acre to obtain volume per acre. This is then tallied by product class and species type. Currently, only three product classes, pulpwood, sawtimber and biomass (volume above merchantable pulpwood top diameter) are provided. User inputted product size class limits determine the product category into which each tree will be recorded.

The advantages to using these models is the fact that the equations used are found in the STEMS growth projection system. Any updates or improvements in the volume equations for

the STEMS system can be incorporated directly into VOLCALC. Also, the use of common height and volume equations provides for a measure of compatibility between the two systems.

Tree List Emulator with Minnesota DNR Phase II Data

The Minnesota DNR Phase II database does not have a tree list associated with each stand in an automated format. In order to obtain a tree list, the original inventory forms would have to be obtained and a tree list tallied from these forms. This task would be far to time consuming and costly to perform for thousands upon thousands of stands, so an alternative approach was used. The Phase II database contains a list of from 1 to 5 "characteristic" trees for that stand. They represent the dominant tree species in that stand. Associated with each characteristic tree is an average diameter and a measure of volume per acre for that particular tree. In the Phase II database all trees are recorded in board feet or cords per acre. These are converted to cubic foot volumes, using the following conversion ratios:

1000 Board Feet = 200 cubic feet
1 cord = 79 cubic feet

From an independent regression equation, an estimate of total number of trees per acre is estimated. The data contained in the individual characteristic trees is then used to disaggregate the total number of trees per acre and allocate tree expansion factors or multipliers to each characteristic tree. The result is a "tree list" that is used by DTREES for processing.

The method of disaggregating the total NT into its species components is done through a simple volume-diameter ratio. It is assumed that a the relationship between tree diameter and tree volume can be expressed in the following manner:

$$RVD_i = V_i/DBH_i^2$$
$$(RVD_i/SRVD) * NT = NT_i$$

Where:
- V_i = volume per acre for $tree_i$
- NT = total number of trees/acre in the stand
- RVD_i = ratio of volume to diameter for $tree_i$
- SRVD = summation of all RVD_i for this stand
- NT_i = number of trees/acre for $tree_i$

Each NT_i is then written to a tree list with associated tree diameter and species code. This is the basic tree list which RGROW requires to make its projections.

The formulation of these "characteristic" trees in the Minnesota Phase II database is of importance, because the tree list is based on these trees. The procedure is given in the Forest Survey Manual, Phase II Intensive Inventory (State of Minnesota Department of Natural Resources, Forestry Division). All species that are of merchantable size are recorded, up to a maximum of 5 species or species-groups, by product type. If a species or species-group has been tallied as having both pulpwood and sawtimber volume, it requires two entries in the database. If more than 4 species or species groups have merchantable volume, the 4 predominant species are recorded, and all minor species and their volumes are recorded as the fifth characteristic tree, and given the species code corresponding to miscellaneous species.

Though this method does record all merchantable tree species and the corresponding volumes, the method has several problems. The aggregation of all minor species into a single miscellaneous species-group class means that the species groups entered into this class are of relatively low importance. While quite often this may be the case, it would be far preferable to have those species represented individually in the tree list so that any possible impact on the prescriptions and final optimization runs could be modeled. This data recording problem can defeat the logic behind some of the decision trees for the covertypes, northern hardwoods, spruce-fir, and white pine, which have different branches based on stand composition. Also, when all minor species are aggregated in this fashion, the growth simulator (RGROW) cannot accurately predict growth, since species-specific information is no longer available.

DTREES Modelling Parameters and Output File Size

DTREES is designed to operate with as many stands as can be stored in the data base. DTREES will process approximately 11 stands per minute. To simulate for example the Sturgeon River State Forest data base with 2,141 forest stands required 195 minutes. DTREES produced for this inventory of 1.9 Mb an output database of approximately 10.4 MB. Sufficient hard disk space should, therefore, be available when large inventory data bases are processed.

DTREES Run Parameters and Error Checking

Despite the size and complexity of the DTREES system, error trapping and error messages have been kept incorporated into the programs. In doing this, the speed of the simulation and memory requirements are compromised somewhat. However, if the codes data base (and associated parameter files on the data subdirectory) which controls the RDTREES simulation system is incomplete, or incorrect, the system may crash or produce data inconsistent with the user's wishes. Therefore it cannot be stressed in more strong terms: **Check and recheck your run parameters for completeness and correct settings!!!** While DTREES will automate a lot of the simulation process for you, there is no substitute for careful planning and use. Like any complex tool, it takes thought to produce good results.

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APPENDIX I

DTREES INPUT DATA

DTREES Inventory Input:

For any given stand your inventory database must be able to provide the following information about every stand:

Stand Identifier:	An alphanumeric code that uniquely identifies a stand from all others in the database.
Covertype:	A code which identifies the covertype for the stand.
Age:	A value for stand age.
Acres:	The stand area in acres.
Site Index:	A value for stand site index.
Basal Area:	A value for the average basal area (in sq.ft./acre) for the stand.
NT:	An estimate of the total number of trees per acre in the stand (all species).
Stand Volume:	A value for total stand volume in all species, in cubic feet per acre.
Stand AMDBH:	A value for stand Arithmetic Mean DBH.
Stand QMDBH:	A value for stand Quadratic Mean DBH.
Inventory Date:	The last 2 digits of the year in which the stand was inventoried.

You must also provide a list of representative trees (a tree list) for the stand. For each tree, you must be able to provide:

Species Code:	The code which identifies a species group
Tree DBH:	A value for that representative tree's DBH.
NT or Vol/Acre:	Either the number of stems per acre or that characteristic trees contribution to the Stand Volume (see above).

Note: If your tree list already has NT/acre, you do not need a value for Stand Volume!

DTREES INPUT

The following are two examples of DTREES simulation on actual data. Both examples utilized a planning horizon of five, 10 year periods.

Input Example. A partial view of the ASCII file for DNR Sturgeon River State Forest

```
6906117W021091245501101430122011821434170083140 0.02101085812.7401107122431007308
6906217W261097246501101530114026841464135102170 0.42101106408.3413311124241109908
6905921W031212233501101570111012841424132120330 0.02101095626.7283013113230001412
6905921W051033233501101550111053841474132112260 0.02101096421.5314107113231006207
6906217W161195246501101530114009841424130080130 0.02101095206.7281007133231001409
6906217W141086246501101430114027841324129153170 0.02101084310.7991103113051007310
6906217W141216246501101430114010841324129153170 0.02101084310.7991103113011007310
6906117W061133245501101530121018831524126103170 0.02101117315.7000007113061009908
```

Misc.Par file

"",0	Stand Identifier, Stand No - processing will start at top of file
"SturgOut"	Default file name for DTREES output data base
"y",1,"Model1"	Parameters indicating: Update to present, No. of management alternative and Model type
1	Decision tree choice (1-4)

List of PAR files on data subdirectory

TimeDat.Par file - contains information on the simulated planning horizon

"EQUAL PLANNING PERIOD LENGTHS"
5
50
1,10
2,10
3,10
4,10
5,10
0

REGEN.PAR	- regeneration lists for all covertypes
MISC.PAR	- miscellaneous run parameters
TIMEINFO.PAR	- tracks beginning and end times for a simulation and stands completed
COVERTYP.PAR	- covertype conversion file
SPECIES .PAR	- species conversion file
MERCHDBH.PAR	- merchantability limits file
CRITICAL.PAR	- random access file of decision tree parameters
GROWCOEF.PAR	- growth coefficients for RGROW routine
HTCOEF.PAR	- height coefficients for RGROW routine

List of MDB files on program directory

DTCODES.MDB	- codes data base shell
DTOUT.MDB	- output data base shell
DTSTANDS.MDB	- stands data base shell

APPENDIX II

COVERTYPE AREAS (acres)

SPECIES VOLUME (cu.ft.) HARVESTED PER COVERTYPE

Pl.Period: 1

Cover type	Vol. Area	Species															
		Aspen	Balm	Birch	Ash	Elm	Oak	Other HdWds	Balsam Fir	White Spruce	Black Spruce	Tam	White Cedar	Jack Pine	Rd/White Pine	Other SoWds	Misc
Ash	381940 1661	7786	9572	5356	321034	885	0	2425	10060	1293	1662	309	11088	0	164	0	10306
L.HWds	21981 139	3520	1221	123	8516	294	0	21	1888	0	77	0	1707	0	0	0	4614
Aspen	1300728 12693	1092046	18747	28295	8131	418	823	5458	55534	7938	13436	1380	2499	15583	3904	10391	36145
Birch	103457 1179	12128	0	66502	42	9	123	1386	4929	1519	645	0	819	1798	1350	3748	8459
Balm	101214 544	21304	56080	1832	2510	0	0	0	9614	2079	393	0	513	112	0	0	6777
N.HWds	2195 34	0	0	1006	123	0	0	757	0	0	0	0	158	0	0	0	151
Oak	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W.Pine	8902 75	251	0	0	0	0	0	0	0	37	0	0	0	2378	5836	400	0
N.Pine	219031 1428	3483	107	2807	45	0	42	135	354	763	100	0	0	7452	10892	191094	1757
J.Pine	398385 1844	20091	518	9405	0	0	36	48	5465	2922	7043	5	0	308241	315	36304	7992
W.Spr.	63217 930	7804	117	424	0	0	0	0	2516	45784	1657	249	0	1306	0	211	3149
Bl.Fir	421192 1820	46512	8167	22615	3941	114	0	2497	271374	10853	10957	1046	10998	3277	1182	3553	24106
B.Spr.	1757083 11117	57185	468	2181	398	0	0	242	76342	1395	1528113	45944	3339	20640	142	3379	17315
NWCed.	53098 466	172	871	1695	4439	0	0	0	2383	201	1728	383	39064	0	0	0	2162
Total Vol.:	4832423	1272282	95868	142241	349179	1720	1024	12969	440459	74784	1565811	49316	70185	360787	23785	249080	122933
Total Area:	33930																

COVERTYPE AREAS (acres)

SPECIES VOLUME (cu.ft.) HARVESTED PER COVERTYPE

Pl.Period: 2

Cover type	Vol. Area	Species															
		Aspen	Balm	Birch	Ash	Elm	Oak	Other HdWds	Balsam Fir	White Spruce	Black Spruce	Tam	White Cedar	Jack Pine	Rd/White Pine	Other SoWds	Misc
Ash	11055 1661	162	0	0	8515	0	0	1947	94	0	0	0	337	0	0	0	0
L.HWds	0 139	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aspen	1071794 12693	919018	16019	24147	5108	1030	2060	5609	41293	10837	9423	234	851	8671	1565	4835	21094
Birch	79478 1179	4749	0	66066	0	0	0	0	1413	0	268	0	0	0	0	2412	4570
Balm	34683 544	4640	24000	251	2003	37	0	0	3386	1	141	142	7	0	0	0	75
N.HWds	2793 34	282	0	254	21	0	0	1932	0	0	0	0	69	0	0	0	235
Oak	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W.Pine	170 75	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
N.Pine	49219 1428	1264	0	742	307	0	207	408	287	183	18	0	0	2117	191	43322	173
J.Pine	20773 1844	1786	0	736	0	0	0	0	808	97	474	0	0	14034	0	2725	113
W.Spr.	30487 930	2881	632	751	0	0	0	0	1273	21510	258	52	0	779	0	784	1567
Bl.Fir	71427 1820	9051	1612	3583	715	77	0	649	45131	1993	2163	162	2103	412	153	295	3328
B.Spr.	42368 11117	0	0	0	0	0	0	0	18118	0	22524	1726	0	0	0	0	0
NWCed.	24051 466	520	0	0	0	66	0	0	479	0	448	0	21324	0	0	0	1214
Total Vol.:	1438298	944513	42263	96530	16669	1210	2267	10545	112282	34621	35717	2316	24691	26013	1909	54373	32379
Total Area:	33930																

COVERTYPE AREAS (acres)

SPECIES VOLUME (cu.ft.) HARVESTED PER COVERTYPE

Pl.Period: 3

Cover type	Vol. Area	Species															
		Aspen	Balm	Birch	Ash	Elm	Oak	Other HdWds	Balsam Fir	White Spruce	Black Spruce	Tam	White Cedar	Jack Pine	Rd/White Pine	Other SoWds	Misc
Ash	8022 1661	0	0	0	4704	0	0	3318	0	0	0	0	0	0	0	0	0
L.HWds	4069 139	84	45	152	1857	379	0	29	589	0	4	0	153	0	0	0	777
Aspen	363919 12693	289944	16092	11027	6305	1827	6152	5128	12531	2313	1755	73	1176	3275	185	908	5228
Birch	65278 1179	13345	0	37069	0	0	0	1177	3306	141	1313	0	0	342	1316	3163	4106
Balm	15493 544	4194	8883	173	951	292	0	0	447	9	0	0	60	130	0	0	354
N.HWds	2825 34	466	0	303	15	0	0	1711	0	0	0	0	44	0	286	0	0
Oak	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W.Pine	7218 75	0	0	94	0	0	0	0	154	0	0	0	0	0	6164	478	328
N.Pine	75406 1428	2404	81	2026	923	0	649	1294	879	118	307	0	0	3882	359	61161	1323
J.Pine	80676 1844	7211	0	3418	0	0	26	0	5091	866	0	0	0	49455	0	14609	0
W.Spr.	28607 930	2874	851	714	0	0	0	0	1244	19280	187	41	0	802	0	835	1779
Bl.Fir	64536 1820	8479	1400	3190	608	73	0	569	41048	1753	1867	136	1782	373	132	237	2889
B.Spr.	122194 11117	465	13	90	0	0	0	7	54377	45	60180	6559	0	88	212	158	0
NWCed.	10836 466	421	131	505	199	0	0	0	886	0	444	100	8072	0	0	0	78
Total Vol.:	849079	329887	27496	58761	15562	2571	6827	13233	120552	24525	66057	6909	11287	58347	8654	81549	16862
Total Area:	33930																

COVERTYPE AREAS (acres)

SPECIES VOLUME (cu.ft.) HARVESTED PER COVERTYPE

Pl.Period: 4

Cover type	Vol. Area	Species															
		Aspen	Balm	Birch	Ash	Elm	Oak	Other HdWds	Balsam Fir	White Spruce	Black Spruce	Tam	White Cedar	Jack Pine	Rd/White Pine	Other SoWds	Misc
Ash	8683 1661	0	0	0	5646	0	0	3037	0	0	0	0	0	0	0	0	0
L.HWds	3888 139	1118	1254	71	632	143	0	7	322	0	11	0	39	0	0	0	291
Aspen	516275 12693	386805	29692	19213	11654	4092	13919	10909	16723	4624	1688	0	2237	7264	1509	2168	3778
Birch	40480 1179	11008	0	20565	90	14	44	595	4533	1961	183	0	31	0	648	244	564
Balm	3528 544	906	2273	75	52	133	0	0	56	4	3	0	26	0	0	0	0
N.HWds	1640 34	277	0	205	10	0	0	975	0	0	0	0	31	0	142	0	0
Oak	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W.Pine	9360 75	429	0	0	0	0	0	0	0	17	0	0	0	1340	7153	421	0
N.Pine	92171 1428	2245	0	2107	1459	0	1044	2020	1249	416	8	0	0	2586	1370	77358	309
J.Pine	51322 1844	5601	0	2303	0	0	37	0	3686	786	0	0	0	29007	0	9902	0
W.Spr.	83247 930	7194	2895	2761	0	0	0	0	3768	55616	140	32	0	2551	0	3180	5110
Bl.Fir	81385 1820	11081	1992	3948	790	151	0	1035	51189	2209	2578	167	2813	331	121	190	2790
B.Spr.	114930 11117	0	0	0	0	0	0	0	50437	0	59668	4825	0	0	0	0	0
NWCed.	5074 466	62	0	0	542	41	0	0	0	0	0	0	4177	0	0	0	252
Total Vol.:	1011983	426726	38106	51248	20875	4574	15044	18578	131963	65633	64279	5024	9354	43079	10943	93463	13094
Total Area:	33930																

COVERTYPE AREAS (acres)

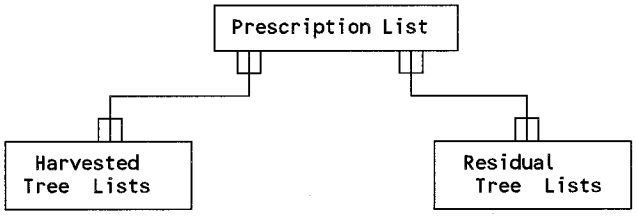
SPECIES VOLUME (cu.ft.) HARVESTED PER COVERTYPE

Pl.Period: 5

Cover type	Vol. Area	Species															
		Aspen	Balm	Birch	Ash	Elm	Oak	Other HdWds	Balsam Fir	White Spruce	Black Spruce	Tam	White Cedar	Jack Pine	Rd/White Pine	Other SoWds	Misc
Ash	13170 1661	0	0	0	7865	0	0	5305	0	0	0	0	0	0	0	0	0
L.HWds	5255 139	150	105	317	2118	838	0	72	1229	0	0	0	351	0	0	0	75
Aspen	546018 12693	378111	43610	25548	16729	6125	20849	16212	16552	4945	1328	0	3396	7479	735	2315	2084
Birch	22618 1179	4238	3694	4140	94	16	41	576	2040	5832	0	0	36	0	0	0	1911
Balm	50282 544	12632	32452	1198	599	2040	0	0	875	64	2	0	420	0	0	0	0
N.HWds	1471 34	252	0	190	8	0	0	863	0	0	0	0	29	0	129	0	0
Oak	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W.Pine	0 75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N.Pine	161780 1428	3850	59	2105	1040	0	872	1621	1192	220	2	0	0	3546	4190	141902	1181
J.Pine	200202 1844	21403	0	8775	0	0	123	0	14081	3051	0	0	0	113856	0	38913	0
W.Spr.	73569 930	6073	2455	2245	0	0	0	0	3237	50401	110	27	0	2083	0	2637	4301
Bl.Fir	54492 1820	7387	1081	2646	478	69	0	517	35441	1411	1351	101	1295	288	107	154	2166
B.Spr.	60448 11117	0	0	0	0	0	0	0	30196	0	27427	2825	0	0	0	0	0
NWCed.	4440 466	0	338	549	0	0	0	0	0	0	279	0	3274	0	0	0	0
Total Vol.:	1193745	434096	83794	47713	28931	9088	21885	25166	104843	65924	30499	2953	8801	127252	5161	185921	11718
Total Area:	33930																

APPENDIX III

DTREES Output Data Base File Structure



File Description

Prescription List — Describes, for each stand and each alternative, the timing of any activity over the entire planning horizon. It also gives some stand information such as age, acres, basal area, and which decision tree was used to generate the alternatives.

Tree Lists — Description of residual or harvested trees for each record in the prescription list. Trees are averaged by species group, and so there is one record per species group, with average DBH and NT/acre provided.

Identifier Index — The original inventory identifier is indexed to an integer value to save space and speed processing. The values are assigned sequentially for a particular identifier index file.

File Name: Prescription List

Field	Type	Description
New Identifier	Integer	Sequential identifier which is paired with original identifier in identifier index file.
Alternative	Integer	Value for alternative management sequence generated for a particular stand by DTREES.
Period	Integer	Period of activity
Node	Integer	Decision node value taken from DTREES alternative sequence generator.
Covertype	Integer	2 digit code from original inventory which designates covertype of stand.
Harv. Option	String	2 character code for harvest: "DN" - Do Nothing "CC" - Clearcut "TH" - Random thinning "SW" - Shelterwood cut "SC" - Selection cut
Basal Area	Integer	Stand Basal Area just prior to activity.
Removal BA	Integer	Basal area removed by activity.

Age	Integer	Stand age at end of period.
Acres	Integer	Stand size in acres.

File Name: Identifier Index

Field	Type	Description
New Identifier	Integer	Integer assigned to each stand sequentially for a given index file.
Original Identifier	String	String of alpha-numeric characters which uniquely identifies stand

File Name: Tree List (Structure same for Harvested and Residual Files)

Field	Type	Description
New Identifier	Integer	Sequential identifier which is paired with original identifier in identifier index file.
Node	Integer	Decision node value taken from DTREES alternative sequence generator.
Species Code	Integer	Original inventory species code
Residual	Integer	Gross cubic foot volume per acre Volume for this species that is above the defined top DOB (diameter outside bark) for pulpwood.
Pulpwood	Integer	Gross cubic foot volume per acre Volume for this species that is between defined Sawtimber top DOB and pulpwood top DOB.
Sawtimber	Integer	Gross cubic foot volume per acre Volume for this species that is above a 1 foot stump and below the defined sawtimber top DOB.
Average DBH	Real	Average DBH for all trees in this species group.
NT	Real	Number of trees per acre in this species group.