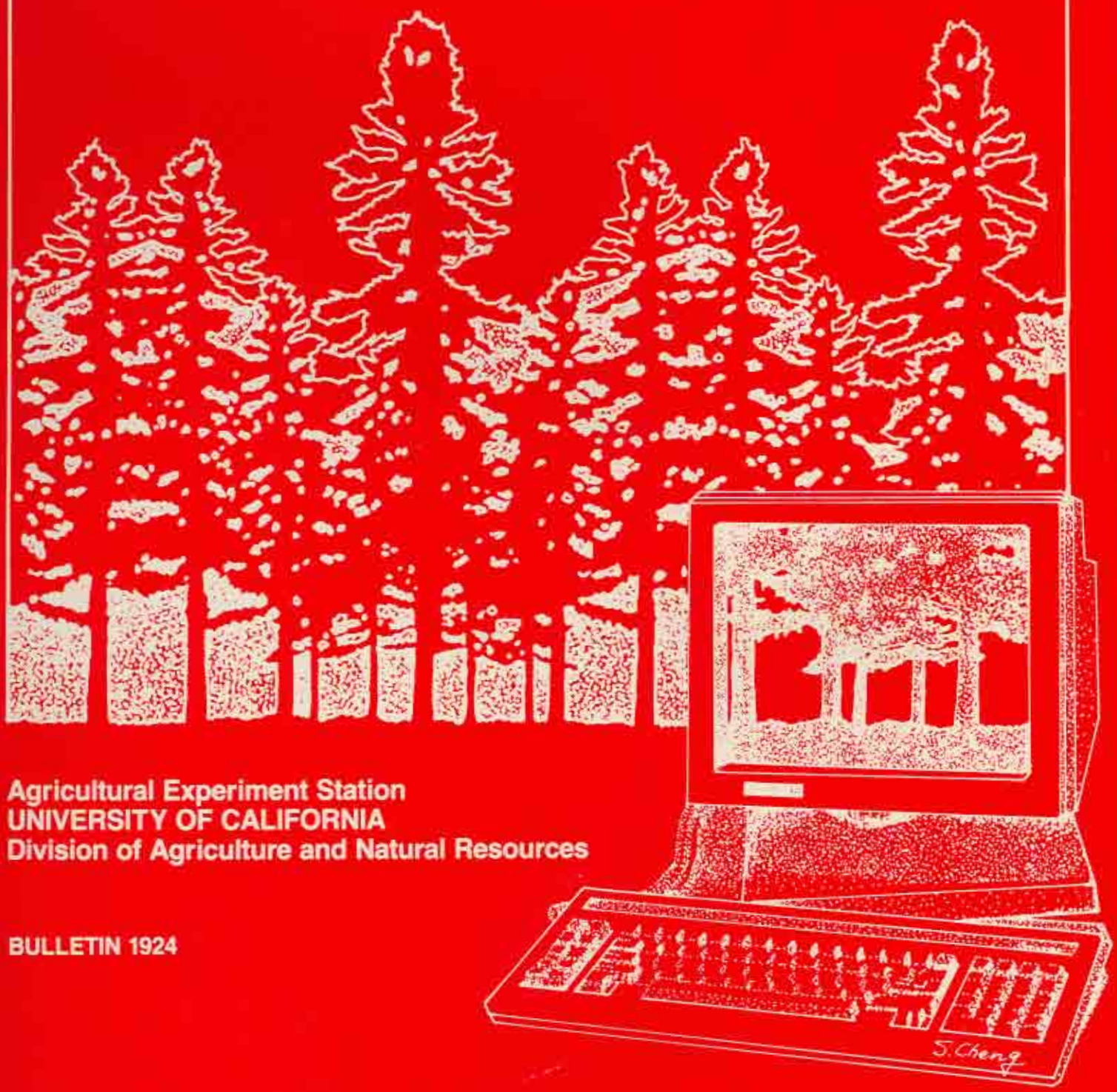
CRYPTOS USER'S GUIDE:

Cooperative Redwood Yield Project Timber Output Simulator



Agricultural Experiment Station
UNIVERSITY OF CALIFORNIA
Division of Agriculture and Natural Resources

BULLETIN 1924

CRYPTOS USER'S GUIDE:

The Cooperative Redwood Yield Project Timber Output Simulator

Agricultural Experiment Station
UNIVERSITY OF CALIFORNIA
Division of Agriculture and Natural Resources

BULLETIN 1924

The authors are Lee C. Wensel, Professor; Bruce Krumland, associate specialist; and Walter J. Meerschaert, postgraduate researcher, Department of Forestry and Resource Management, University of California, Berkeley.

Summary

The computer simulator CRYPTOS is designed to model the changes that take place in young-growth redwood and Douglas-fir stands in the north coast region of California. CRYPTOS requires the user to enter a stand description and allows the user to perform various operations and print out various descriptive reports of the stand. This interactive program is written in standard FORTRAN 77 code. The current version is running on IBM PC compatible personal computers, the Apple Macintosh, and Data General mini-computers. To run the program, the user answers questions or issues two-letter commands. The list of commands available at any stage can be displayed by typing **pc** (for print commands).

Disclaimer

This document and associated software were prepared as part of a project under the auspices of the University of California. Neither the University of California nor any of its employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, product, or process disclosed. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the University of California. The views and opinions of authors expressed here do not necessarily state or reflect those of the University of California, and shall not be used for advertising or product endorsement purposes.

A Product of the Redwood Yield Cooperative

Members
University of California

Arcata Redwood Company
Georgia-Pacific Corporation
Harwood Lumber Company
Louisiana-Pacific Corporation
Simonson Lumber Company
Simpson Timber Company

Research conducted under AES project 3815-ms.

PREFACE

Previous versions of CRYPTOS were developed to run on Digital Equipment Corporation PDP 11/70 and VAX mini-computers. The last version of CRYPTOS (version 4.0) to be released to the public became available in 1982. Since then, as part of a separate research project supported by the Northern California Forest Yield Cooperative, we have developed the California Conifer Timber Output Simulator (CACTOS). CACTOS used much of the theoretical structure and many of the actual parts of CRYPTOS. A logical next step in this evolution was to put the CRYPTOS growth routines into the new simulator. Thus, version 5.0 of CRYPTOS was born.

The work that led to CRYPTOS and CACTOS has depended upon the efforts and money of our industry cooperators. This cooperation effort should continue. Thus, we ask every CRYPTOS user to keep us informed of the program use. Also, whenever available, we hope to remain informed of the results of any tests of the CRYPTOS program performed against actual growth data.

ACKNOWLEDGMENTS

The research embodied in CRYPTOS is the result of years of cooperative research supported by members of the timber industry. Financial contributions from Arcata Redwood Company, Georgia-Pacific Corporation, Harwood Lumber Company, Louisianna-Pacific Company, Simonson Lumber Company and Simpson Timber Company were joined with University support and McIntire-Stennis forestry research funds to form the financial base for this work. In kind support was also provided by California's Jackson State Demonstration Forest. Representatives of these companies contributed their time and expertise to the planning efforts as well as assisted in the collection of the necessary research data from their respective properties.

Special leadership was provided by Jere Melo in getting the cooperative effort launched and by Ken Stumpf in acting as the industry coordinator. Special recognition is also give to Bruce Krumland, who was employed full or part time on the project from 1974 through 1982. The dedication that Bruce showed toward this effort was responsible for the first version of the simulator and his recommendations were useful in producing the current version as well. Ed Murphy, Keitlyn Watson, John Jue, Joel Dye, and others contributed to various aspects of the research upon which the estimates are based. Peter Daugherty is recognized for his efforts in revising the original CRYPTOS program to make a simulator for the Northern California Forest Yield Cooperative (CACTOS), to Vaughan Landrum who helped to revise CACTOS to produce the current version of CRYPTOS, and to Walter Meerschaert who is currently responsible for maintaining the program code.

This truly cooperative effort has benefited from the review comments of numerous individuals within the cooperative and without. Among the outside reviewers that must be mentioned are David Bruce, Bob Curtis, and Bob Monserud. Among the inside reviewers special thanks is given to Greg Biging, my valued colleague, for his tireless efforts in reviewing both research results and proposed manuscripts. To all I express my personal gratitude and thanks. However, I alone take responsibility for any errors in CRYPTOS. Therefore, please address all suggestions to me.

Last, but not least, I'd like to recognize the contributions of Pete Passof, Rick Standiford, Gary Nakamura, and John LeBlanc for their support and for the efforts that they have given toward making CRYPTOS available to the users. Their short courses and individualized instruction have assisted hundreds of users.

Lee C. Wensel

CONTENTS

Summary i

Preface ii

Acknowledgments iii

I. Introduction 1

II. Preliminaries 5

A. PC version 5
B. Apple Macintosh version 6

III. Structure and Strategies 7

IV. Input and Output Files 9

A. Stand description input file 10
B. Ingrowth file 11
C. Species grouping file 12
D. User calibration file 12
E. Output files 13

V. Initialization Routine and Program Defaults 14

VI. Main Program 18

A. Report commands 18
B. Growing trees 21
C. Entering ingrowth 22
D. Harvest 23
E. User calibration 23
F. Utility commands 23

VII. Harvest Routine 25

VIII. Miscellaneous Notes 29

IX. Advanced Topics 31

A. Growth period adjustment 31
B. Batch mode 31

Literature Cited 36

User Notes 37

Contents (continued)

Appendices 38

A. Sample input files 39
B. Sample runstream 43
C. Harvest option R3 67
D. Specifying calibration factors 79
E. Command summary 88

Error Reporting Procedure 89

I. INTRODUCTION

CRYPTOS, the Cooperative Redwood Yield Timber Output Simulator, is an interactive computer program designed to simulate growth and yield of redwood and Douglas-fir forest stands found in the north coastal region of California. The objective of this User's Guide is to describe the operation of the CRYPTOS program. Further detail on the architecture of the simulator and the development of the growth models contained in the CRYPTOS program are reported by Krumland and Wensel (1980, 1981) and Krumland (1982). Volume tables used are given by Wensel and Krumland (1983); site indices in Wensel and Krumland (1986), and mortality estimates by Krumland, Dye, and Wensel (1978). The program, written in standard FORTRAN 77 code (ANSI, 1978), is operational on the following systems:

(1) Data General mini-computers under AOS/VS
(2) IBM-PC compatibles under MS-DOS v2.1 or later
(3) Apple Macintosh personal computers

Most of the program code is identical to that in CACTOS (Wensel, Daugherty, and Meerschaert, 1986). This is particularly true for most of the utility functions.

Range and applicability

The CRYPTOS program can be applied to real or imagined forest stands of any size/age composition. However, it is recognized that the theoretical projection capabilities of the CRYPTOS program may be somewhat heroic and some forecasting situations may be without empirical supporting data. Such unsupported simulations may be of use to the user, but a brief discussion of the range of stand conditions used to build the growth models will provide the user with an understanding of the foundation upon which CRYPTOS rests.

The growth models imbedded in the CRYPTOS program have been developed from the records of an extensive collection of permanent growth plots located in Del Norte, Humboldt, and Mendocino counties. The majority of growth plots were located in the coastal zone that is subject to fog influence and is commonly referred to as the northern redwood region. By basal area, the average composition of sample plots was approximately 60 percent young-growth redwood, 25 percent other young-growth conifers (primarily Douglas fir), and the remainder being comprised of residual old growth and hardwoods. The main species groups (young-growth redwood, Douglas-fir, and tan oak) ranged in composition from zero to 100 percent although single-species compositions greater than 70 percent were mostly restricted to redwood. Very few stands composed of trees under 15 years of breast high age or over 90 years of age were sampled. In terms of stocking, over 85 percent of the sample plots had between 50 and 450 trees per acre. About 70 percent of the sample plots were from apparently even-aged stands with the remainder being from two-storied or multi-aged conditions. About 25 percent of the growth plots had been partially harvested prior to growth sampling.

For stand conditions comparable to the sample data, extensive testing of the CRYPTOS model has indicated a reasonable compliance between simulated yields and empirical growth plot development. Detailed tests are described by Krumland (1982). The reliability of the CRYPTOS model beyond these sample ranges is currently unknown and users who are contemplating using the model in such situations are cautioned to do some additional checking.

Organization of CRYPTOS 5.0

It is important for the CRYPTOS user to understand the organization and operation of the program. This understanding will not only make the program easier to use but should also make the results more meaningful. While

the program is interactive, a complete reading of this manual is suggested for efficient and meaningful use of the simulator. An hour invested in reading this manual will pay for itself by making use of the program more efficient.

The general structure of the components of CRYPTOS are illustrated in figure 1. Upon starting the program, the user is asked to give the computer filenames of the stand description, yield summary, and report files. The user is then given the option of changing any of the initial conditions and standard options in the program, such as minimum top diameters and species groupings. Then the program will offer the main program menu for the user to select among the various simulation and report-generating commands available. These components are briefly described below and then treated in detail in subsequent chapters.

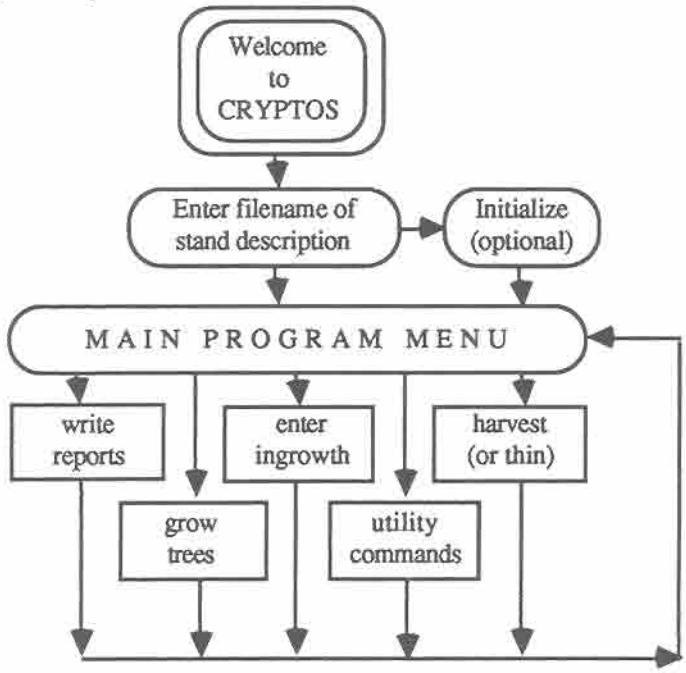


Figure 1. Structure of components of CRYPTOS

Stand description

A stand description consists of the site index and initial age (optional) of each species and a list of the trees representing the stand. The tree list contains the following information for each tree: species, DBH, total height, live crown ratio or height to the crown base, and the number of trees per acre represented.

Frequently the manager will want to model a stand without having all of these data items. In such cases, GENR, the stand GENeratoR (Krumland and Wensel 1980) can be used to generate hypothetical stand descriptions.

Initialization

There are other data items the user may wish to change in the program. These are optional items that specify the way in which the program output is structured, but they have little or nothing to do with the simulation of the stand development. Reasonable default values are set by the program so that the initialization process can be completely ignored until the user is familiar with the entire program operation. The initialization process is discussed in detail in section V. (The user may obtain a listing of the initialization commands by typing **pc** in response to the initialization prompt "initgo:".)

Main program menu

CRYPTOS is menu driven to make it "user friendly." The program is operated by either responding to questions from the program, or by typing a two-letter command in response to the main program menu prompt "go:" A complete list of the commands available from the main menu is provided when **pc** (print commands) is typed.

Generation of reports

Within the main program menu, provision is made to summarize the current stand in different ways. The options available range from a simple list of tree records to a log stock summary or yield/harvest summaries. One summary of particular interest is the print profile command (**pf**) which displays the current stand profile, showing the average height and crown size by diameter class. Reports shown on the screen can be saved in a report file for later processing. Per-acre summaries of the 5-year growth, ingrowth, and harvest are automatically stored in the yield summary file.

Growth prediction

The actual growth prediction is done in response to the grow command, **gr**. At this point, the program computes the summary stand statistics, computes a density measure for each tree (depending upon the size of the tree in relation to the others in the stand), and accesses the various equations used to predict the changes in the tree characteristics for a user-specified number of 5-year growth cycles (Krumland 1982). Thus, the growth process actually changes the stand representation as given by the tree list. Individual tree growth detail and/or growth summaries for each growth cycle may be requested. Before or after the "grow" command (**gr**) is issued, the user can invoke commands to harvest part of the stand and/or to print out various stand summaries.

Calibration

User calibration of basal area and/or height may be specified. Calibration can be used to adjust the final growth prediction. Such adjustments may be necessary due to silvicultural activities, microsite, or any similar factor not specifically addressed in CRYPTOS. Users can implement this feature as an option from both the initialization routine and the main program. Calibration schemes are entered either through the keyboard or from an external file. A scheme may be applied at any point in stand growth simulation and for any number of growth cycles. Given this versatility, users can create and apply a variety of schemes. However, the degree of calibration is limited to prevent drastic alterations to the response surfaces of the growth models.

Ingrowth

For short-term simulations of growth, ingrowth (growth of trees to merchantable size) can be provided for by including smaller trees in the original stand description. However, for longer simulations, trees not otherwise provided for in the description may have to be entered to more accurately represent the stand development. These trees can be entered using the ingrowth command, **ig**. This command allows the user to enter tree descriptions from the keyboard or from a specified external file.

Harvest options

Several harvest options provide the ability to perform thinning operations on the stand currently held in the computer memory in much the same patterns that one might harvest stands on the ground. This enables one to compare alternative simulations with the same starting data but with different thinning options.

Utility commands

Utility commands allow the user to save the current stand description (either internally or externally) for later use. This permits more efficient generation of several alternative prescriptions for a single stand. These commands are discussed in more detail in section III, Structure and Strategies.

II. PRELIMINARIES

This section gives a brief set of instructions for operating CRYPTOS on IBM PC compatible and Apple Macintosh personal computers. Be sure to make a backup copy of the program disk before running. Also, the user should be familiar with the basic file handling capabilities of the computer before running CRYPTOS.

II.A PC version

The PC version of CRYPTOS is designed to operate on IBM PC compatible personal computers running under DOS v2.1 or later with a minimum of 256K of free memory (RAM), above that used by any resident software. CRYPTOS has been tested on the IBM PC and Compaq Plus computers. The program package is contained on a 5.25-inch floppy disk containing the executable code in a file called "cryptos.exe," and several demonstration input files called "demo.sd," "demo.sg," "demo.ig," and "demo.cl." We recommend that the user make a backup copy of this disk prior to use.

The operating system (MS-DOS or PC-DOS) has a default limit of only nine files that can be opened at one time. Since some applications of CRYPTOS could exceed this number, the user should reset this number to 25. (See your system manual for instructions on how to do this, as it may vary among the various PC-compatibles.) The method of operation varies, depending on the configuration of the user's personal computer. Possible configurations for single floppy drive, dual floppy drive, and hard drive systems are given here.

(1) Single floppy disk drive

The most efficient way to run CRYPTOS on a single disk drive machine is to have the executable file, "cryptos.exe" on one floppy disk (disk 1); and the input files on another disk (disk 2). To operate, insert disk 1 in the drive and type "cryptos (return)" to invoke the program. When the logo appears on the screen, remove disk 1 from the drive and insert disk 2, the disk containing the input files; then proceed with the execution of the program. Operating CRYPTOS in this manner results in all the output files being placed on disk 2. Thus, the user will have one disk with the executable program and one disk containing input/output files, thereby maximizing the storage space for input/output files.

(2) Dual floppy disk drives

The strategy for this configuration is similar to the single drive machines. Insert the disk with the executable file "cryptos.exe" into drive A:. Insert the disk with the input files in drive B. To operate, the user should have prompt "B>" and type "A:cryptos (return)." This command invokes CRYPTOS from the A drive while reading input files from and writing output files to the B drive.

(3) One floppy disk and one hard disk drive

The strategy for this configuration is to install CRYPTOS on the hard disk and to use floppy disks only to backup files produced. To install, insert the program disk into the floppy disk drive and copy all files to the hard disk, preferably into a directory created for this purpose (see the DOS manual for the "mkdir" command). Once the files are copied to the hard disk, remove the floppy and store in a safe place, as the program disk is not needed again unless the files on the hard disk are lost or damaged. To operate, the user should have the hard disk drive prompt and be in the proper directory. Type "cryptos (return)" to start the program. Input and output files are read from and written to the

hard disk. It is strongly recommended that important output files be copied to floppy disk for backup.

II.B Apple Macintosh personal computers

The Apple Macintosh version of CRYPTOS requires 512K of memory and operates basically the same as on the PC-compatibles. No special programming has been done to make use of the special features of the Macintosh's pull-down menus or mouse. The program disk contains the CRYPTOS program file as well as a system file, coefficient file, and several demonstration files. The possible configurations of the system depend upon the number of disk drives available and include the following combinations:

(1) Single floppy disk system

CRYPTOS can be run from a single floppy drive with little or no disk swapping. The system file should be trimmed of unnecessary fonts and desktop applications and the Imagewriter file can be deleted, since printing the files is done separately by a word processing program. Thus, the following files are needed to run CRYPTOS:

Name	Size	Kind
CRYPTOS v5.2	182K	CRYPTOS program file
Finder	47K	Apple system finder file (size varies with version)
System	87K	Apple system file (size varies with options loaded)

If there are no bad sectors on the disk, this leaves about 79K available for data files on a 400K disk, or 479K on an 800K disk..

(2) Two floppy disk drives (or a hard disk drive)

Adding a second disk drive, or a hard disk, to the system increases the flexibility of CRYPTOS. One disk drive should be set up with the files listed above and any "utility" program files needed. The second disk drive is then used to load data disks. All file names specified for CRYPTOS contain the disk (or volume) name followed by a colon. For example, if the data disk volume is named "D1", the demonstration stand description file, yield summary, and report file are named "D1:demo.sd," "D1:demo.yd," and "D1:demo.rp," respectively. Any file names given without the disk drive (or volume) name are assumed to be on the program disk. Note that up to 32 characters can be used for the entire file name.

Be sure to check Appendix E for further operational differences between the Macintosh version and other versions of CRYPTOS.

III. STRUCTURE AND STRATEGIES

The CRYPTOS program provides the user with a menu from which various operations may be selected to forecast changes over time in the user-supplied stand description. The menu allows the user to: (a) initialize or change the default program parameters which determine the minimum DBH, merchantable top diameter, species groupings, etc. used for summaries; (b) simulate changes in the stand description by growth, harvest, or ingrowth; and (c) prepare reports describing the stand at any point in time.

Initialization

Initialization, or changing the default program parameters, is only allowed at the outset of a simulation run. Once a user exits the initialization routine (or declines to enter it) the user must rerun the program to change any program parameters. While becoming familiar with the operation of the program, the user may skip the initialization step. However, a clear understanding of the defaults will help the user to avoid the need to rerun a simulation to correct reporting defaults. See section V for a full discussion of the default parameters.

Stand description

Each tree record in the stand description contains the following five items:

(1) a two-digit species code
(2) DBH in inches
(3) total height in feet
(4) live crown ratio or height to the crown base
(5) number of trees per acre represented by this tree record

A detailed explanation of the stand description file is given in the section on sample input files, section IV.A and an illustration of a stand description is given in Appendix A.

The above tree list represents the stand CRYPTOS uses throughout the simulation. Since these data are frequently drawn from a sample, it is important that they be carefully examined to see that they really do represent the stand of interest. For example, if the sample wound up with greater or lesser density, under- or overabundance of certain species, larger or smaller trees, etc., the simulation results may not represent the stand the user intended.

Output

CRYPTOS produces two output files for every simulation run. The yield summary is produced automatically and contains summaries for all 5-year growth cycles, harvests, and ingrowth. The report file is an auxiliary output file. The program opens the report file and labels it with the stand identifier, site index, initial age of the stand, and the merchantability limits selected at the initialization stage. Any further additions to the report file are controlled by the user. Many of the user-requested reports (i.e., information produced by the "report" commands) may be routed to the report file. Commands that can be routed to the report file are identified by an asterisk on the command summary page (see Appendix F). The other report commands (i.e., ones that cannot be routed to the report file) are provided as aids for controlling the simulation. Report commands are discussed in more detail in sections VI and VII.

Simulation

The program is also designed to allow efficient simulation of alternative prescriptions of a single stand. The generation of a complete yield stream and report for each prescription is accomplished by the save (**sv**) and restore (**rt**) commands. The **sv** command internally saves the stand description, yield summary, and report file as they exist at the time of command execution. Simulation of the first alternative can then be continued. The **rt** command automatically saves the yield summary and report file for the first alternative, and then prompts the user for names for the new yield summary and report file, which are restored to the condition existing before the **sv** command was issued. The stand description is also restored to the saved condition. Simulation of the next alternative can be continued from that point. The actual stand description resulting from the alternative prescription may be saved externally (i.e., on the disk) at the user's discretion, by using the **es** command. Internally saved files are available while in the current stand description while externally saved files are also available after the run is completed. The externally saved stand description can be entered at a later time for further simulation by entering the **ns** command. In this case, the yield summary and report file start with the externally saved condition as the first entry.

Figure 2 illustrates the simulation of four alternative prescriptions for a single stand. Stand output for each prescription is saved at nodes 2, 3, 5, and 6 with the **es** (external save) command.

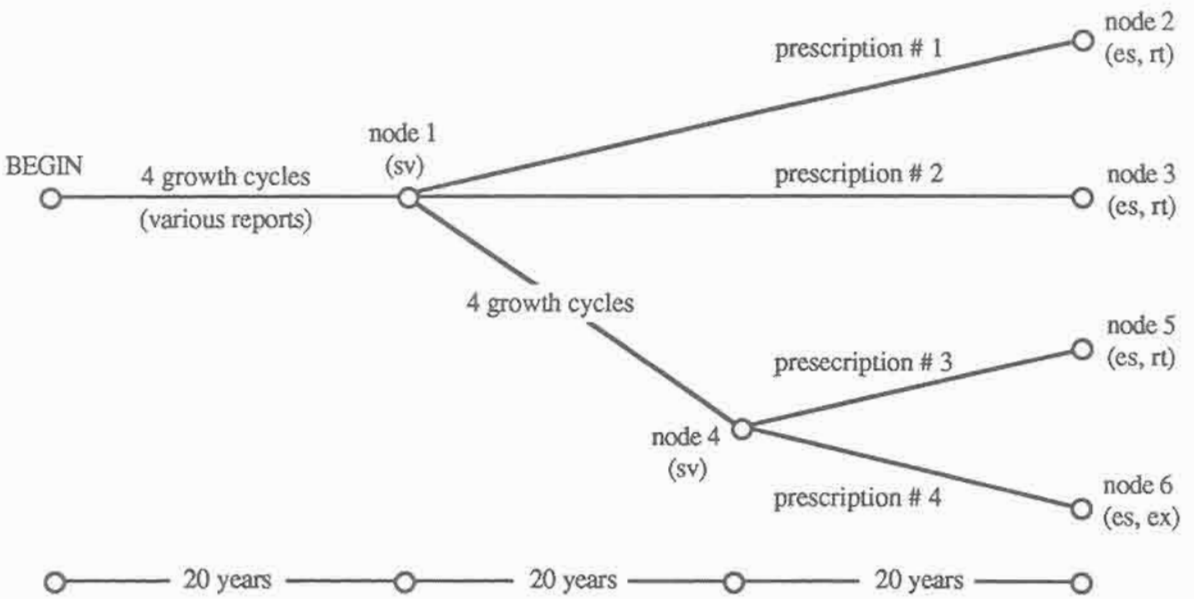


Figure 2. Simulation of four alternative prescriptions of a single stand

The nodes represent points where the **sv**, **rt**, or **es** commands are used. The lines represent other simulation commands issued to grow and thin the stand and to create various reports. Prescriptions 1 and 2 represent two different thinnings occurring after 20 years of growth. Prescriptions 3 and 4 represent two different thinnings occurring after 40 years of growth. Thus, after 60 years of simulation, the user ends up with four stands, each with a different stand history.

Finally, CRYPTOS permits the simulation of many stands during one entry into the program through the use of the **ns** (new stand) command. This command allows the entry of a new stand description input file without exiting the program. The previous stand's yield summary and report files are automatically saved, and the user is prompted for the names of the new stand description input file and the two output files. At this point the user can reenter the initialization routine to set program parameters. The **ns** command reinitializes the program parameters to their default values.

IV. INPUT AND OUTPUT FILES

CRYPTOS accepts four types of user input files and produces four types of output files. The input files recognized by CRYPTOS include:

(1) a stand description file that provides the basic information about the stand to use in the simulation

(2) an ingrowth file (optional) that can be used to enter ingrowth to the stand description at any point in simulation

(3) a species grouping file (optional) that defines the manner in which the species are grouped for reporting purposes

(4) a calibration file (optional) that provides adjustments to use in the growth simulation

The output files include:

(1) the yield summary file which is automatically updated by CRYPTOS as the simulation proceeds

(2) the report file which is used to save tables that are selected by the user during the course of the simulation

(3) externally saved stand description files, created by the **es** command to save copies of the current stand description for later use

(4) externally saved calibration scheme files, created during execution of the calibration **cl** command to save calibration schemes for later use

All input and output files are referenced by file names chosen by the user. CRYPTOS allows up to 32 characters in a file name. However, users are cautioned to observe limits placed on file names by the computer system they are using. Individual systems may support the use of path names as part of the file name. The authors strongly recommend adoption of the following, or similar, convention in naming files. The convention recommended gives each file name a root and an ending. The root indicates the stand being processed and the ending indicates the type of file. Root names are at the discretion of the user but they should have a meaningful pattern developed to fit the application. The ending names should be one of the following:

.sd	stand description file	.cl	calibration scheme
.ig	ingrowth file	.fn	batch mode filenames
.yd	yield summary file	.cm	batch mode commands
.rp	report file	.sg	species grouping file

Thus, "demo.sd" and "demo.yd" are the stand description and yield summary files for the stand "demo". Adoption of the above conventions allows for easy recognition of file types and efficient file management.

Several filenames should not be used, since they are already used by CRYPTOS, are: "isave1," "isave2," and "fort.xx," where xx is a number from 11 to 15, inclusive.

Standard FORTRAN notation is provided here to describe the format of each line of input. Real numbers are expressed in the form rFw.d where w is the field width (total number of characters including blanks and decimal); d is the number of characters to the right of the decimal; and r is the number of times this format is repeated by this specification. An actual decimal point in the field overrides the number specified by d in Fw.d. Thus, the format 5F8.3 specifies 5 real numbers 8 characters wide with 3 places to the right of the decimal (e.g. 1234.567). Integer formats are of the form rIw, where w is the field width and r is the repeater. Character formats are of the form rAw, where w is the number of characters in the field and r is the repeater.

IV.A Stand description input file

After CRYPTOS has been invoked, the program welcomes the user to the program and requests a stand description input filename. This filename refers to the stand description input file of the stand the user wishes to simulate. The stand description input file must have the following structure (follow this description by reference to the demonstration file in Appendix A):

Line (1) Stand identifier and tree record count (format A20, I10). The stand identifier is composed of up to 20 alphanumeric characters and the rightmost digit of the tree record count is in column 30.

Line (2) Fifty-year site indices for (in this order) redwood, Douglas-fir, other conifers, tanoak, red alder, other hardwoods, residual redwoods, and other residuals (format 8F5.0). Site index must be entered for every species present. Zeroes or blanks may be entered for species not present on the plot.

Line (3) Optional breast height ages for the species in the order and format given for site index in line 2. Zeroes or blanks may be entered if actual values are unknown. (Age is a descriptive variable only and is not needed for the model to function.)

Line (4-end) Individual tree records follow, one per line. Each tree record has the following five items (format 5F8.3, i.e., one line for each tree record):

(1) species number (see below)

(2) DBH in inches

(3) total height in feet

(4) live crown ratio (decimal fraction) or height to the crown base, (HTCB is converted to live crown ratio on input)

(5) per-acre expansion (i.e., the number of trees per acre represented by this tree record)

Species Codes - The following species codes are used in CRYPTOS:

Species	Number	Code
young growth redwood	1	(RW)
young growth Douglas-fir	2	(DF)
young growth other conifers	3	(OC)
tanoak	4	(TO)
red alder	5	(RA)
other hardwoods	6	(OH)
residual redwoods	7	(RR)
other residuals	8	(OR)

Note: CRYPTOS has a maximum internal memory storage capacity of 500 tree records. If the number of tree records in the stand description input file is greater than 500, the program automatically terminates. The record quintupling process (Krumland and Wensel 1981) produces five tree records for each user-entered tree record. Therefore the effective limit on user-entered tree records is 100 records. Any stand description input file with more than 100 records results in a warning, notifying the user that the record quintupling process cannot proceed normally. The program will then quintuple as many records as memory allows, starting with the first tree record and proceeding through the records as ordered in the input file.

An example of a stand description input file is shown in Appendix A.

IV.B Ingrowth file

An ingrowth file may be used to add ingrowth to the stand description during the simulation. The ingrowth command is discussed in detail in section VI.C. The ingrowth file must have the following structure:

Line (1) The number of ingrowth tree records (format I5).

Line (2-end) The ingrowth tree records follow. Each record has the following five items (format 5F8.3, i.e., one line for each ingrowth tree record):

(1) species number

(2) DBH in inches

(3) total height in feet

(4) live crown ratio (decimal fraction) or height to the crown base, (HTCB is converted to live crown ratio on input)

(5) per-acre weight (i.e., the number of trees per acre represented by this ingrowth tree record)

An example of an ingrowth file is shown in Appendix A.

Note: To users of previous versions of CRYPTOS, calibration factors for ingrowth may not be entered in column 6. Unlike CRYPTOS 4.0, calibration is handled separately by the program, and will be applied to ingrowth as well as to all other tree records in the stand description files if a calibration scheme is implemented by the user (see the "cl" command and chapters V and VI.E for calibration details).

IV.C Species grouping file

CRYPTOS allows user-defined species groups for summary reporting, specifying species to use in various reports, and for targeting species to cut. Implementation of this option is discussed in section V. The species grouping file specifies the species group names and species included in each group. The file must have the following structure:

Line (1) The number of species groups desired (format I3).

Line (2-end) List the species group records.
Each species group record contains the following items
(format A10, 8I2; i.e., one line for each group):

(1) the group name (up to 10 characters long), and

(2) the species codes of species that belong in that group

Note: No species may be included in more than one group, and each of the eight species codes must be assigned to a group.

An example of a species grouping file is shown in Appendix A.

IV.D User calibration file

The user calibration file, discussed in detail in Appendix D, contains a table of calibration factors entered by the user using the **cl** command. Calibration can be for the basal area growth and/or height growth and may be applied by species and by up to five diameter class ranges defined by the user. Users are cautioned not to use the calibration file to make such drastic changes in the growth rates so as to defeat the integrity of the growth equations. As a partial control on this, calibration is restricted to changes in the growth rates of no more than 20 percent. The calibration file contains calibration vectors for basal area and height models, with one line containing the size classes and the next line containing the corresponding calibration factor for each of the 18 permissible species:

Line (1-16) Calibration vectors for basal area by species, two lines per species (format 2(5F8.2/)). The first line for each species contains the lower limit for each class; the second line contains the calibration factors corresponding to the lower limits in the first line.

Line (29-44) Calibration vectors for height by species, two lines per species (format 2(5F8.2/)).

Indicator variables are also contained in this file. These variables tell the program how to interpret and apply the calibration scheme:

Line (57) Three indicator variables (format 3I3). These variables instruct the program how to interpret the calibration scheme. The first variable indicates the models to calibrate. It has the value:

1 - basal area only
2 - height only
3 - both basal area and height

The second and third values indicate how basal area and height factors are entered. They have the values:

1 - all species together
2 - by individual species

Line (58-59) Eight indicator variables (format 2(8I3/)). These variables indicate if a specific species has a basal area (line 58) or height (line 59) calibration vector. These lines are significant, depending on the value of the second or third indicators on line 57. A "1" in this field indicates that a calibration factor is present for that species.

Because of the complexity of these indicators and their effect on the meaning of the calibration vectors, users should not attempt to externally edit a calibration file. If calibration vectors and indicators are changed irrespective of each other, erroneous growth predictions can be produced. For this reason, the calibration command **cl** allows for keyboard entry of the calibration scheme and editing of an existing scheme. The program also allows for external saving of calibration schemes after keyboard entry.

An example of a user calibration input file is shown in Appendix A.

IV.E Output files

After the stand description filename has been entered, the program requests names for the yield summary and report files. The yield summary is created automatically during a simulation and contains the yield and periodic growth for each period in the simulation. The report file can be used to save user-selected reports. When the program is terminated, the yield summary and report files are saved with the user-defined names. These files can then be printed or used for further analysis.

A stand description can be saved in an output file created by the external save command (**es**). This command saves the stand description in a formatted file, with a user-supplied name, and it can be reentered as a stand description input file for further simulation. The **es** command may be issued at any point in the simulation. An externally saved stand description differs from a user stand description in that the record quintupling procedures may have been performed on the stand. An indicator variable is placed in an externally saved stand which causes the program to notify the user of this condition before performing further record quintupling procedures.

An externally saved user calibration scheme is an output file created as an option in the **cl** command. The external file saving capability serves as storage for calibration schemes after keyboard entry. These files may be retrieved at a later time for use in other simulations. The calibration file is also referenced by a user-supplied filename.

V. INITIALIZATION ROUTINE AND PROGRAM DEFAULTS

Once the user has entered file names for the stand description, the yield summary, and report file, the program gives the user the opportunity to enter the initialization routine to alter any of the program defaults while in the CRYPTOS system. The user chooses this option by entering "y", which results in the prompt (see sample runstream in Appendix B):

initgo:

The initialization routine menu contains the following commands:

pc	print commands
cm	set cubic foot DBH minimum
ct	set cubic merchantable top
bm	set board foot DBH minimum
bt	set board foot merchantable top
sc	list species groups and current group indicator
sp	set species groups
su	list user defined species groups
fl	set print flag
yf	set yield flag
cl	set calibration scheme
iq	set record quintupling option
ex	return to main program

Explanation of commands

pc Print the list of available commands and their functions.

cm Print and allow changes in the current minimum DBH used in computing summary statistics for cubic foot volume. This minimum DBH is also used for computing the number of trees, the basal area, and the average (quadratic mean) DBH of the stand. Therefore, the cubic minimum DBH must be less than or equal to the board foot minimum DBH (default is 0 inch).

ct Print and allow changes in the merchantable top limit for cubic foot volume estimation (may be 5, 6, 7, or 8 inches, default is 6 inches).

bm Print and allow changes in the current minimum DBH used in computing summary statistics for board foot volumes (default is 8 inches).

bt Same as the **ct** command, only it applies to board foot merchantable top (may be 5, 6, 7, or 8 inches; default is 6 inches). In estimating volumes, if a tree's DBH is less than the merchantable top limit, that tree is assigned a volume of zero.

sc List available species group options, their indicator numbers, and the option currently in effect.

sp Combine species into several groups for use in summary reporting, designating species used in the various reports, and/or targeting species for harvesting. The following code indicators and groups are permissible:

Code	Group
0	Report by totals only (i.e., all species combined).
1	(This code is default.) No combining occurs. Reports will be by individual species that were indicated as permissible in the input section.
2	Make two groups for summary reporting: (1) conifers - composed of all conifer species (2) hardwoods - composed of all hardwood species
3	Make three groups for summary reporting: (1) redwoods - (young growth and residual redwoods) (2) whitewoods - (all other conifers) (3) hardwoods - (all hardwoods)
4	Make four groups for summary reporting: (1) redwoods - (young growth redwoods) (2) whitewoods - (all other young growth conifers) (3) hardwoods - (all hardwoods) (4) residuals - (all residuals)
5	User defined grouping option. Any combination of up to eight groups designated by the user in a species grouping file described in the input section. If code 5 is entered, the program will request the species grouping filename. See section IV.C for format of species grouping file.

Note: Regardless of the option chosen, totals are reported. Species groups should only be used when actually needed, because their use slows the computation process. Using species groups does not alter the growth projections which are made for individual species.

su List the user-defined species group names and the species included in the groups. This command is used to insure that the species grouping file was read in correctly.

fl Set print flag for nonexistent species groups in the yield summary. The choices are:

0 - Print a line of 0's if the species is not present
1 - Do not print if the species is not present (default)

yf Set yield summary flag to indicate summary format. The choices are:

0 - By totals only
1 - By the same criteria as specified with the **fl** and **sp** options (default)

cl Set up a user-defined calibration scheme (see section IV.D and Appendix D) for later implementation in the **gr** or growth simulation routine. When the **cl** command is entered the user is given three options for entry method:

0 - Cancel option and return to menu
1 - Keyboard entry of calibration scheme
2 - Entry from an external file

Keyboard entry of calibration scheme

When keyboard entry has been requested, the program asks the user which models to calibrate. The choices are:

1 - Basal area only
2 - Height only
3 - Both basal area and height

The program executes the next section once if option 1 or 2 is chosen (i.e., only one of the models is calibrated) or twice if option 3 is chosen (i.e., both models are calibrated).

Entering calibration vectors

The program first asks the user if the same basal area (height) calibration factors apply to all species. If the user answers "n" for no, the program asks for the codes of the species to include in the first calibration group. If the user answers "y" the calibration is for all species and the program skips the section for entering species codes.

The program then asks if the user wishes to enter calibration factors by diameter (height) classes. If "n" is entered, the program asks the user to enter the calibration factor. This calibration factor is applied to all species included in the group regardless of tree diameter (height). Growth adjustments are all relative to the model norm, hence the default calibration factor is 1.00 (i.e., 100 percent of model norm). Entering 1.12 would increase basal area (height) growth by 12 percent. CRYPTOS limits the range of adjustment between 0.8 and 1.2 (80 and 120 percent of model norm). If the user enters "y" for calibration by size class, the program asks the user for the number of size classes desired (2-5).

Classes are defined by a lower size limit and a corresponding calibration factor. The lower size limit for the first size class is set to 0.0 and the user is asked to enter the calibration factor for this limit. The program then asks for the lower DBH (height) limit and calibration factor for the 2nd, 3rd, 4th, and 5th size classes.

When size classes are used, the tree's DBH (height) determines the calibration factor applied. (See Appendix D for detailed discussion of application.) If calibration is done by species, the program asks if the user wants to enter another calibration group. The user may enter as many groups as desired by answering "y" to this question. The program repeats the section starting with the entering of species codes included in the nth group.

External-file entry of calibration scheme

When external-file entry is requested, the program asks the user for the name of the calibration file and attempts to locate it. If the file cannot be found (i.e., the wrong name was entered), the program notifies the user and requests the file name again. When the file is found, the program reads the calibration scheme contained in the file. If an error ocurs while reading a calibration scheme, the program notifies the user and resets the program calibration to the default values.

Calibration summary

When entry of the calibration scheme is completed (either by keyboard entry or reading an external file), the program prints a summary of the calibration scheme on the screen. We recommend that the user save this in the report file to provide documentation on user calibration.

Once a calibration scheme is designated, it may be applied as a user option in the **gr** command (see section VI.B for detailed instructions). Note that the calibration scheme is not automatically applied. The calibration may also be redesignated at any point in the simulation (see **cl** command discussion under main program, section IV.E). For further discussion on use, see Appendix D, which includes a flow diagram and a sample runstream.

iq Inhibit the record quintupling process. The record quintupling process uses the variance of observations on the actual measurements to generate additional measurements for the stand description file. Up to a limit of 500 total records, this has the effect of multiplying the number of records in the stand description file by a factor of 5. For a detailed discussion of pseudo-stochastics in CRYPTOS see Krumland (1982).

ex Exit the initialization routine and enter the main routine.

Note: If a command is not recognized, the program responds with an appropriate message and allows the user to reenter a command.

VI. MAIN PROGRAM

After initialization, the user enters the main program. In the main program, the user may issue commands to grow the stand, enter the harvest routine, or specify the reports to save in the report file. The prompt for the main program is:

go:

The main program menu contains the following commands:

Report Commands

	pi	print initial description		**pm**	print DBH mins and merch tops
•	**sc**	print current species group	•	**su**	print user-defined species group
•	**dp**	display tree file		**et**	print elapsed time
•	**dt**	enter DBH distribution routine	•	**pf**	enter stand profile routine
•	**dc**	print DBH class table		**st**	print stock table
	yd	print yield table	•	**sl**	print standing log table
	cg	print current 5-year growth			

Simulation Commands

•	**gr**	enter growth routine		**ig**	add ingrowth to tree file
	ct	enter harvest routine	•	**cl**	initialize/reset user calibration

File Utility Commands

†	**cf**	change output file number	†	**es**	external save of current stand
†	**sv**	save current stand status		**ns**	start over with new stand
†	**rt**	restore stand saved by sv	†	**os**	truncate yield summary
	ex	exit from program	†	**pc**	print commands

• Information from this command may be routed to the report file.
†. These file utility commands cannot be used in batch mode.

VI.A Report commands

CRYPTOS has several report commands allowing the user to generate various descriptions of the stand during the simulation. Most of the reports can be saved in the report file if desired (these commands are identified in the command summary). The other report commands are available to aid the user in controlling the simulation. The information presented in these reports is automatically placed in the report file and/or yield summary.

Many of the report commands allow the user to specify the species to include in the report. In these cases, the program asks the user to enter the species choices. The alternatives are:

0 All species together
1 By one or more species
2 By one or more species groups

If "0" is entered, a report including all species present is printed. If a "1" is entered, the program lists the species codes and asks the user to enter the codes of the species to include in the report, terminated with a "/". If a "2" is entered, the program lists the species group codes, and asks the user to enter the codes of the groups to include, terminated with a "/". The species choice is listed at the top of the report. However, this list of species is just a labeling convention and does not mean that all species listed are present in the stand. Thus, careful development of species lists results in greater clarity of the report summaries.

pi Print initial stand description (i.e., stand identifier, site indices, and initial ages as supplied in the stand description input file). This initial description is automatically placed as a header in the yield summary and report file.

pm Print cubic and board foot DBH minimums and merchantable tops. These limits are also placed as a header in the yield summary and report file.

sc Print the available species grouping options, which species are included in the groups, and which option is in effect. This table may be placed in the report file. Note: This command does not print user-defined groups. If the user-defined grouping option is in effect, use the **su** command.

su Print the user-defined species group names and the species included in the group if the option is in effect. This table may be placed in the report file.

dp Display the current status of the tree record file (i.e., the tree records from the stand description file). The program requests a record skip causing the program to skip records when printing (e.g., entering "1" causes every tree record to be printed, entering "2" causes every second record to be printed, etc.). This table may be placed in the report file. Note: The table saved in the report file will have the same record skip as the table printed to the screen.

et Print the simulated elapsed time, in years passed since entering the stand. This command is a user aid and may not be routed to the report file. All reports list the elapsed time as part of the report header.

dt Graph the current diameter distribution. The user controls the species to include in the graph as discussed earlier. Graphs created by this command may be saved in the report file.

pf Graph the current stand profile, showing the average tree height and crown length by diameter class. The user controls the species to graph. Graphs created by this command may be saved in the report file.

dc Print a diameter class table showing current stocking (trees, basal area, and volume) and the most recent 5-year growth. The user controls the species to include in the table. After the species are entered, the program asks the user for the lower DBH limit, the upper DBH limit, and the class interval. The lower DBH limit sets the first class to include in the table. The first diameter class printed includes trees with DBH's from 0 inch to the DBH specified. The default is 0 inch DBH. The upper DBH limit sets the last class to include in the table. The last table entry includes all trees with a DBH greater than the upper DBH limit. The default is 50 inches DBH. The class interval sets the width of the diameter classes. The default is a 2-inch class width. To choose the defaults, the user enters a "/" in response to the prompt. This table may be saved in the report file. After the user indicates whether or not to save the table, the program asks the user if more tables are desired. Entering a "0" returns the user to the main program prompt, "go:". Entering a "1" causes the table to be reprinted showing averages, rather than totals, by DBH classes. Entering a "2" converts the table to percentages, where the entries are a percent of the included species totals. Entering a "3" produces percentages, where the entries are a percent of the stand total.

The upper DBH limit is sometimes adjusted from the user-supplied input (a) to make the upper DBH limit an even multiple of the increment and (b) to insure that there are not more than 25 classes. The diameter class table is labeled "standing diameter class table" when the **dc** command is issued after a growth simulation (i.e., **gr** command). When the **dc** command is issued after a harvest simulation (see **ct** command, section VII) the table is labeled, "Residual diameter class table." The growth figures listed in a "standing" diameter class table are the current 5-year growth of the stand. The growth figures listed in a "residual" table include only that portion of growth attributable to the trees remaining (residual) after the harvest. For growth figures on trees removed by harvest, see harvest diameter class command, **hc** (section VII). If a diameter class table is produced at elapsed time of zero, the table is labeled "standing" (unless harvest is done at time zero) and does not include growth figures (unless ingrowth is added at time zero).

st Print the current stand inventory (stock table) indicating average DBH, stems/acre, basal area/acre, and cubic and board foot volumes/acre by the species groups set by the **sp** command in the initialization routine. The information in this table is automatically placed in the yield summary after every change to the stand (i.e., after every growth cycle, harvest, and ingrowth entry), and may not be routed to the report file.

yd Print the current yield summary. This command is a user aid that allows the user to look at the yield summary without exiting the program.

sl Print the standing log inventory by 2-inch diameter classes. The inventory reports volumes for Redwood and Whitewood (which includes Douglas-fir and other conifers). The report is by 16-foot logs for cubic volumes and 16.3-foot logs for board-foot volumes. Cubic volumes are estimated by Smalian's formula applied to 1-foot segments of the log. Board volumes are estimated using the Scribner board-foot volume equation for logs with a top dib (diameter inside bark) greater than 9 inches. For logs with a top diameter inside bark (dib) less than or equal to 9 inches, Scribner factors are used to calculate log volume. All volumes reported by this command have been adjusted to be compatible with the whole-tree volume equation totals reported in the yield file (Wensel and Krumland 1981). The equation/taper ratio used to adjust the volumes is reported below the totals for each species group. The table may be saved in the report file.

A tree that does not contain at least one-half of a log is not included on either the cubic-foot or board-foot section of the table. Also the number of logs in the smaller dib classes may be different for cubic foot and board foot sections even when the same merchantability limits are used. This difference results from scaling top logs to the nearest foot for cubic-foot volume, while scaling top

logs to the nearest one-half log for board-foot volume.

cg Print the current 5-year growth by species group as specified by the **sp** command. This information is contained in the yield summary, and may not be routed to the report file.

VI.B Growing trees - the gr command

After issuing the **gr** command, the user must specify the number of growth cycles to simulate, whether or not mortality and calibration are applied, and the level of detail to report.

Number of growth cycles

Growth estimates are computed in terms of 5-year growth cycles. Thus, a 20-year simulation is requested by specifying "4" growth cycles.

Mortality

The mortality option is "on" when the growth routine is entered. To turn the mortality option "off," place a minus sign in front of the number of cycles. A 20-year simulation without mortality is specified as "-4" growth cycles. The message "MORTALITY ON" or "MORTALITY OFF" reminds the user of the status of the mortality option. Also, the letter "M" is placed in the yield summary for any growth period to which mortality is applied.

Calibration

If a calibration scheme has been designated before issuing the **gr** command (see **cl** command, section V and VI.E), the program alerts the user and asks how the calibration should be applied. The form of this message depends on how the calibration scheme is designated. If only one model (either basal area or height) has been calibrated, the program asks the user if this calibration scheme should be applied to the number of growth cycles requested. If the user enters "y" for yes, the calibration factors are applied to designated growth predictions at the end of every 5-year growth cycle entered. The user should take note of this compound process when designating and applying calibration schemes in CRYPTOS. If both basal area and height models have calibration schemes, the program gives the user the following application choices:

0 Do not apply calibration scheme
1 Apply basal area calibration scheme only
2 Apply height calibration scheme only
3 Apply both basal area and height calibration schemes

If a calibration scheme is applied to a given growth cycle, one of the following letter codes is placed in the yield summary for that growth period: "D" if only basal area is applied, "H" if only height is applied, or "B" if both calibrations are applied.

Tree detail and summary code

The program then asks if either individual tree growth detail or growth summary information is desired. If either option is desired, the user must enter "y" for yes. Entering "n" for no causes the program to grow the stand for

the number of cycles requested. The prompt "go:" appears when the growth simulation is completed.

If "y" is entered, the program first requests a record skip for the individual tree growth detail. The choices are:

0 for no individual growth detail
1 for detail on every tree record
2 for detail on every second tree record, etc.

After the tree detail record skip is entered, the program requests the growth summary code. The choices are:

0 for no summary
1 for summary by totals only
2 for summary by species groups as specified by **sp** command

After the summary code is entered, the program asks if the user wants the tree detail or summary information printed in the report file. The way the program routes the tree detail and summary to the report file differs from other report routing. The user cannot preview the tree detail or growth summary before making a decision to place the information in the report file.

VI. C Entering ingrowth - the **ig** command

CRYPTOS currently has no provision for internally generating ingrowth. Therefore the user may wish to enter additional tree records to better represent the stand development for longer simulations. To add more trees to the stand at some point in the simulation to represent, for example, sapling reproduction 10 to 15 years after a heavy harvest, the user enters the **ig**, ingrowth command. When the **ig** command is entered, the program requests an ingrowth input mode. The choices are:

1 Enter the ingrowth tree records from the keyboard
2 Read the ingrowth tree records from an external file

If input mode 1 is chosen, the program asks the user for the number of ingrowth records to add to the stand. The program then asks the user for five items for each tree record. The items are: species code, DBH in inches, total height in feet, live crown ratio in decimal fraction, and the per-acre weight (i.e.,the number of trees/acre the record represents).

If input mode 2 is chosen, the program asks the user for the ingrowth filename. When the filename is entered, the program reads the file and adds the ingrowth tree records to the internal stand representation.

Ingrowth is automatically recorded in the yield summary under the heading of "INGROWTH." The record lists ingrowth by the species groups specified by the **sp** command, and by totals. The next entry is "The Stand After Ingrowth." This entry lists the stand stocks and growth. The growth figures listed are for the current 5-year growth, plus ingrowth. Note: If ingrowth is entered immediately after a harvest, growth figures will include growth remaining after harvest plus ingrowth. After ingrowth input and recording in the yield summary are completed, the program informs the user that ingrowth has been completed and then returns the user to the main program's "go:" prompt.

The user may use the **yd** command to view the yield summary, to ensure ingrowth has been properly recorded. The **dp** or display tree records command also provide a visual check on ingrowth input.

VI.D Harvest - the ct command

CRYPTOS allows the user to simulate harvesting or thinning and to produce reports on the harvest or thinning. To simulate a harvest, the user enters **ct**, the cut command. The harvest routine is a menu-driven routine like the initialization routine and main program. The harvesting routine is described in detail in section VII.

VI.E User calibration - the cl command

As discussed in section V, the user calibration scheme may be redesigned at any point in the simulation by issuing the **cl** command in response to the "go:" prompt. If no calibration scheme exists in the program memory, the **cl** command behaves exactly as described in section V. However, if a calibration scheme is present and the user chooses to redesignate only one model (basal area or height), the other model remains as previously designated. If both models are redesignated or if a different external file is read, the complete scheme is replaced.

The use of the **ns**, new stand command, does not reinitialize the calibration scheme. The calibration scheme stored in memory remains there until replaced by the user or until the program is terminated.

VI.F Utility commands

CRYPTOS provides a number of utility commands that allow the user to: (1) efficiently generate alternative prescriptions for a single stand; (2) simulate many stands during one entry into the program; and (3) produce simple diagnostic reports. The first two functions use the **sv**, **rt**, **es**, and **ns** commands, which are discussed in section III, Structure and Strategies. These commands are described below, along with the diagnostic commands.

sv Internally save the current state of the stand. This command saves the stand description, the report file and the yield summary as they exist at the time of the execution of the **sv** command. Only one stand state may be in saved status at any time.

rt Internally restore the stand in saved status. The program first saves the current report file and yield summary, then requests names for another yield summary and another report file. Once these file names are entered, the program restores the stand description, the report file, and the yield summary to the state existing at the time of the save.

Note: If the user wishes to externally save the current stand description, the **es** command must be entered prior to the restore command, because the restore command destructively replaces the current stand description with the internally saved stand description.

es Externally save the current stand description. The program requests a filename for the externally saved stand description. The program formats the file so that the user can reenter the stand using the **ns** command or when first entering the program. In both cases, the report file and yield summary start with the stand description as the first entry.

ns Start over with a new stand. This command saves the current report file and yield summary, then requests a new stand description input filename. From this point on the program runs from the beginning, except that the welcome page is not printed. The user is allowed to enter the initialization routine, and must enter it if other than default parameters are desired, because the **ns** command reinitializes all parameters (with the exception of the calibration scheme and **r3** harvest parameters) to their default values. This command also deletes any stand in internal saved status.

os Omit (remove) any stand in internal saved status and reinitialize the yield summary and report file so that the current stand state is the first entry in the output files.

cf Change the output file number. The default output file number is 6 (i.e., the screen). This command allows the user to change this number to any number between 11 and 15. Implementing this command causes the output normally printed to the screen to be printed to a file named "fort.xx," where "xx" equals the user-entered file number. This command may be used for printing single reports or reports that cannot be routed to the report file. The file(s) "fort.xx" are saved at program termination. However, if the CRYPTOS program is run again and the same unit number is specified, any data stored in "fort.xx" is erased without warning. Caution: "fort.xx" files are intended for temporary use only.

pc Print the list of available commands.

ex Exit from the program. The program automatically saves the output files.

VII. HARVEST ROUTINE

When the **ct** command is executed, the user enters the harvest routine. The harvest routine initially requests a harvest label which is printed in the harvest section of the yield summary. This label may be up to 30 characters long and can be used to document the type of harvest simulated. The prompt in this routine is:

cutgo:

The harvest routine menu contains the following commands:

Harvest commands

	pc	print harvest commands
	cf	change output file number
•	**dt**	enter DBH distribution routine
•	**pf**	enter stand profile routine
	st	print current stock table
•	**dc**	print DBH class table
	r1	harvest - DBH control
	r2	harvest - basal area control
	r3	harvest - free
	r4	harvest - sanitation
•	**ih**	print intermediate harvest since last **ih** call
•	**ch**	print cumulative harvest since entering cut routine
•	**th**	print total harvest since beginning simulation
•	**hc**	print cumulative harvest DBH class table
•	**hl**	print cumulative harvest log stock table
	ex	exit cutting routine

• Information from this command may be routed to the report file.

Explanation of commands

The harvest routine is menu driven with two letter commands similar to the main program commands. Many of the commands are for producing reports on the stand or the harvest, and some of these reports may be placed in the report file. There are four harvest commands: **r1**, **r2**, **r3**, and **r4** which allow the user to alter the tree records to simulate a harvest. These commands ask the user for the species to cut, using the same conventions as for specifying species to include in reports.

pc Print list of available harvest routine commands and their functions.

dt Graph the current diameter distribution (same as in main program). This command is used to view the change in the diameter distribution resulting from a harvest.

pf Graph the current stand profile (same as in the main program).

st Print the current stand inventory (stock table) (same as in the main program).

dc Print the diameter class table. If this command is issued prior to harvesting, it behaves exactly as described in the main program section. If the command is issued after harvest has occurred, the table will contain the residual trees (of the species specified) as they exist at the time the command is issued. The additional tables (e.g., percentages of the stand totals) are not offered until the user exits the harvest routine, as final stand conditions are not determined until then.

rl Harvest (remove) trees with DBH control. The program requests four values which specify the prescription:

(1) The smallest diameter to cut (dl)
(2) The largest diameter to cut (du)
(3) The amount (decimal fraction) of the smallest diameter to cut (pl)
(4) The amount (decimal fraction) of the largest diameter to cut (pu)

These values are entered on the same line, separated by commas. After entering these values, the user specifies the species to cut. The program then processes the tree records, ignoring trees if they are not the appropriate species. If the tree qualifies, the next sequence of events follow:

(a) If the tree diameter "d" is between "du" and "dl," its per-acre weight is reduced by the fraction "x" where:

$$x = pl - \left[\frac{(d - dl)}{(du - dl)}\right](pl - pu)$$

Hence, if d = 12.0, du = 18.0, dl = 6.0, pu = 0.2, and pl = 0.8, then:

$$x = 0.8 - \left[\frac{(12 - 6)}{(8 - 6)}\right](0.8 - 0.2) = 0.5$$

and 0.5 times the tree record's per-acre weight is cumulated as harvests.

(b) If the tree diameter, "d," is less than "dl," and "dl" is prefixed by a minus sign, all of the tree record's per-acre weight is cumulated as harvest. The same is true for "d" greater than "du", and "du" prefixed with a minus sign.

(c) Otherwise, the tree record is not altered.

r2 Harvest (remove) trees with Basal Area Control. This routine allows the user to specify harvest by basal area to cut or by basal area to leave (i.e., residual basal area). The program asks the user to specify which method to use. Entering a "0" indicates the basal area specified is the amount to cut. Entering a "1" indicates the basal area specified is the amount to leave. The amount of basal area in the current stand is shown on the screen and the user is prompted to specify the amount of basal area to cut or to leave. The user is then prompted to specify the species included in the harvest. This harvest option is intended to mimic thinning from below or thinning from above. If a positive basal area is entered, the program mimics a thinning from below. The trees with the smallest ($DBH^{1.5}$ * lcr) are removed first. This formula for tree selection removes the trees with the smallest DBH first, unless the live crown ratio (lcr) of the next largest tree is much smaller than the previous tree (e.g., a tree with a 10-inch DBH and 0.4 lcr will be cut before an 8-inch DBH tree with a lcr of 0.6). If a negative basal area is specified (i.e., prefixed by a minus sign), the program mimics a thinning from above. The trees with the largest values of ($DBH^{1.5}$ * lcr) are removed first. Thus, a tree with a larger DBH is removed first unless the next smaller DBH tree has a much smaller live crown ratio. (Note: all trees with crown ratios of 0.6 or greater are treated as though they have crown ratios of 0.6.)

r3 Free harvest. This command invokes harvest option **r3**, designed to allow the user to simulate almost any type of harvest. Briefly, **r3** allows the user to set up to 24 variable-width diameter classes; harvest in any of these classes; specify amount to cut by either number of trees or basal area, in either absolute amount or percent; and specify species to cut, as well as which tree characteristics to consider in selecting trees in a given class. The flexibility of this option requires some initial planning to fully utilize its capabilities. A detailed description and an example of **r3** are in Appendix C.

r4 Sanitation harvest. This harvest option removes trees in the stand with a live crown ratio less than or equal to the user-specified live crown ratio. The program requests the live crown ratio target and allows the user to specify the species to cut.

Note: Any combination of the harvest options, (i.e., **r1**, **r2**, **r3**, and **r4**) can be executed successively to allow considerable flexibility in simulating harvest.

ch Print cumulative harvest since the user entered the harvest routine. This table can be saved in the report file.

ih The first time this command is executed, it behaves as a **ch** command. The next time it is executed, the **ih** command prints the intermediate harvest, which has occurred since the last time the **ih** command was executed. This table can be saved in the report file.

th Print total harvests that have occurred since the beginning of the simulation. The commands **ch** and **ih** only report harvests that occur within a given entry into the harvest routine. The **th** command reports all harvests that have occurred. This table can be saved in the report file during the simulation. The table is automatically placed at the end of the yield summary when the simulation is terminated (i.e., the last entry in the yield summary is the total amount harvested during the simulation by species groups as specified by the **sp** command).

hc Same as the **dc** command in the main program, except that the diameter class table is for harvested trees. As with the **dc** command, the user specifies the species to include. This table includes all trees, of requested species, harvested since entering the harvest routine, and the current 5-year growth removed by the harvest. This table may be saved in the report file.

hl Same as the **sl** command in the main program, except that the report is for harvested logs. The table contains volume by logs for trees harvested since entering the harvest routine, and may be saved in the report file.

ex Exit harvest routine, and return to main program. The program asks the user if a lag time is desired. This option mimics the lag time occurring between a thinning and the time the stand begins to respond. If "y" (for yes) is entered, the program requests the number of years of growth the stand "captures" in the next 5-year growth cycle. For example, if the user enters "4", then the stand captures 4 years of growth or 80 percent of the "normal" 5-year growth.

If the user clearcuts the stand (i.e., removes all the trees), CRYPTOS allows the user to exit to the main program, but does not allow the simulation to continue. The user is given the choice to start over with a new stand or to exit the program. In either case, the yield summary and report file are saved. Between clearcutting the stand and exiting the harvest routine the program allows the generation of reports, but does not allow further harvesting. However, **r3** is the only harvest option that informs the user that the stand has been clearcut.

VIII. MISCELLANEOUS NOTES

Output definitions

The following is a list of captions and definitions where all quantities are for trees larger than the specified merchantability limits:

et	elapsed time in years since the start of simulation
dbar	average stand quadratic mean DBH in inches
basar	basal area per acre in square feet
cfvol	cubic foot volume per acre in thousands
bdvol	scribner board foot volumes per acre in thousands (hardwoods not included)
tpa	trees (stems) per acre
bagro	5-year, basal area growth per acre in square feet
cvgro	5-year, cubic-foot volume growth per acre in thousands
bdgro	5-year, board-foot volume growth per acre in thousands (hardwoods not included)

The following items apply to individual trees if lists are requested by the display tree file (**dp**) or the grow (**gr**) command:

sp	species code
sg	species group code
DBH	tree diameter at breast height in inches
ht	total tree height in feet
cr	crown ratio expressed as a decimal fraction
exp	tree expansion factor (i.e., number of trees per acre represented)
dgro	current 5-year DBH growth in inches
hgro	current 5-year total height growth in feet
hcal	absolute fraction of normal height growth generated by record quintupling process (does not affect separate user calibration)
dcal	absolute fraction of normal basal area growth generated by record quintupling process (does not affect separate user calibration)

Notes

(1) All growth estimates are net figures (gross growth minus mortality) and include trees that are part of the internal tree list growing into the size classes specified by the **cm** and **bm** program options. Ingrowth entered by the user is recorded in the yield summary and added to the growth figures only in the sections titled, "STAND AFTER INGROWTH."

(2) Harvest statistics are computed as the difference between the stand summaries taken before and after the harvest. The exception is the harvest **dbar** which is converted to the average diameter of the harvested trees.

(3) Species codes are initially truncated to "real number" representations of integers in the range of 1-8. Tree records with species codes outside this range are deleted from the tree list on input.

IX. ADVANCED TOPICS

IX.A Growth period adjustment

CRYPTOS has an option which allows the user to report the amount of growth at any point less than 10 years elapsed time. This option is useful when the user wishes to compare the CRYPTOS growth projections with permanent plot growth measurements. The user implements this option by adding a "growth period adjustment value" (greater than zero and less than 10) to the first line of the stand description input file. The value should be placed in columns 46 through 50 inclusive (format F5.2; i.e., the decimal point occupies column 48). If the input file has the value "4.25" (indicating 4.25 growing seasons between measurements) in this location, CRYPTOS adjusts the elapsed time of the first growth period to 4.25 years. If the value is 6.5, CRYPTOS grows the stand for one 5-year growth period and adds a second growth cycle with an elapsed time of 1.5 years. Note that the second growth cycle is added automatically, thus growing the stand for one cycle with a growth period adjustment value greater than 5.0 results in two growth periods simulated.

A second use for this option occurs when the user wishes to align the projections of two or more stand descriptions measured at different points in time. In this case the growth period adjustment value represents the number of growing seasons elapsed between the time of measurement and some selected reference time. Implementation is the same as described above.

IX.B Batch mode

CRYPTOS is capable of batch processing multiple stand descriptions through multiple prescriptions. This option is useful when the user wishes to run more than one stand description through the same set of simulations or multiple prescriptions on the same stand description. The user invokes the batch mode by entering a "b" in response to the prompt "enter 'return' to continue" at the begining of the program run.

When the user invokes the batch mode, CRYPTOS prompts the user for two filenames, one file contains the "input filenames" and the other file contains the "batch commands." These are described below. After these two input files are successfully opened, the program asks the user to choose the output files to be produced by the simulation. In addition to the yield summary and report file, batch mode can produce a "tree list" file. This file is a sequentially accessed, unformatted (binary) file designed for post-processing. The tree list file is described below. The user has the option of producing any combination of these output files, by entering "y" or "n" in response to the prompt for each file type. The program then asks the user where the command prompts and other screen output should be printed during the batch operation. The user may choose an external file, the screen, or a scratch file for automatic deletion upon completion. As the simulation proceeds, the filename of the input file being processed is printed to the screen.

Input filenames file

This input file contains the filenames of the stand description input files to be processed (format A32, left justified). An example of an input filenames file (for the PC version) is shown below:

```
        columns:
        0         1         2         3 3
line    1234567890.........0.........0.2
  1     demo1.sd
  2     demo2.sd
  3     demo3.sd
  4     \stand1\meas1\input\demo4.sd
```

The above file tells the program that four stand descriptions (demo1.sd through demo4.sd) are to be simulated. The first three files are assumed to reside in the current directory, while the fourth filename specifies the directory drive in which the file is located. Unless a drive designation is included, all files are assumed to be on the default drive.

In batch mode the output filenames are automatically supplied by the program. The program takes the root name of the stand description file (the characters preceding the first period '.' or blank ' ') and appends a prescription code and extension to form an appropriate output filename. The prescription code is a 5-character code supplied by the user on the first line of the batch command file. The extensions are '.yd', '.rp', '.es', and '.ctl' for the yield summary, report, external save, and tree list output files, respectively. As specified above, the stand description filename may be up to 32 characters long. The output file naming convention used in batch mode allows for a 32-character root name, a five-character prescription code, and a four-character extension (counting the period). Users should exercise care in the use of these conventions as some systems allow fewer than 32 characters in a filename. For example, DOS only allows an eight-character root name and a four-character extension, including the ".". Thus, PC users should choose stand description file root names and prescription code lengths such that the combination does not exceed eight characters (e.g., a user could use a five character root name and a three character prescription code). PC users can use the rest of the allowable characters to specify directory location (path) of the file.

The output filenames formed by the program have precedence over existing files. If a file with the same name already exists, it will be overwritten *without warning*. The exception to this convention occurs with the external save file. If a file with the same name exists, the externally saved stand description will be appended to the existing file. This exception allows for multiple execution of the external save, **es**, command. No separator code is placed between the externally saved stand descriptions because the first line of the description specifies the number of tree records that follow. **Caution:** In batch mode the filename of the external save file is supplied automatically; do not specify a filename in the command file.

Batch mode can use concatenated files for input and produce concatenated files for output. This is useful for running many inventory plots through the simulator, eliminating the need for keeping track of several sets of filenames. The program automatically checks for concatenated files and processes all stand descriptions contained within each file. When concatenated files are used for input, the program automatically produces concatenated output files, appending the output associated with each new stand description to the appropriate output file. The program will place an asterisk in column 2 on a separate line between concatenated report files or yield summaries. These asterisks can be used later to separate the concatenated files for analysis. No separater code is placed between concatenated externally saved stand description files.

Batch commands input file

This input file contains the commands and responses to prompts that define the simulation to run. The first line is reserved for the up to five-character prescription code associated with the simulation (format A5 left justified). This code is used to form the output filenames for a particular simulation. The second line must contain the value "y" or "n" (format A1). If the second line contains an "n", the program skips to the main program menu and expects the third line to be a main program command. If the second line contains a "y", the program enters the initialization routine and expects the third line to be an initialization command. The last line in a given set of simulation commands must contain either the main command **ex** or **ns**. The **ex** command causes termination of the simulation on one stand and initiation of the simulation on the next stand. The **ns** command tells the program to run the current stand through

another set of simulation commands which follow the **ns** command. The lines that follow the **ns** command follow the same structure as the first set of commands, with the first line reserved for a new prescription code, the second line reserved for the initialization option choice, and so on. In this way multiple simulations can be stacked in the command file and executed in a single batch run. If the multiple simulation option is used, each set of commands must have an unique prescription code to prevent the overwriting of files from a previous simulation. The following is an example of a batch commands input file with a single set of simulation commands:

command file	explanation
`RX212 prescription 2, compartment 12 . . .`	
	five-character prescription code followed by prescription description
`y . . . . . .`	enter initialization routine
`iq. . . . . .`	set quintupling option (toggle)
`1 . . . . . .`	inhibit quintupling option
`ex. . . . . .`	exit initialization routine
`dp. . . . . .`	display tree records
`1 . . . . . .`	set record skip to one (i.e., display all tree records)
`y . . . . . .`	save the display tree record report in report file
`gr. . . . . .`	enter grow routine
`-1. . . . . .`	grow for one cycle, without mortality
`y . . . . . .`	display tree detail and/or summary info
`1 . . . . . .`	record skip of one
`2 . . . . . .`	summary by species groups
`y . . . . . .`	route information to report file
`dp. . . . . .`	display tree records
`1 . . . . . .`	set record skip to one
`y . . . . . .`	save the display tree record
`es. . . . . .`	perform external save of stand
`ex. . . . . .`	end simulation

This command file could be used to simulate stand descriptions for comparison with permanent plot growth data, if the stand description input files contain growth period adjustment values.

Some commands in the interactive version do not work in batch mode and/or serve no purpose for the batch version. The user-aid report commands (e.g., **et**, **pi**, **pm**, etc.) that cannot be routed to the report file serve no purpose because the user is not normally watching the screen during batch mode. The utility commands **cf**, **os**, **ns**, **sv**, and **rt** should not be used in batch mode. They produce undesirable results if attempted.

Tree list output file

The tree list file is an output file designed for post-processing. It reports the growth and yield predictions at the finest level of detail, the tree record. Reporting predictions in terms of tree records allows for validation on an individual tree basis as well as production of customized summaries not available within the simulator.

The file contains all the information currently printed in the yield summary and also the tree list used to produce the summary. The first two records of the file contains header information. The rest of the file contains yield sections, one for the initial stand condition and one for the stand condition after every change simulated for the stand (i.e., one after each growth cycle, harvest, and ingrowth simulation). The file is a direct access unformatted file (record length 36 bytes). These file properties minimize the size of the file and the I/O processing time. The contents of the file are described below by record number (all numbers are four bytes long, all strings are one byte per character):

Record number	Information and variable type
Header information:	
1	"CRYPTOS " (8 characters)
3 - 4	Version information (72 characters)
5 - 6	Prescription description (72 characters)
7 - 100	Not used by CRYPTOS
File Information:	
101	Total number of records, number of stand descriptions (2 integers)
Stand Description Information:	The rest of these records are repeated for each stand description simulated...
S1	Prescription information: number of entries, harvests, and ingrowth (3 integers)
S2	Stand description header (20 characters), cubic min. DBH (real), cubic merch. top (integer), board foot min DBH (real), board foot merch. top (integer)
S3	Site for species 1 to 7 (7 reals)
S4	Site for species 8 (real)
S5	Age for species 1 to 7 (7 reals)
S6	Age for species 8 (real)
Yield Information :	The rest of these records are repeated for each growth entry, ingrowth, and harvest on this stand.
Y1	Entry type:growth=1, harvest=2, ingrowth=3 (integer); elapsed time (real); number of tree records (integer)
Y2 - Y17	Yield information for each species and totals, one record for each species. Each record contains: Average stand DBH Number of stems per acre Basal area per acre Cubic volume per acre Board foot volume per acre Basal area growth per acre Cubic volume growth per acre Board foot volume growth per acre (8 reals)

Record number	Information and variable type
Y18 - Y18+number of tree records-1	
	One record for each tree record in the stand description, each record consists of the following: Species code DBH Total height Live crown ratio Current per-acre weight Diameter growth Height growth Per-acre weight before mortality Per-acre weight before harvest (9 reals)

The tree list file option should not be used with the species grouping option, because the tree list file does not preserve the species grouping codes and the stand summaries would not be interpretable.

The batch mode of CRYPTOS produces a batch report file with the name "batch.rp." This report file lists all files processed by and all input processing errors that occur during a batch run. If an I/O error occurs, the program termination message is ERRORS IN BATCH RUN. SEE "BATCH.RP". Errors in the batch command file cannot be discovered by CRYPTOS prior to the execution of the simulation. Errors cause the program to either crash or behave unpredictably. Therefore, it is important to test the batch sequence interactively before starting a batch run.

LITERATURE CITED

King, James E.

1966. Site index curves for Douglas-fir in the Pacific Northwest. Weyerhaeuser For. Rep. No. 8. Weyerhaeuser For. Res. Cntr. Centralia, Wash. 49 pp.

Krumland, Bruce E.

1982. A forest yield projection system for the north coast region of California. Ph.D. dissertation. Dept. of Forestry and Res. Mgmt., Univ. Calif., Berkeley.

Krumland, Bruce E. and Lee C. Wensel.

1980. User's guide to GENR - an interactive program to generate records of typical young growth stands in coastal California. Research Note No. 17, Cooop. Redwood Yield Research Project, Dept. of Forestry and Res. Mgmt., Univ. Calif., Berkeley. 12 pp.

1981. A tree increment model for north coast California: implement and design. Research Note No. 15, Cooop. Redwood Yield Research Project, Dept. of Forestry and Res. Mgmt., Univ. Calif., Berkeley. 56 pp.

Krumland, Bruce E., Joel Dye, and Lee C. Wensel

1978. Individual tree mortality models for the north coast region of California. Research Note No. 6. Coop. Redwood Yield Research Project, Dept. of Forestry and Res. Mgmt., Univ. Calif., Berkeley. 7 pp.

Wensel, Lee C., Peter J. Daugherty, and Walter J. Meerschaert

1986. CACTOS user's guide: the California conifer timber output simulator. Ag. Exp. Sta., Div. Agric. and Nat. Res. Univ.Calif., Berkeley. Bulletin 1920. 91 pp.

Wensel, Lee C., and Bruce E. Krumland

1983 Volume and taper relationships for redwood, Douglas-fir, and other conifers in California's north coast. Ag. Exp. Sta., Div. Agric. and Nat. Res. Univ.Calif., Berkeley. Bulletin 1907. 39 pp.

1986. A site index system for Redwood and Douglas-fir in california's north coast forest. Hilgardia, 54(8):1-14.

USER NOTES

APPENDICES

A. Sample input files 39

B. Sample runstream 43

C. Harvest option r3 67

D. Specifying calibration factors 79

E. Command summary..... 88

APPENDIX A. SAMPLE INPUT FILES

Example of a CRYPTOS stand description input file

```
          columns:
                   1         2         3         4         5         6         7
line      1234567890.........0.........0.........0.........0.........0.........0
 1    |   test stand                   30
 2    |    110. 125.  73.  94.
 3    |     50.  55.  48.  50.
 4    |      1.000   5.575  41.974    .790   9.161
 5    |      1.000   7.260  51.138    .820  13.226
 6    |      1.000   8.946  60.699    .827  15.713
 7    |      1.000  10.631  70.163    .819  16.796
 8    |      1.000  12.316  79.056    .801  16.696
 9    |      1.000  14.002  87.014    .781  15.686
10    |      1.000  15.687  93.827    .761  14.061
11    |      1.000  17.372  99.445    .743  12.096
12    |      1.000  19.058 103.935    .728  10.028
13    |      1.000  20.743 107.434    .717   8.034
14    |      1.000  22.428 110.109    .708   6.235
15    |      1.000  24.114 112.123    .701   4.695
16    |      1.000  25.799 113.623    .696   3.435
17    |      1.000  27.484 114.730    .693   2.444
18    |      1.000  29.170 115.542    .690   1.693
19    |      2.000   5.327  71.837    .853   6.987
20    |      2.000   7.065  81.861    .840  10.589
21    |      2.000   8.804  91.426    .815  13.444
22    |      2.000  10.542 100.204    .786  15.338
23    |      2.000  12.280 107.978    .757  16.189
24    |      2.000  14.018 114.646    .732  16.047
25    |      2.000  15.756 120.212    .710  15.069
26    |      2.000  17.495 124.754    .693  13.477
27    |      2.000  19.233 128.390    .679  11.521
28    |      2.000  20.971 131.259    .668   9.438
29    |      2.000  22.709 133.496    .660   7.422
30    |      2.000  24.448 135.223    .654   5.611
31    |      2.000  26.186 136.548    .649   4.081
32    |      2.000  27.924 137.559    .645   2.858
33    |      2.000  29.662 138.326    .643   1.929
          -----    ------  -------    ----   ------
        SPECIES    DBH     HEIGHT    CROWN  PER ACRE
        NUMBER  (INCHES)   (FEET)    RATIO   WEIGHT
```

Example of CRYPTOS ingrowth file

```
        column:
                        1         2         3         4
line        1234567890.........0.........0.........0
 1      |   003
 2      |   1.000    7.500   45.000    0.850   10.000
 3      |   2.000    7.000   40.000    0.800   10.000
 4      |   3.000    6.200   30.000    0.860   07.000
            -----   ------  -------     ----   ------
           SPECIES   DBH    HEIGHT   CROWN  PER ACRE
           NUMBER (INCHES)  (FEET)    RATIO   WEIGHT
```

Example of a CRYPTOS species grouping file

```
        column:
                        1         2
line        1234567890.........0
 1      |   5
 2      |   redwoods  01
 3      |   doug fir  02
 4      |   other con 03
 5      |   hardwoods 040506
 6      |   residuals 0708
            --------- --------
            GROUP     SPECIES
             NAME     CODES
```

Example of a CRYPTOS user calibration file

This file was created using the runstream in Appendix D.

```
                 column:
                         1         2         3         4
line             1234567890.........0.........0.........0   basal area calibration factors
1      |          0.00     6.00     12.00    30.00    30.00 <- diameter class lower limits and...
2      |          0.90     0.93      1.00     1.06     1.06 <- calibration factors for species 1
3      |          0.00     6.00     12.00    30.00    30.00    ...
4      |          0.90     0.93      1.00     1.06     1.06    likewise for species code 2, etc.
5      |          0.00     0.00      0.00     0.00     0.00
6      |          1.00     1.00      1.00     1.00     1.00
7      |          0.00     0.00      0.00     0.00     0.00
8      |          1.00     1.00      1.00     1.00     1.00
9      |          0.00     0.00      0.00     0.00     0.00
10     |          1.00     1.00      1.00     1.00     1.00
11     |          0.00     0.00      0.00     0.00     0.00
12     |          1.00     1.00      1.00     1.00     1.00
13     |          0.00     0.00      0.00     0.00     0.00
14     |          0.93     0.93      0.93     0.93     0.93
15     |          0.00     0.00      0.00     0.00     0.00
16     |          0.93     0.93      0.93     0.93     0.93
17     |          0.00     0.00      0.00     0.00     0.00
18     |          1.00     1.00      1.00     1.00     1.00
19     |          0.00     0.00      0.00     0.00     0.00   not used in Cryptos
20     |          1.00     1.00      1.00     1.00     1.00
21     |          0.00     0.00      0.00     0.00     0.00
22     |          1.00     1.00      1.00     1.00     1.00
23     |          0.00     0.00      0.00     0.00     0.00
24     |          1.00     1.00      1.00     1.00     1.00
25     |          0.00     0.00      0.00     0.00     0.00
26     |          1.00     1.00      1.00     1.00     1.00
27     |          0.00     0.00      0.00     0.00     0.00
28     |          1.00     1.00      1.00     1.00     1.00
```

Continued on next page.

column:

```
                 1         2         3         4
line     1234567890.........0.........0.........0  height calibration factors
29   |     0.00    45.00     45.00     45.00     45.00  <- height class lower limit and...
30   |     0.94     1.00      1.00      1.00      1.00  <- calibration factor for species 1
31   |     0.00    45.00     45.00     45.00     45.00     ...
32   |     0.94     1.00      1.00      1.00      1.00     ...likewise for species code 2, etc.
33   |     0.00     0.00      0.00      0.00      0.00
34   |     1.00     1.00      1.00      1.00      1.00
35   |     0.00     0.00      0.00      0.00      0.00
36   |     1.00     1.00      1.00      1.00      1.00
37   |     0.00     0.00      0.00      0.00      0.00
38   |     1.00     1.00      1.00      1.00      1.00
39   |     0.00     0.00      0.00      0.00      0.00
40   |     1.00     1.00      1.00      1.00      1.00
41   |     0.00     0.00      0.00      0.00      0.00
42   |     0.88     0.88      0.88      0.88      0.88
43   |     0.00     0.00      0.00      0.00      0.00
44   |     0.88     0.88      0.88      0.88      0.88
45   |     0.00     0.00      0.00      0.00      0.00
46   |     1.00     1.00      1.00      1.00      1.00
47   |     0.00     0.00      0.00      0.00      0.00
48   |     1.00     1.00      1.00      1.00      1.00  not used in Cryptos
49   |     0.00     0.00      0.00      0.00      0.00
50   |     1.00     1.00      1.00      1.00      1.00
51   |     0.00     0.00      0.00      0.00      0.00
52   |     1.00     1.00      1.00      1.00      1.00
53   |     0.00     0.00      0.00      0.00      0.00
54   |     1.00     1.00      1.00      1.00      1.00
55   |     0.00     0.00      0.00      0.00      0.00
56   |     1.00     1.00      1.00      1.00      1.00
57   |   3  2  2                                        <- Indicator values that control
58   |   1  1  0  0  0  0  1  1  0  0  0  0  0  0  0  <- the operation and
59   |   1  1  0  0  0  0  1  1  0  0  0  0  0  0  0  <- interpretation of the above
                                                          calibration factors see section
                                                          IV.D.
```

APPENDIX B. SAMPLE RUNSTREAM

Boldface indicates user entry.

Italic indicates reference in User's Guide.

```
                                WELCOME TO

      CCCCC   RRRRRRR   YY    YY  PPPPPPP   TTTTTTTT    OOOO     SSSSS
     CCCCCCC  RR    RR  YY    YY  PP    PP  TTTTTTTT   OOOOOO   SS   SS
    CC        RR    RR   YY  YY   PP    PP     TT     OO    OO  SS
    CC        RRRRRRR     YYYY    PPPPPPP      TT     OO    OO   SSSSS
    CC        RR  RR       YY     PP           TT     OO    OO       SS
     CCCCCCC  RR   RR      YY     PP           TT      OOOOOO   SS   SS
      CCCCC   RR    RR     YY     PP           TT       OOOO     SSSSS

        The Cooperative Redwood Yield Project Timber Output Simulator

        Copyright 1982,1987 The Regents of the University of California



 enter "return" to continue


        The Cooperative Redwood Yield Project Timber Output Simulator

                                by

                Lee C. Wensel, Bruce Krumland, P.J. Daugherty,
              Walter Meerschaert, Vaughan Landrum, and Ken Brown

                Department of Forestry and Resource Management
                      University of California, Berkeley

                A Product of the Redwood Yield Cooperative

                            Industry Members
  Arcata Redwood Company                      Louisiana-Pacific Corporation
  Georgia-Pacific Corporation                 Simonson Lumber Company
  Harwood Lumber Company                      Simpson Timber Company

  Research conducted under AES project 3815-ms.



 enter "return" to continue
 Open the stand description file
```

```
Enter a file name here: demo.sd                                  IV-A pg. 10

Open the yield file
Enter a file name here: demo.yd                                  IV-E pg. 13

Open the report file
Enter a file name here: demo.rp                                  IV-E pg. 13


In this program, if the computer is waiting for a command
it will give you a prompt that is:
   go:       If you are in the main program
   initgo:   If you are in the initialization routine
   cutgo:    If you are in the cutting routine


   Do you want to enter the initialization routine,
 to change any of the initial (default) control options? (y=yes): y


            INITIALIZATION ROUTINE
            ----------------------
   Type "pc" to get a list of available commands.                Set minimum
                                                                 tree sizes for
                                                                 summary
                                                                 tables.

initgo:cm                                                        V pg. 14

 Cubic min. DBH =  0.0 enter new;
 (must be less than board ft DBH min.): 0.0


initgo:ct                                                        V pg. 14

 Cubic merch top =  6 in. - Enter new (5 to 8): 5


initgo:bm                                                        V pg. 14

 Board foot min. DBH =  8.0 enter new: 8.0


initgo:bt                                                        V pg. 15

 Board foot merch top =  6 in.- enter new (5 to 8): 5


initgo:sc                                                        V pg. 15

   SPECIES GROUP CODES

   0 - totals only
```

```
  1 - 1) Redwood        2) Douglas-fir    3) Other conif.    4) Tanoak
      5) Alder          6) Other hwd.     7) Res. redwd      8) Res. conif.

  2 - 1) Conifers       2) Hardwoods

  3 - 1) Redwoods       2) Whitewoods     3) Hardwoods

  4 - 1) YG Redwood     2) Whitewoods     3) Hardwoods     4) Residuals

  5 - User defined species grouping option
      (see user guide for implimentation procedures)

Current code is 1

 Enter new code,(0 - 5): 5
```

Enter species group definitions from file demo.sg.

```
 Open the species grouping file
 Enter a file name here: demo.sg

   (Use "su" command to check species groups.)
```

```
initgo:fl
```

V pg. 16

```
 Print flag =  1 can be either:
   0) - print a line of zeroes if species not present
   1) - do not print if species not present (default)

 Enter 0 or 1 : 1
```

```
initgo:yf
```

V pg. 16

```
 Yield flag =  1 can be either:
   0) - by totals only
   1) - by criteria specified by "fl" and "sp" options (default)

 Enter 0 or 1 : 1
```

```
initgo:ex
```

V pg. 17

```
   Exiting initialization routine


           MAIN PROGRAM
           ------------
   Type "pc" to get a list of available commands
   Current output file is  6 (the screen)
```

```
go:pi
```

VI-A pg. 19

```
  Initial Description
```

```
stand label = test stand

 species        site  age
 redwood        110.  50.
 Douglas-fir     125.  55.
 tanoak          73.  48.
 alder           94.  50.
```

go:**pm**

VI-A pg. 19
Print minimum size specifications

```
            min.dbh    merch top
 cubic ft.    0.0         5
 board ft.    8.0         5
```

go:**sc**

VI-A pg. 19

```
SPECIES GROUP CODES

  0 - totals only

  1 - 1) Redwood        2) Douglas-fir    3) Other conif.    4) Tanoak
      5) Alder          6) Other hwd.     7) Res. redwd      8) Res. conif.

  2 - 1) Conifers       2) Hardwoods

  3 - 1) Redwoods       2) Whitewoods     3) Hardwoods

  4 - 1) YG Redwood     2) Whitewoods     3) Hardwoods       4) Residuals

  5 - User defined species grouping option
      (see user guide for implimentation procedures)

Current code is 5

Do you want this table placed in the report file? (y=yes): n
```

go:**su**

VI-A pg. 19
User-defined species groups.

```
CURRENT SPECIES GROUPING
------------------------
redwoods  :
      Redwood
doug fir  :
      Douglas-Fir
other con :
      Other con.
hardwoods :
      Tanoak
      Alder
      Other Hwd.
residuals :
      Res. Redwd
      Res. conif.

Do you want this table placed in the report file? (y=yes): y

  Table saved in report file.
```

go:**dp**

VI-A pg. 19

```
      Display tree records

Total records = 120   enter record skip: 10


Tree record
Record skip =  10    elapsed time =   0.00 yrs
 no.  sp   dbh   ht    cr   exp  hcal   dcal   sg
-----------------------------------------------------
  1   RW   5.6   42.  0.79  2.29 0.472 0.590    1.
 11   RW  22.4  110.  0.71  1.56 1.015 1.473    1.
 21   DF  14.0  115.  0.73  4.01 1.171 1.058    2.
 31   RW   5.6   42.  0.79  2.29 0.678 0.586    1.
 41   RW  10.6   70.  0.82  4.20 0.831 0.809    1.
 51   RW  15.7   94.  0.76  3.52 1.193 1.034    1.
 61   RW  22.4  110.  0.71  1.56 1.221 1.469    1.
 71   RW  27.5  115.  0.69  0.61 1.326 1.777    1.
 81   DF   7.1   82.  0.84  2.65 0.536 0.393    2.
 91   DF  14.0  115.  0.73  4.01 1.174 1.055    2.
101   DF  19.2  128.  0.68  2.88 1.217 1.370    2.
111   DF  24.4  135.  0.65  1.40 1.229 1.591    2.


Do you want this table placed in the report file? (y=yes):n
```

```
        Begin Growth Routine

        MORTALITY ON

 Enter the number of 5 yr. growth cycles desired
   Note: a "-" (minus) prefix shuts off mortality for all cycles entered.
 Enter number of cycles here: 3

 Do you want either individual tree growth detail
         or summary info printed?(y=yes): y

 Individual tree detail Record skip:
   0 for no detail
   1 for detail on every tree record
   2 for detail on every 2nd tree record
     ect.

 Enter Record skip: 10

 Summary codes:
   0 for no summary
   1 for summary by totals only
   2 for summary by species groups

 Enter summary code: 2

 Do you also want the tree detail or summary info
  to be printed to the report file?(y=yes): y


 TREE GROWTH DETAIL - elapsed time =   5.00 yrs
 sp  dbh  ht   cr   exp hcal dgro hgro dcal
-------------------------------------------
 RW 21.8 110. 0.66  2.0 0.97 1.05  2.9 1.36
 DF 13.4 113. 0.72  3.9 1.13 1.08  5.5 0.93
 DF 31.1 146. 0.62  0.5 1.22 1.43  7.2 1.76
 RW 11.2  71. 0.75  4.1 0.83 0.60  0.4 0.80
 RW 16.5  96. 0.70  3.5 0.99 0.83  1.7 1.04
 RW 21.8 112. 0.66  2.0 1.38 1.05  4.1 1.36
 RW 28.7 119. 0.64  0.6 1.33 1.17  4.6 1.77
 DF  7.6  83. 0.79  2.5 0.53 0.50  0.9 0.40
 DF 13.4 113. 0.72  3.9 1.13 1.08  5.5 0.93
 DF 20.7 136. 0.65  2.8 1.22 1.45  7.3 1.36
 DF 25.9 143. 0.63  1.4 1.23 1.50  7.3 1.59
 DF 31.1 146. 0.62  0.5 1.23 1.43  7.2 1.76


 GROWTH SUMMARY - CYCLE =  1  elapsed time =  5.00
     species    bagro   cvgro   bdgro
-------------------------------------
     redwoods    19.1   0.67    4.10
     doug fir    28.3   1.78   12.42
     Totals      47.4   2.45   16.52
```

TREE GROWTH DETAIL - elapsed time = 10.00 yrs

sp	dbh	ht	cr	exp	hcal	dgro	hgro	dcal
RW	22.7	113.	0.62	2.0	0.97	0.93	2.5	1.36
DF	14.4	119.	0.68	3.8	1.13	0.99	5.1	0.93
DF	32.4	152.	0.59	0.5	1.22	1.34	6.5	1.76
RW	11.7	71.	0.69	4.1	0.83	0.52	0.3	0.80
RW	17.2	97.	0.65	3.5	0.99	0.73	1.4	1.04
RW	22.7	115.	0.61	2.0	1.38	0.95	3.6	1.36
RW	29.7	124.	0.60	0.6	1.33	1.07	4.2	1.77
DF	8.0	84.	0.74	2.4	0.53	0.44	0.7	0.40
DF	14.4	119.	0.68	3.8	1.13	0.99	5.1	0.93
DF	22.0	142.	0.62	2.8	1.22	1.35	6.7	1.36
DF	27.3	149.	0.60	1.4	1.23	1.40	6.6	1.59
DF	32.4	152.	0.59	0.5	1.23	1.34	6.5	1.76

GROWTH SUMMARY - CYCLE = 2 elapsed time = 10.00

species	bagro	cvgro	bdgro
redwoods	17.6	0.64	4.19
Doug-fir	27.5	1.81	13.21
Totals	45.1	2.45	17.41

TREE GROWTH DETAIL - elapsed time = 15.00 yrs

sp	dbh	ht	cr	exp	hcal	dgro	hgro	dcal
RW	23.6	115.	0.57	2.0	0.97	0.83	2.1	1.36
DF	15.3	123.	0.65	3.7	1.13	0.91	4.8	0.93
DF	33.7	158.	0.57	0.5	1.22	1.27	5.9	1.76
RW	12.2	71.	0.62	4.0	0.83	0.46	0.3	0.80
RW	17.9	98.	0.60	3.5	0.99	0.64	1.2	1.04
RW	23.6	118.	0.57	2.0	1.38	0.86	3.3	1.36
RW	30.7	127.	0.55	0.6	1.33	0.98	3.8	1.77
DF	8.4	84.	0.69	2.3	0.53	0.39	0.6	0.40
DF	15.3	123.	0.65	3.7	1.13	0.92	4.8	0.93
DF	23.3	149.	0.60	2.8	1.22	1.26	6.1	1.36
DF	28.7	155.	0.58	1.4	1.23	1.31	6.0	1.59
DF	33.7	158.	0.57	0.5	1.23	1.27	5.9	1.76

GROWTH SUMMARY - CYCLE = 3 elapsed time = 15.00

species	bagro	cvgro	bdgro
redwoods	16.3	0.61	3.90
Doug-fir	26.8	1.83	14.32
Totals	43.0	2.44	18.23

Tree detail and/or summary info saved in report file.

go:**dt** *VI-A pg. 19*

```
       Print diameter distribution

 How to specify species to be graphed    ?
   0 - All species together
   1 - By one or more species
   2 - By one or more species groups

 Enter 0, 1, or 2 : 0


Diameter Distribution
elapsed time =  15.00 yrs
All species combined

 dbh  trees |             15             30             45             60
            ..............................................................
2 - 4     0. |
4 - 6     0. |
6 - 8    14. |11111111111111
8 -10    21. |111111111111111111111
10-12    27. |1111111111111111111111111
12-14    30. |111111111111111111111111111111
14-16    47. |1111111111111111111111111111111111111111111111111
16-18    29. |11111111111111111111111111111
18-20    26. |1111111111111111111111111
20-22    23. |111111111111111111111111
22-24    19. |1111111111111111111
24-26    15. |111111111111111
26-28    12. |111111111111
28-30     9. |111111111
30-32     6. |111111
32-34     6. |111111
34-36     0. |
------------
total  285.

 Do you want this graph placed in the report file? (y=yes): y

   Table saved in report file.
```

go:**pf** *VI-A pg. 20*

```
       Print stand profile

 How to specify species to be graphed    ?
   0 - All species together
   1 - By one or more species
   2 - By one or more species groups

 Enter 0, 1, or 2 : 1
```

```
The species group codes are:

    1 - Redwood        2 - Douglas-fir   3 - Other conif.  4 - Tanoak
    5 - Alder          6 - Other hwd.    7 - Res. redwd.   8 - Res. conif

 Enter codes to be graphed
 (separated by commas, terminated by "/"): 1,2/


Stand Profile
elapsed time =  15.00 yrs
species = RW DF

                 feet above ground
 DBH  Trees |    24    48    72    96   120   144   168   192   216   240
            ..............................................................
2 - 4    0. |
4 - 6    0. |
6 - 8   14. |=====>>>>>>>>>
8 -10   21. |======>>>>>>>>>>
10-12   27. |=======>>>>>>>>>>>>
12-14   30. |========>>>>>>>>>>>>>>
14-16   47. |=========>>>>>>>>>>>>>>>
16-18   29. |===========>>>>>>>>>>>>>>>>>>
18-20   26. |============>>>>>>>>>>>>>>>>>>>
20-22   23. |=============>>>>>>>>>>>>>>>>>>>>
22-24   19. |==============>>>>>>>>>>>>>>>>>>>>>
24-26   15. |================>>>>>>>>>>>>>>>>>>>>>>
26-28   12. |================>>>>>>>>>>>>>>>>>>>>>>
28-30    9. |================>>>>>>>>>>>>>>>>>>>>>>>
30-32    6. |================>>>>>>>>>>>>>>>>>>>>>>>
32-34    6. |================>>>>>>>>>>>>>>>>>>>>>>>>
34-36    0. |
------------
total  285.

 Do you want this graph placed in the report file? (y=yes): y

   Table saved in report file.


go:dc                                                          VI-A pg. 20

       Print diameter class table

 How to specify species to be included?
   0 - All species together
   1 - By one or more species
   2 - By one or more species groups

 Enter 0, 1, or 2 : 2

 The species group codes are:
    1 - redwoods       2 - Doug-fir       3 - other conif.   4 - hardwoods
    5 - residuals
```

```
Enter codes to be included
(separated by commas, terminated by "/"): 2/


Enter lower dbh limit (default=0),
      upper dbh limit (default=50),
  and class interval (default=2");
(separated by commas).Enter a "/" to choose defaults: /


     Standing diameter class table -- et =  15.00 yrs
     table is totals by DBH class
     ------------------------------------------------------------
     stand label = test stand
     species groups = doug fir
     ------------------------------------------------------------
                    stocks                          growth
     ------------------------------------------------------------
     | trees | basar  | cfvol |  bdvol || basar  | cfvol |  bdvol ||
     ------------------------------------------------------------
  6- 8|   5.7 |   1.21 |  0.00 |   0.00 ||   0.03 |  0.00 |   0.00 ||
  8-10|   9.1 |   3.47 |  0.12 |   0.48 ||   0.15 |  0.00 |   0.48 ||
 10-12|  11.9 |   7.54 |  0.30 |   1.31 ||   0.53 |  0.02 |   0.12 ||
 12-14|  13.9 |  12.95 |  0.57 |   2.79 ||   1.12 |  0.06 |   0.36 ||
 14-16|  15.0 |  19.05 |  0.91 |   4.85 ||   1.82 |  0.11 |   0.74 ||
 16-18|  15.1 |  24.90 |  1.26 |   7.10 ||   2.50 |  0.17 |   1.15 ||
 18-20|  14.3 |  29.57 |  1.53 |   9.07 ||   3.00 |  0.21 |   1.50 ||
 20-22|  12.9 |  32.35 |  1.70 |  10.41 ||   3.23 |  0.23 |   1.70 ||
 22-24|  11.1 |  32.99 |  1.74 |  10.94 ||   3.19 |  0.23 |   1.74 ||
 24-26|   9.2 |  31.61 |  1.66 |  10.68 ||   2.94 |  0.21 |   1.64 ||
 26-28|   7.3 |  28.63 |  1.49 |   9.77 ||   2.54 |  0.18 |   1.46 ||
 28-30|   5.5 |  24.64 |  1.27 |   8.45 ||   2.07 |  0.15 |   1.22 ||
 30-32|   4.0 |  20.19 |  1.03 |   6.92 ||   1.61 |  0.12 |   0.97 ||
 32-34|   4.7 |  27.61 |  1.38 |   9.43 ||   2.03 |  0.15 |   1.26 ||
     ------------------------------------------------------------
totals| 139.8 | 296.71 | 14.94 |  92.19 ||  26.75 |  1.83 |  14.32 ||


Do you want this table placed in the report file? (y=yes): y

  Table saved in report file.


Do you want more tables?
  0: exit
  1: average tree by DBH class
  2: percentages of species group total
  3: percentages of all species total
More? Enter 0,1,2, or 3: 3
```

Standing diameter class table -- et = 15.00 yrs
table is percentages of all species total

stand label = test stand
species groups = doug fir

	stocks				growth		
	trees	basar	cfvol	bdvol	basar	cfvol	bdvol
6- 8	2.0	0.22	0.00	0.00	0.06	0.00	0.00
8-10	3.2	0.64	0.55	0.36	0.36	0.18	2.61
10-12	4.2	1.39	1.34	1.00	1.24	0.91	0.66
12-14	4.9	2.39	2.57	2.13	2.60	2.44	1.96
14-16	5.3	3.51	4.10	3.71	4.24	4.64	4.04
16-18	5.3	4.59	5.64	5.43	5.80	6.83	6.32
18-20	5.0	5.45	6.88	6.94	6.97	8.49	8.21
20-22	4.5	5.96	7.62	7.97	7.52	9.31	9.31
22-24	3.9	6.08	7.80	8.37	7.42	9.27	9.53
24-26	3.2	5.82	7.44	8.17	6.82	8.58	9.02
26-28	2.5	5.28	6.69	7.48	5.90	7.46	8.00
28-30	1.9	4.54	5.69	6.46	4.82	6.14	6.69
30-32	1.4	3.72	4.61	5.30	3.74	4.80	5.31
32-34	1.7	5.09	6.18	7.21	4.71	6.13	6.92
totals	49.1	54.68	67.11	70.55	62.20	75.18	78.58

Do you want this table placed in the report file? (y=yes): **3**

Table saved in report file.

go:**sl**

VI-A pg. 20

STOCK TABLE

elapsed time = 15.00 years

species	dbar	tpa	basar	cfvol	bdvol
redwoods	17.63	145.	245.9	7.32	38.49
Doug-fir	19.73	140.	296.7	14.94	92.19
Totals	18.69	285.	542.7	22.27	130.68

YIELD SUMMARY: units = english

stand label = test stand

	min. DBH	merch top
cubic ft.	0.0	5
board ft.	8.0	5

species	site	init. age
Redwood	110.	50.
Douglas-Fir	125.	55.
Other conif.	73.	48.
Tanoak	94.	50.

species	et	dbar	tpa	basar	cvol	bdvol	bagro	cvgro	bdgro	
redwoods	0.00	15.36	150.0	193.0	5.40	26.29	0.0	0.00	0.00	
Doug-fir	0.00	16.18	150.0	214.1	9.52	52.23	0.0	0.00	0.00	
Totals	0.00	15.77	300.0	407.1	14.93	78.52	0.0	0.00	0.00	
redwoods	5.00	16.21	148.1	212.1	6.08	30.39	19.1	0.67	4.10	
Doug-fir	5.00	17.44	146.1	242.4	11.30	64.66	28.3	1.78	12.42	
Totals	5.00	16.83	294.2	454.5	17.38	95.04	47.4	2.45	16.52	M
redwoods	10.00	16.96	146.5	229.7	6.72	34.58	17.6	0.64	4.19	
Doug-fir	10.00	18.62	142.8	270.0	13.11	77.87	27.5	1.81	13.21	
Totals	10.00	17.80	289.2	499.6	19.83	112.45	45.1	2.45	17.41	M
redwoods	15.00	17.63	145.1	245.9	7.32	38.49	16.3	0.61	3.90	
Doug-fir	15.00	19.73	139.8	296.7	14.94	92.19	26.8	1.83	14.32	
Totals	15.00	18.69	284.9	542.7	22.27	130.68	43.0	2.44	18.23	M
species	et	dbar	tpa	basar	cvol	bdvol	bagro	cvgro	bdgro	

Print log table

Standing log inventory
---
stand = test stand
elapsed time = 15.00

Cubic volume (MCF/ac) by log size

sp.	Redwood		whitewood							
dib	logs	cvol	logs	cvol	logs	cvol	logs	cvol	logs	cvol
6	184.1	0.75	184.1	0.72						
8	101.9	0.77	141.3	1.00						
10	82.2	0.89	145.4	1.53						
12	71.7	1.07	110.1	1.64						
14	59.2	1.21	121.0	2.40						
16	34.6	0.92	67.2	1.74						
18	17.7	0.58	54.8	1.74						
20	15.9	0.64	39.0	1.50						
22	5.7	0.28	30.7	1.46						
24	3.5	0.21	10.2	0.59						
26	0.0	0.00	6.8	0.46						
28	0.0	0.00	1.9	0.15						
Totals		7.32		14.94						
eqn/taper		1.01		1.02						

Board volume (MBF/ac) by log size

sp.	Redwood		whitewood							
dib	logs	bdvol	logs	bdvol	logs	bdvol	logs	bdvol	logs	bdvol
6	180.0	1.02	178.2	0.85						
8	96.4	2.80	162.6	5.49						
10	86.4	4.66	115.9	7.08						
12	67.3	5.68	107.3	9.45						
14	59.4	7.32	126.5	16.62						
16	34.0	5.70	63.6	11.18						
18	18.5	4.01	62.0	14.04						
20	15.5	4.15	36.7	10.52						
22	6.5	2.21	23.8	8.28						
24	2.3	0.93	10.2	4.28						
26	0.0	0.00	6.8	3.32						
28	0.0	0.00	1.9	1.09						
Totals		38.49		92.19						
eqn/taper		1.01		1.05						

```
Do you want this table placed in the report file? (y=yes): n
```

go:**cg** *VI-A pg. 21*

```
   Current (past) 5 years growth - elapsed time =  15.
   ---------------------------------------------------

   species     bagro   cvgro   bdgro
   --------------------------------
   redwoods     16.3   0.61     3.90
   doug fir     26.8   1.83    14.32
   Totals       43.0   2.44    18.23
```

go:**ig** *VI-C pg. 22*

```
Ingrowth input mode:
  1) - enter ingrowth trees from the keyboard
  2) - enter ingrowth trees from an external file
Enter 1 or 2 : 1

Enter number of ingrowth records : 1

Enter ingrowth tree record items

 no.  sp  dbh  ht  cr  exp
 -------------------------
       x xx.x xxx .xx xx.x
 -------------------------
  1    3  2.6  25 .45 10.0

Ingrowth added to tree records and yield summary.
```

go:**ig** *VI-C pg. 22*

```
Ingrowth input mode:
  1) - enter ingrowth trees from the keyboard
  2) - enter ingrowth trees from an external file
Enter 1 or 2 : 2

Open the ingrowth file
Enter a filename here: demo.ig

Ingrowth added to tree records and yield summary.
```

go:**sv** *VI-F pg. 23*

```
   Internally saving stand, please wait...
```

```
   Stand saved internally;
   Saving yield summary and report file, please wait...

   Yield summary and report file saved.
   Save completed.
```

go:**gr** *VI-B pg. 21*

```
       Begin Growth Routine

   MORTALITY ON

 Enter the number of 5 yr. growth cycles desired
   Note: a "-" (minus) prefix shuts off mortality for all cycles entered.
 Enter number of cycles here: 3

 Do you want either individual tree growth detail
        or summary info printed?(y=yes): n
```

go:**st** *VI-A pg. 20*

```
          STOCK TABLE
          -----------
          elapsed time =  30.00 years

  species       dbar    tpa    basar   cfvol   bdvol
  ---------------------------------------------------
  redwoods     18.82    151.   292.1    9.03   49.58
  doug fir     22.08    141.   375.6   20.49  136.29
  other con     5.51     15.     2.4    0.01    0.00
  Totals       20.00    307.   670.1   29.53  185.86
```

go:**es** *VI-F pg. 24*

```
 External save of stand

 Open the external save file
 Enter a file name here: demo.es

 Saving stand please wait...

 Stand saved in file demo.es
```

go:**rt** *VI-F pg. 24*

```
 Yield summary saved in demo.yd
 Report summary saved in file demo.rp
```

```
Open the yield file
Enter a file name here: demo1.yd


Open the report file
Enter a file name here: demo1.rp

  Restoring stand to saved status, please wait...

  Stand restored to saved status;
  Restoring report file to saved status, please wait...

  Report file restored to saved status;
  Restoring yield summary to saved status, please wait...

  Yield summary restored to saved status.
  Restoration completed.
```

go:**ct** *VI-D pg. 23*

```
          HARVEST ROUTINE
          ---------------
Enter harvest label (up to 30 char): demo harvest

  Type "pc" to get a list of available commands.
```

cutgo:**r1** *VII pg. 26*

```
  Harvest with DBH control

Values needed:  1) Smallest dia. to be cut
                2) Largest dia. to be cut
                3) Amount (decimal fraction) of smallest dia. to be cut
                4) Amount (decimal fraction) of largest dia. to be cut

Enter values (separated by commas): 0.0,10.0,0.5,0.7

How to specify species to be harvested?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0

  Harvest completed.
```

cutgo:**r2** *VII pg. 27*

```
  Harvest with Basal Area Control

How would you like to harvest?
       [0] Specify basal area to cut.
```

```
       [1] Specify basal area to leave.
Enter here : 0

Stand Basal Area is 537.8 sq.ft./acre

Enter basal area to cut : -50

How to specify species to be harvested?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 1

The species group codes are:
   1 - Redwood        2 - Douglas-Fir   3 - Other con.    4 - Tanoak
   5 - Alder          6 - Other hwd.    7 - Res. redwd.    8 - Res. conif.

Enter codes to be harvested
(separated by commas, terminated by "/"): 1/

  Harvest completed.
```

cutgo:**r4** *VII pg. 27*

```
  Sanitation harvest

This routine will remove all trees that have a live crown ratio
equal to or below the user specified live crown ratio;

Specify live crown ratio target: .35

How to specify species to be harvested?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0

  Harvest completed.
```

cutgo:**ch** *VII pg. 27*

```
          CUMULATIVE HARVESTS
          -------------------
          elapsed time =  15.00 years
```

species	dbar	tpa	basar	cfvol	bdvol
redwoods	18.47	30.	56.5	1.84	10.93
doug fir	7.39	16.	4.8	0.08	0.32
other con	4.56	10.	1.1	0.00	0.00

```
 Totals        14.26     56.    62.4    1.92   11.24

Do you want this table placed in the report file? (y=yes): n
```

cutgo:**ih** *VII pg. 27*

```
          INTERMEDIATE HARVESTS
          ---------------------
          elapsed time =  15.00 years

 species        dbar    tpa     basar   cfvol  bdvol
 ---------------------------------------------------
 redwoods      18.47     30.    56.5    1.84   10.93
 doug fir       7.39     16.     4.8    0.08    0.32
 other con      4.56     10.     1.1    0.00    0.00
 Totals        14.26     56.    62.4    1.92   11.24

Do you want this table placed in the report file? (y=yes): n
```

cutgo:**r2** *VII pg. 27*

```
  Harvest with Basal Area Control

How would you like to harvest?
       [0] Specify basal area to cut.
       [1] Specify basal area to leave.
Enter here : 1

Stand Basal Area is 487.8 sq.ft./acre

Enter basal area to leave:  150

How to specify species to be harvested?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0

  Harvest completed.
```

cutgo:**st** *VII pg. 26*

```
          STOCK TABLE
          -----------
          elapsed time =  15.00 years

 species        dbar    tpa    basar   cfvol   bdvol
 ---------------------------------------------------
 redwoods      26.09     5.     17.3    0.60    3.49
 doug fir      28.16    31.    132.7    6.82   45.25
 Totals        27.89    35.    150.0    7.42   48.73
```

cutgo:**ih** *VII pg. 27*

```
          INTERMEDIATE HARVESTS
          ---------------------
          elapsed time =  15.00 years

 species        dbar    tpa    basar   cfvol   bdvol
 ---------------------------------------------------
 redwoods      16.36   120.    175.2    4.92   24.08
 doug fir      16.97   103.    161.9    8.05   46.62
 other con      4.30     7.      0.7    0.00    0.00
 Totals        16.40   230.    337.8   12.97   70.70

Do you want this table placed in the report file? (y=yes): n
```

cutgo:**hc** *VII pg. 28*

```
             Print diameter class table


How to specify species to be included?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0


Enter lower dbh limit (default=0),
      upper dbh limit (default=50),
  and class interval (default=2");
(separated by commas).Enter a "/" to choose defaults: /
```

```
Harvest  diameter class table -- et =  15.00 yrs
table is totals by DBH class
note: growth figures include ingrowth if harvested
-------------------------------------------------------------
stand label = test stand
All species combined
-------------------------------------------------------------
                stocks                          growth
-------------------------------------------------------------
| trees | basar  | cfvol |  bdvol || basar  | cfvol |  bdvol ||
-------------------------------------------------------------
 2- 4|  10.0 |   0.37 |  0.00 |   0.00 ||   0.37 |  0.00 |   0.00 ||
 4- 6|   0.0 |   0.00 |  0.00 |   0.00 ||   0.00 |  0.00 |   0.00 ||
 6- 8|  40.9 |  10.39 |  0.04 |   0.00 ||   7.35 |  0.04 |   0.00 ||
 8-10|  21.3 |   8.34 |  0.19 |   0.68 ||   0.47 |  0.01 |   0.49 ||
10-12|  26.7 |  16.24 |  0.45 |   1.81 ||   1.08 |  0.03 |   0.15 ||
12-14|  30.0 |  26.04 |  0.84 |   3.78 ||   1.94 |  0.08 |   0.43 ||
14-16|  46.6 |  57.88 |  1.88 |   8.97 ||   4.30 |  0.18 |   1.05 ||
16-18|  28.9 |  49.07 |  1.94 |  10.38 ||   4.10 |  0.22 |   1.44 ||
18-20|  26.3 |  55.19 |  2.32 |  13.04 ||   4.74 |  0.27 |   1.88 ||
20-22|  22.9 |  57.96 |  2.52 |  14.81 ||   5.01 |  0.30 |   2.15 ||
22-24|  19.1 |  57.26 |  2.55 |  15.45 ||   4.87 |  0.30 |   2.23 ||
24-26|   3.3 |  11.50 |  0.39 |   2.24 ||   0.78 |  0.03 |   0.24 ||
26-28|   3.0 |  12.02 |  0.42 |   2.51 ||   0.82 |  0.04 |   0.29 ||
28-30|   3.4 |  15.71 |  0.56 |   3.36 ||   1.02 |  0.05 |   0.38 ||
30-32|   2.4 |  12.56 |  0.45 |   2.75 ||   0.79 |  0.04 |   0.31 ||
32-34|   1.7 |   9.70 |  0.34 |   2.17 ||   0.58 |  0.03 |   0.24 ||
-------------------------------------------------------------
totals| 286.5 | 400.23 | 14.89 |  81.94 ||  38.22 |  1.61 |  11.28 ||

Do you want this table placed in the report file? (y=yes): y

  Table saved in report file.
```

cutgo:**dc**

VII pg. 26

```
      Print diameter class table


How to specify species to be included   ?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0

Enter lower dbh limit (default=0),
      upper dbh limit (default=50),
  and class interval (default=2");
(separated by commas  Enter a "/" to choose defaults: /
```

```
Residual diameter class table -- et =  15.00 yrs
table is totals by DBH class
note: growth figures include ingrowth
-------------------------------------------------------------
stand label = test stand
All species combined
-------------------------------------------------------------
                stocks                        growth
-------------------------------------------------------------
| trees | basar  | cfvol |  bdvol || basar  | cfvol |  bdvol ||
-------------------------------------------------------------
24-26|  12.1 |  42.02 |  2.02 |  12.76 ||   3.66 |  0.24 |   1.89 ||
26-28|   9.0 |  35.55 |  1.73 |  11.17 ||   2.99 |  0.20 |   1.61 ||
28-30|   5.5 |  24.64 |  1.27 |   8.45 ||   2.07 |  0.15 |   1.22 ||
30-32|   4.0 |  20.19 |  1.03 |   6.92 ||   1.61 |  0.12 |   0.97 ||
32-34|   4.7 |  27.61 |  1.38 |   9.43 ||   2.03 |  0.15 |   1.26 ||
-------------------------------------------------------------
totals|  35.3 | 150.00 |  7.42 |  48.73 || 12.36 |  0.86 |   6.95 ||

Do you want this table placed in the report file? (y=yes): y

  Table saved in report file.
```

```
   Print log table

         Harvest log inventory
         ---------------------
         stand = test stand
         elapsed time =  15.00
-----------------------------------------------------------------------
                    Cubic volume (MCF/ac) by log size
-----------------------------------------------------------------------
sp. |  Redwood   | whitewood  |            |            |            |
-----------------------------------------------------------------------
dib |  logs  cvol|  logs  cvol|  logs  cvol|  logs  cvol|  logs  cvol|
-----------------------------------------------------------------------
  6 | 186.2  0.75| 152.1  0.58|
  8 | 100.2  0.76| 120.1  0.84|
 10 |  77.5  0.84| 126.4  1.33|
 12 |  67.6  1.01|  83.4  1.24|
 14 |  55.7  1.14|  95.8  1.91|
 16 |  29.9  0.80|  38.4  1.02|
 18 |  16.0  0.53|  24.1  0.78|
 20 |  11.3  0.45|  11.1  0.44|
 22 |   5.7  0.28|   0.0  0.00|
 24 |   3.5  0.21|   0.0  0.00|
-----------------------------------------------------------------------
Totals       6.76         8.13
eqn/taper    1.01         1.03
-----------------------------------------------------------------------
                    Board volume (MBF/ac) by log size
-----------------------------------------------------------------------
sp. |  Redwood   | whitewood  |            |            |            |
-----------------------------------------------------------------------
dib | logs  bdvol| logs  bdvol| logs  bdvol| logs  bdvol| logs  bdvol|
-----------------------------------------------------------------------
  6 | 173.8  1.02| 143.6  0.85|
  8 |  96.0  2.79| 146.6  4.89|
 10 |  81.7  4.41|  96.3  5.91|
 12 |  63.2  5.30|  83.4  7.42|
 14 |  55.9  6.88|  95.8 12.59|
 16 |  29.3  4.89|  38.4  6.83|
 18 |  16.8  3.64|  24.1  5.42|
 20 |  10.8  2.91|  11.1  3.03|
 22 |   6.5  2.22|   0.0  0.00|
 24 |   2.3  0.93|   0.0  0.00|
-----------------------------------------------------------------------
Totals      35.00        46.94
eqn/taper    1.01         1.05
-----------------------------------------------------------------------

 Do you want this table placed in the report file? (y=yes): y

   Table saved in report file.
```

cutgo:**ex** *VII pg. 28*

```
Do you wish to implement a lag time for response to thin? (y=yes): n

Exiting harvest routine.
Returning to main program.
```

go:**yd** *VI-A pg. 20*

```
YIELD SUMMARY: units = english
-------------

stand label = test stand

                min. DBH    merch top
     cubic ft.    0.0         5
     board ft.    8.0         5

species       site   init. age
Redwood       110.      50.
DouglasFir    125.      55.
Other con.     73.      48.
Tan Oak        94.      50.

-------------------------------------------------------------------------------
species        et  dbar    tpa  basar   cvol  bdvol   bagro  cvgro  bdgro
-------------------------------------------------------------------------------
redwoods     0.00  15.36  150.0  193.0   5.40  26.29    0.0   0.00   0.00
doug fir     0.00  16.18  150.0  214.1   9.52  52.23    0.0   0.00   0.00
Totals       0.00  15.77  300.0  407.1  14.93  78.52    0.0   0.00   0.00
-------------------------------------------------------------------------------
redwoods     5.00  16.21  148.1  212.1   6.08  30.39   19.1   0.67   4.10
doug fir     5.00  17.44  146.1  242.4  11.30  64.66   28.3   1.78  12.42
Totals       5.00  16.83  294.2  454.5  17.38  95.04   47.4   2.45  16.52   M
-------------------------------------------------------------------------------
redwoods    10.00  16.96  146.5  229.7   6.72  34.58   17.6   0.64   4.19
doug fir    10.00  18.62  142.8  270.0  13.11  77.87   27.5   1.81  13.21
Totals      10.00  17.80  289.2  499.6  19.83 112.45   45.1   2.45  17.41   M
-------------------------------------------------------------------------------
redwoods    15.00  17.63  145.1  245.9   7.32  38.49   16.3   0.61   3.90
doug fir    15.00  19.73  139.8  296.7  14.94  92.19   26.8   1.83  14.32
Totals      15.00  18.69  284.9  542.7  22.27 130.68   43.0   2.44  18.23   M
-------------------------------------------------------------------------------
INGROWTH:
-------------------------------------------------------------------------------
other con   15.00   2.60   10.0    0.4   0.00   0.00
Totals      15.00   2.60   10.0    0.4   0.00   0.00
-------------------------------------------------------------------------------
                       STAND AFTER INGROWTH            includes ingrowth
-------------------------------------------------------------------------------
redwoods    15.00  17.63  145.1  245.9   7.32  38.49   16.3   0.61   3.90
doug fir    15.00  19.73  139.8  296.7  14.94  92.19   26.8   1.83  14.32
Totals      15.00  18.38  294.9  543.0  22.27 130.68   43.4   2.44  18.23
-------------------------------------------------------------------------------
```

INGROWTH:

redwoods	15.00	7.50	10.0	3.1	0.04	0.00			
Doug-fir	15.00	7.00	10.0	2.7	0.00	0.00			
other con	15.00	6.20	7.0	1.5	0.00	0.00			
Totals	15.00	7.00	27.0	7.2	0.04	0.00			
		STAND AFTER INGROWTH					includes ingrowth		
redwoods	15.00	17.16	155.1	249.0	7.36	38.49	19.3	0.64	3.90
Doug-fir	15.00	19.14	149.8	299.4	14.94	92.19	29.4	1.83	14.32
Totals	15.00	17.70	321.9	550.2	22.31	130.68	50.6	2.48	18.23
HARVESTS:	demo harvest						growth harvested		
redwoods	15.00	16.81	150.4	231.7	6.76	35.00	18.1	0.59	3.51
Doug-fir	15.00	16.02	119.1	166.7	8.13	46.94	18.2	1.03	7.77
other con	15.00	4.45	17.0	1.8	0.00	0.00	1.8	0.00	0.00
Totals	15.00	16.00	286.5	400.2	14.89	81.94	38.2	1.61	11.28
		STAND AFTER HARVEST					growth remaining		
redwoods	15.00	26.09	4.7	17.3	0.60	3.49	1.2	0.06	0.39
Doug-fir	15.00	28.16	30.7	132.7	6.82	45.25	11.2	0.81	6.55
Totals	15.00	27.89	35.3	150.0	7.42	48.73	12.4	0.86	6.95
species	et	dbar	tpa	basar	cvol	bdvol	bagro	cvgro	bdgro

go:**ex**

VI-F pg. 24

```
Yield summary saved in demo1.yd
Report summary saved in demo1.rp
```

APPENDIX C. HARVEST OPTION R3

The harvest command **r3** calls the "free" harvest subroutine. This interactive option gives the user considerable flexibility in simulating harvest. Using **r3**, one can easily create up to 24 variable-width diameter classes, each available for harvesting. Harvesting can be done by species groups, specified species, or all species. Harvesting may be done in units of trees or square feet of basal area, and may also be specified as a fraction of the number of trees or square feet of basal area available for harvesting. User-specified overall cutting limits are used to prevent accidential overharvesting. The user can also specify which tree characteristic(s) to consider when removing trees.

Harvesting under **r3** is designed to give the user freedom to regulate the cutting parameters. To give the user a flexible routine, a moderate amount of interaction is required. A flowchart detailing the program/user interaction is given on the next page. To initialize **r3**, the user must respond to questions when prompted by CRYPTOS. The program also indicates the form of the response required.

The harvest specification consists of two phases: (1) the program initialization, and (2) the actual harvest specification. Once initialized, **r3** allows multiple harvests and even allows the user to go back and change the specifications given in the initialization cycle. The initialization and harvesting phases are described below, and a sample runstream is given to illustrate the operation of **r3**.

Initialization

The "free" harvest option is called by entering the harvest routine with the **ct** (or cut) command and choosing the option **r3** in response to the harvest prompt, "cutgo:". The user then sets the basic pattern for the way the harvest will be specified.

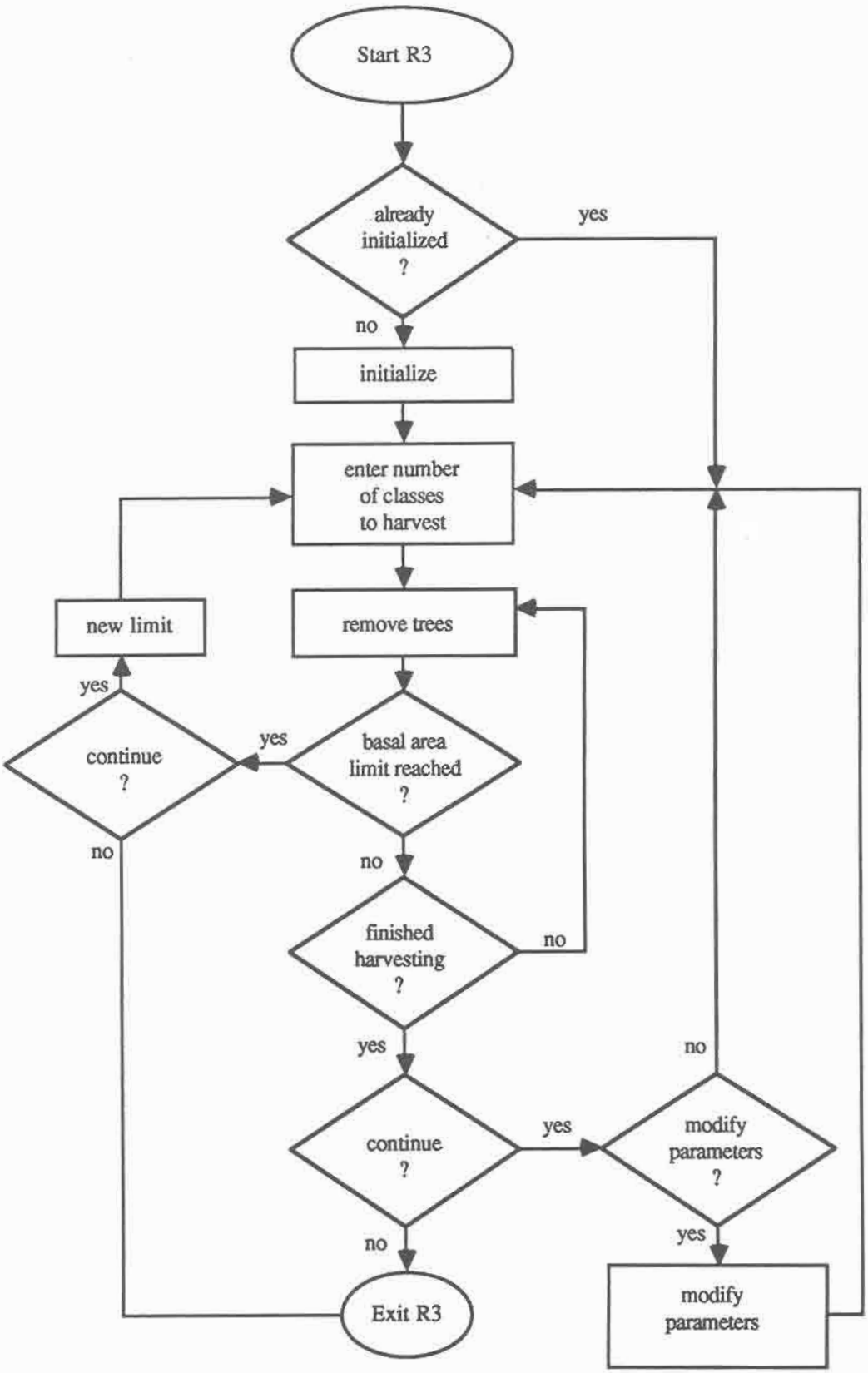
Diameter classes. Up to 24 variable-width diameter classes may be requested. The number of classes desired is requested, followed by a prompt for the upper limits of each DBH class, specified in ascending order. The lower limit for the first diameter class is zero inch. If the upper limit for the last diameter class does not include the largest tree in the tree list, an additional diameter class is automatically created. This ensures that every tree in the stand can be harvested.

Maximum basal area to cut. The maximum fraction of total basal area which may be cut is specified by the user. The user may not wish to remove more than a certain fraction of the total basal area in a stand. The decimal fraction specified by the user is used as a cutoff for harvesting. If the limit is reached, a message appears on the screen and the user is given the option of continuing or stopping the harvest.

Species to cut. Cutting may be done by (1) all species, (2) individual species, or (3) species groups. As with the other harvest options, **r3** recognizes species "targets" when removing trees.

Cut by DBH, crown, or both. Removal may be prioritized by considering (1) DBH, (2) live crown ratio, or (3) live crown ratio and DBH. The routine prioritizes removals in each diameter class by first removing (1) small trees, (2) trees with poor live crown ratios, or (3) trees with low values for (lcr * DBH** 1.5). The third option is used to prioritize removals similiar to field guides, where one considers both DBH and live crown ratio when removing trees.

Figure C.1: Flowchart of Harvest Option **R3**.



How to cut. The user may harvest by tree (option 1) or by basal area (option 2), specifying either the number of trees or the square feet of basal area to remove. Diameter class statistics are reported in the units used for cutting.

Actual units or relative units. Harvest may be specified in either (1) absolute or (2) fractional terms. By specifying absolute terms, the user gives the number of trees or square feet of basal area to be removed. Fractions are specified as a decimal proportion of the amount available for removal.

Number of DBH classes to cut. This entry establishes the number of times the user is asked for cutting information. The user cannot operate in more diameter classes than created.

Harvesting

Once initialized, **r3** asks the user in which diameter class to cut. If three diameter classes have been established (>0-16", >16-22", and >22-30"), and the user wishes to operate in the 22-30" class, entering "3" calls up the third diameter class for harvesting. Stand and diameter class statistics are then reported in the form specified during initialization. The user enters the amount to cut (i.e., a fraction of all the trees available, a percentage of square feet or basal area, etc.) and **r3** starts cutting. All harvesting proceeds normally unless the cutting specifications exceed the user-defined limit. If the limit is reached, a message is printed allowing the user to continue or to stop the harvesting session (continuation requires a new upper limit set on cutting). If all harvesting proceeds normally, a "normal termination" message appears at the end of the session. The user may then choose to stop or to continue harvesting. Stopping returns the user to the "cutgo:" prompt. Should the user choose to continue, the program asks if the user wishes to harvest with the same initialization or a modified one. Modifying allows the user to change any number of the initialization parameters. Harvesting can then continue as before.

Following is a sample run showing the majority of **r3**'s features.

Example of harvest option R3.

Boldface indicates user entry.

Italics indicates helpful annotations.

```
                              WELCOME TO

      CCCCC   RRRRRRR   YY    YY  PPPPPPP   TTTTTTTT    OOOO     SSSSS
     CCCCCCC  RR    RR  YY    YY  PP    PP  TTTTTTTT   OOOOOO   SS   SS
    CC        RR    RR   YY  YY   PP    PP     TT     OO    OO  SS
    CC        RRRRRRR     YYYY    PPPPPPP      TT     OO    OO   SSSSS
    CC        RR  RR       YY     PP           TT     OO    OO       SS
     CCCCCCC  RR   RR      YY     PP           TT      OOOOOO   SS   SS
      CCCCC   RR    RR     YY     PP           TT       OOOO     SSSSS

        The Cooperative Redwood Yield Project Timber Output Simulator

       Copyright 1982,1987 The Regents of the University of California

enter "return" to continue:  1
demo.sd
demo.yd
demo.rp

            MAIN PROGRAM
            ------------
    Type "pc" to get a list of available commands
    Current output file is 6 (the screen)

 go:ct

            HARVEST ROUTINE
            ---------------
  Enter harvest label (up to 30 char): example of harvest routine r3

    Type "pc" to get a list of available commands.

 cutgo:pf

        Print stand profile

  How to specify species to be graphed?
    0 - All species together
    1 - By one or more species
    2 - By one or more species groups

  Enter 0, 1, or 2 : 0
```

Enter names of input and output files, suppressing prompts.

Enter harvest routine.

Stand Profile

```
Stand Profile
elapsed time =   0.   yrs
All species combined

                 feet above ground
 DBH  Trees |    24    48    72    96   120   144   168   192   216   240
            ..............................................................
0 - 2   40. |=>
2 - 4    0. |
4 - 6   10. |==>>>>>
6 - 8   40. |==>>>>>>>
8 -10   50. |======>>>>>
10-12    0. |
12-14   10. |========>>>>>>>>>>
14-16    5. |=========>>>>>>>>>>>>
16-18   10. |=========>>>>>>>>>>
18-20    5. |===========>>>>>>>>>>>>>
20-22   25. |===========>>>>>>>>>>>>>
22-24    5. |============>>>>>>>>>>>>
24-26    5. |==================>>>>>>>>>>
26-28   10. |==================>>>>>>>>>>
28-30    5. |===========>>>>>>>>>>>>>>>>>
------------
total  220.

 do you want this graph placed in the report file? (y=yes):n

cutgo:r3
```

Call R3.

```
 WELCOME TO FREE CUTTING

 How many diameter classes to establish? (max= 24): 5
 What is the upper dia limit for the 1st  dia class?: 4
 What is the upper dia limit for the 2nd  dia class?: 10
 What is the upper dia limit for the 3rd  dia class?: 18
 What is the upper dia limit for the 4th  dia class?: 24
 What is the upper dia limit for the 5th  dia class?: 30
```

Establish 5 diameter classes and set upper limits.

```
 Enter maximum fraction of total BA which may be cut: .3
```

Set max cut at 30% of total basal area.

```
 How to specify species to be harvested?
   0 - All species together
   1 - By one or more species
   2 - By one or more species groups

 Enter 0, 1, or 2 : 0
```

Set target species (all species combined)

```
 You may remove either trees or basal area by
 considering the following:
   (1)-- smallest dbh in the class
   (2)-- live crown ratio
   (3)-- lcr and dbh
```

```
Enter option to use: 3
```

Consider lcr and dbh when removing trees

```
How to cut?  by tree (1) or by BA (2)
Enter 1 or 2 : 1
```

Removals in units of number of trees

```
Cut in absolutes (1) or fraction (2) ?
Enter 1 or 2 : 2
```

Removals by fraction of total number of trees

```
How many dia classes to operate in (1- 5)? : 5
```

Harvest in 5 classes

```
Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 228.58 sq.ft./ac.
  0.00% of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 1st  ( 1,2,3, etc): 1
```

Harvest in 1st diameter class, remove 50% of trees in this class.

```
How many trees to harvest?
  Trees in this class =  40.00
Enter amount here: .5

Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 228.42 sq.ft./ac.
  0.07% of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 2nd  ( 1,2,3, etc): 2
```

Harvest in 2nd class

```
How many trees to harvest?
  Trees in this class = 100.00
Enter amount here: .1

Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 227.06 sq.ft./ac.
  0.67% of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 3rd  ( 1,2,3, etc): 3
```

Harvest in 3rd class

```
How many trees to harvest?
  Trees in this class =  25.00
```

```
Enter amount here: .0


Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 227.06 sq.ft./ac.
  0.67% of the initial basal area has been cut.


diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 4th  ( 1,2,3, etc): 4
```

Harvest in 4th class

```
How many trees to harvest?
  Trees in this class =  35.00
Enter amount here: .1

Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 218.23 sq.ft./ac.
  4.53% of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 5th  ( 1,2,3, etc): 5
```

Harvest in 5th class

```
How many trees to harvest?
  Trees in this class =  20.00
Enter amount here: .5

You have finished harvesting. Normal termination.
Basal area harvested is  46.65 sq.ft./ac. or 20.41 % of total basal area.
Remaining basal area = 181.92 sq.ft./ac.

Do you want to continue harvesting?(yes= y): y
```

Continue harvesting

```
The harvesting routine is initialized. You may
  (1)-- Continue harvesting without changing parameters
  (2)-- Modify harvest routine parameters
Enter 1 or 2 : 2
```

Modify parameters

```
      ---Menu for Changing Parameters---

(1) End Harvest Routine
(2) Start Harvesting Again
(3) Adjust Diameter Classes
(4) Change Species Keys
(5) Change Key for Sort
(6) Change Removal Limit
(7) Cut by Tree or B.A.?
(8) Absolutes or Proportions?

Which option?: 4
```

Change species targets

```
How to specify species to be harvested  ?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 1

The species codes are:
   1 - Redwood        2 - Douglas-fir       3 - Other conif.    4 - Tanoak
   5 - Alder          6 - Other hwd.        7 - Res. redwd.     8 - Res. conif.

Enter the codes of species to be harvested
(separated by commas, terminated with a "/"): 1/

      ---Menu for Changing Parameters---

(1) End Harvest Routine
(2) Start Harvesting Again
(3) Adjust Diameter Classes
(4) Change Species Keys
(5) Change Key for Sort
(6) Change Removal Limit
(7) Cut by Tree or B.A.?
(8) Absolutes or Proportions?

Which option?: 7
```

Modify removal units

```
How to cut?  by tree (1) or by BA (2)
Enter 1 or 2 : 2

      ---Menu for Changing Parameters---

(1) End Harvest Routine
(2) Start Harvesting Again
(3) Adjust Diameter Classes
(4) Change Species Keys
(5) Change Key for Sort
(6) Change Removal Limit
(7) Cut by Tree or B.A.?
(8) Absolutes or Proportions?
```

```
Which option?: 8
```

Change way to specify cut amount. Cut in absolutes.

```
Cut in absolutes (1) or proportions (2) ?
Enter 1 or 2 : 1

      ---Menu for Changing Parameters---

(1) End Harvest Routine
(2) Start Harvesting Again
(3) Adjust Diameter Classes
(4) Change Species Keys
(5) Change Key for Sort
(6) Change Removal Limit
(7) Cut by Tree or B.A.?
(8) Absolutes or Proportions?

Which option?: 2
```

Resume harvesting.

```
How many dia classes to operate in (1- 5) ? : 2
```

Harvest in two classes.

```
Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 181.92 sq.ft./ac.
 20.41% of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 1st  ( 1,2,3, etc): 5
```

Harvest in 5th class.

```
How much basal area to harvest ?
  B.A. in this class =   40.5
  You are harvesting by species groups.
  There is   40.5 sqr ft. of basal area available for cutting
Enter amount here: 30.5
```

Reached 30% limit set earlier, set new limit.

```
You have reached the allowed limit!

Do you wish to continue? (y=yes)
(If you answer n for no, you will exit R3): y

Enter a new fraction of total BA for removal: .4

Initial total basal area = 228.58 sq.ft./ac.
Current basal area = 160.00 sq.ft./ac.
 30.00% of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0


Enter dia class to harvest 2nd  ( 1,2,3, etc): 5
```

Harvest in 5th class again.

```
How much basal area to harvest?
  B.A. in this class =   18.6
  You are harvesting by species groups.
  There is   18.6 sqr ft. of basal area available for cutting
Enter amount here: 12.6

You have finished harvesting. Normal termination.
Basal area harvested is  81.17 sq.ft./ac. or 35.51% of total basal area.
Remaining basal area = 147.40 sq.ft./ac.

Do you want to continue harvesting? (yes= y): n
```

Quit harvesting.

```
cutgo:pf
```

Print another stand profile to see the effects of the cut.

```
 Print stand profile

How to specify species to be graphed?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0

Stand Profile
elapsed time =   0.   yrs
All species combined

                 feet above ground
 DBH  Trees |    24    48    72    96   120   144   168   192   216   240
            ..............................................................
0 - 2   20. |=>>
2 - 4    0. |
4 - 6    0. |
6 - 8   40. |==>>>>>>>
8 -10   50. |======>>>>>
10-12    0. |
12-14   10. |========>>>>>>>>>>
14-16    5. |=========>>>>>>>>>>>
16-18   10. |=========>>>>>>>>>>
18-20    5. |===========>>>>>>>>>>>>>
20-22   22. |===========>>>>>>>>>>>>>
22-24    5. |============>>>>>>>>>>>>
24-26    0. |
26-28    0. |
28-30    1. |===========>>>>>>>>>>>>>>>>>
------------
total  168.

 Do you want this graph placed in the report file? (y=yes): n
```

```
cutgo:r3
```

Re-enter r3 to get the 28-30 inch class.

```
WELCOME TO FREE CUTTING

Parameters for R3 are set from previous use.
Do you wish to use these parameters?(y = yes): y

How many dia classes to operate in (1- 5) ? : 1

Initial total basal area = 147.40 sq.ft./ac.
Current basal area = 147.40 sq.ft./ac.
  0.   % of the initial basal area has been cut.

diameter class :    1     2     3     4     5
   upper limit :    4.0  10.0  18.0  24.0  30.0

Enter dia class to harvest 1st  ( 1,2,3, etc): 5

How much basal area to harvest?
  B.A. in this class =    6.0
  You are harvesting by species groups.
  There is    6.0 sqr ft. of basal area available for cutting
Enter amount here: 6.0

You have finished harvesting. Normal termination.
Basal area harvested is   6.00 sq.ft./ac. or  4.07 % of total basal area.
Remaining basal area = 141.40 sq.ft./ac.
```

Use same parameters.

Harvest in one class.

Harvest all of 5th diameter class.

```
Do you want to continue harvesting?(yes= y): n
```

*Exit from **R3**.*

```
cutgo:pf

      Print stand profile

How to specify species to be graphed?
  0 - All species together
  1 - By one or more species
  2 - By one or more species groups

Enter 0, 1, or 2 : 0
```

Get another profile to see the effects of the cut.

```
Stand Profile
elapsed time =   0.   yrs
All species combined

                 feet above ground
 DBH  Trees |    24    48    72    96   120   144   168   192   216   240
            ..............................................................
0 - 2   20. |=>>
2 - 4    0. |
4 - 6    0. |
6 - 8   40. |==>>>>>>>
8 -10   50. |======>>>>>
10-12    0. |
12-14   10. |========>>>>>>>>>>
14-16    5. |=========>>>>>>>>>>>>
16-18   10. |=========>>>>>>>>>>
18-20    5. |===========>>>>>>>>>>>>>
20-22   22. |===========>>>>>>>>>>>>>
22-24    5. |============>>>>>>>>>>>>
------------
total  167.

 Do you want this graph placed in the report file? (y=yes): n

cutgo:ex
```

Exit harvest routine continue with simulation.

APPENDIX D: SPECIFYING CALIBRATION FACTORS

The calibration option, **cl**, gives users a flexible tool for adjusting height and/or basal area growth predictions for perceived differences between predicted and actual growth rates. It is assumed that growth is of the same form as that predicted by CRYPTOS, but of a higher or lower magnitude. Thus, adjustments are expressed as percentages using calibration factors. It is likely that differences may not occur stand-wide, or even occur equally among the components of tree growth. Hence, this option allows the user to specify calibration factors for basal area and/or height growth by any combination of species and/or appropriate size classes. Such a designation is referred to as the calibration scheme.

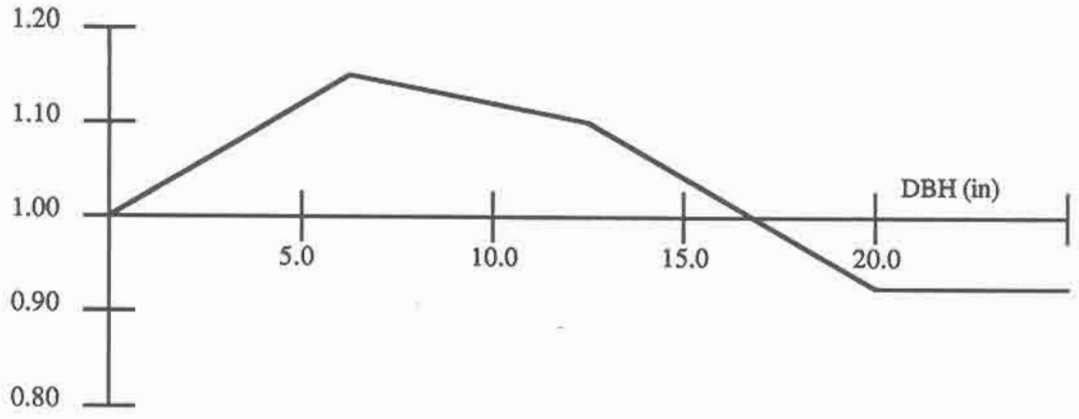
Calibration schemes are applied to growth predictions at any time in growth simulation and for any duration of growth periods. In calibrated runs, growth estimates are adjusted after each 5-year growth period, and subsequent predictions are based on the adjusted diameters and/or heights. Calibration in this manner is a compound process, and the calibration factors in a specified scheme should reflect this fact.

The decision process required of the user in **cl** enables efficient keyboard designation if the calibration scheme is known beforehand. Figure D.1 presents the process schematically, and a more detailed explanation is in section V. Only one scheme can reside internally in CRYPTOS; however, the user can change this scheme within a simulation session.

A piecewise linear function is used to assign factors to individual tree records based on tree size at the beginning of a growth period. Using designated factors and size limits (hereafter referred to as a vector), specific factors are determined by linear interpolation between these values. By convention, the first size limit in a vector is 0 (inch or foot), for which the user supplies a factor. The last designated size limit is the lower limit of the last size class. Hence, the last factor applied as a constant to all trees larger than this limit. For example, suppose the following vector is designated for Douglas-fir basal area growth:

Size	Factor
0.0"	1.00
6.0"	1.15
12.5"	1.10
20.0"	0.94

The graph of Douglas-fir's calibrations specified by this vector would be as follows:



In the case where one calibration factor is applied to all size trees of a species, this graph would be a horizontal line.

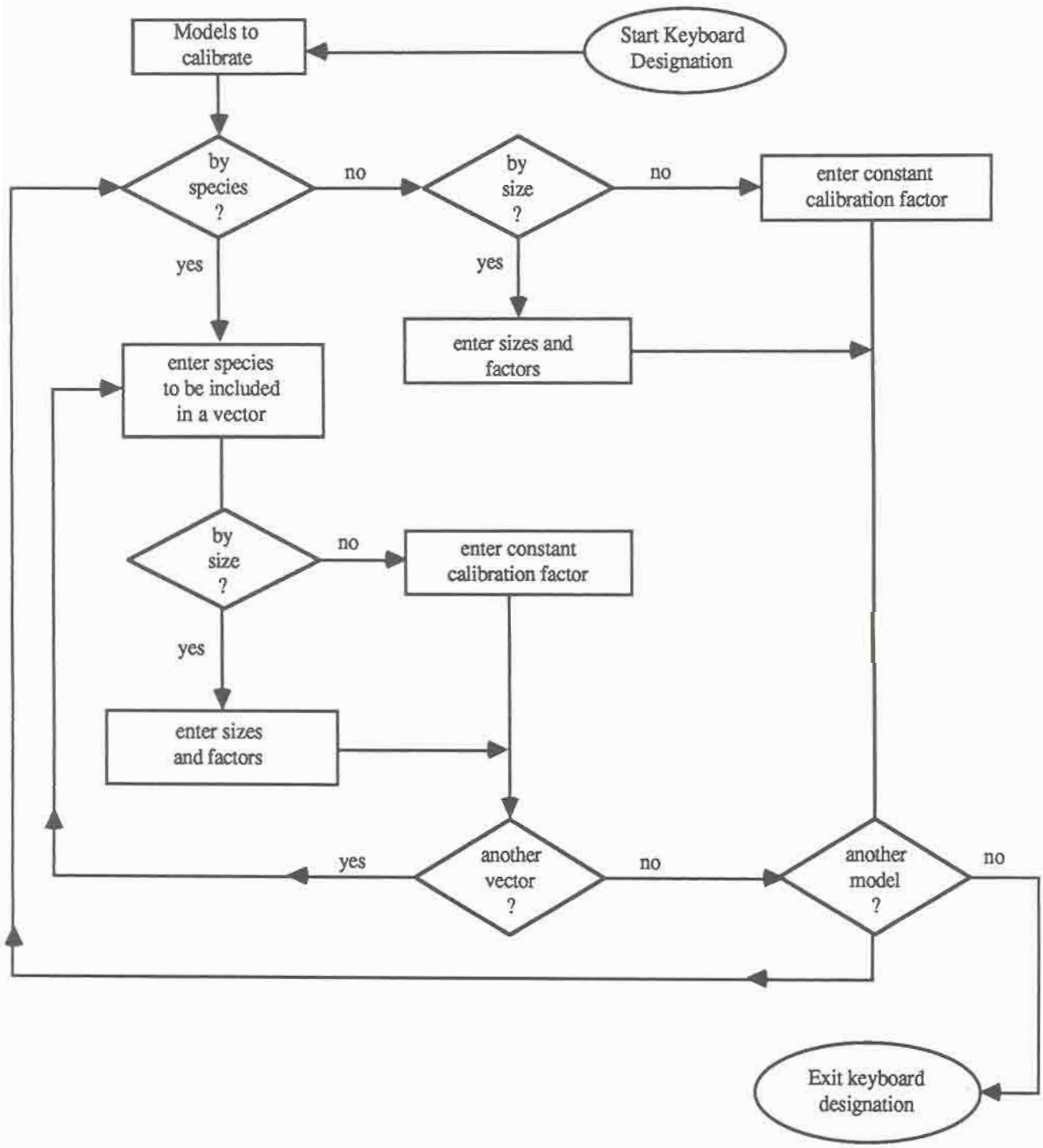
There are a few reasonable restrictions on the calibration procedure. To preserve the integrity of the CRYPTOS response surfaces, growth predictions may be adjusted by no more than plus or minus 20 percent. Size

designations are limited to the significant size variables (i.e., only diameter size limits are allowed for basal area calibration, and only total heights for height calibration). Specifying otherwise is functionally unsound for CRYPTOS. Finally, to keep the schemes manageable, users are limited to five sizes per calibration vector (more than needed because calibration should be done broadly and with large amounts of sample data.)

User discretion and available data determine the adequacy of calibration schemes. Once successful schemes are developed, they may be stored externally in formatted files through **cl**. Retrieval of a file for use in growth simulation is also done in **cl**.

The versatility of the calibration option is great and proficiency will come with use. The following sample runstream illustrates how to designate a calibration scheme and to apply it in growth simulations.

Figure D.1: User Calibration Decision Process Flowchart



SAMPLE CALIBRATION RUNSTREAM

Boldface indicates user entry.

```
                                WELCOME TO

      CCCCC   RRRRRRR   YY    YY  PPPPPPP   TTTTTTTT    OOOO     SSSSS
    CCCCCCC   RR    RR  YY    YY  PP    PP  TTTTTTTT   OOOOOO   SS   SS
   CC         RR    RR   YY  YY   PP    PP     TT     OO    OO  SS
   CC         RRRRRRR     YYYY    PPPPPPP      TT     OO    OO   SSSSS
   CC         RR  RR       YY     PP           TT     OO    OO       SS
    CCCCCCC   RR   RR       YY     PP           TT      OOOOOO   SS   SS
     CCCCC    RR    RR      YY     PP           TT       OOOO     SSSSS

        The Cooperative Redwood Yield Project Timber Output Simulator

       Copyright 1982,1985 The Regents of the University of California


enter "return" to continue;1
demo.sd
demo.yd
demo.rp


In this program, if the computer is waiting for a command
it will give you a prompt that is:
   go:       If you are in the main program
   initgo:   If you are in the initialization routine
   cutgo:    If you are in the cutting routine


   Do you want to enter the initialization routine,
 to change any of the initial (default) control options? (y=yes): y


   INITIALIZATION ROUTINE                                          V page 16
   ----------------------
   Type "pc" to get a list of available commands.


initgo:cl
```

```
                    Calibration Entry Routine

How to enter calibration scheme?
  0 - exit calibration routine
  1 - enter from keyboard
  2 - enter from an external file
Enter 0,1, or 2 : 1

What model(s) are to be calibrated?
  1 - Basal Area only
  2 - Height only
  3 - Both Basal Area and Height
Enter 1,2, or 3 : 3
```

V page 16-17

```
                Section for entering Basal Area calibration


Are the same Basal Area calibration factor(s) to be applied
to ALL species? (y=yes,n=no) : n

The species codes are:
   1 - Redwood        2 - Douglas-fir     3 - Other conif.       4 - Tanoak
   5 - Alder          6 - Other hwd.      7 - Res. redwd.        8 - Res. conif.

Enter the codes of the species to be included in the
  1st Basal Area calibration group,
(separated by commas,terminated by a "/"): 1,2/

Do you want to enter calibration factors by dia size classes?
(y=yes,n=no): y

How many dia size classes are wanted? Range is 2 to 5 classes.
Entering 1 is the same as not requesting dia size classes.
Enter here: 4

The lower dia limit for the 1st  size class is 0.0.
Please enter the corresponding calibration factor in decimal fraction,
(entering 1.12 increases growth by 12 % ): 0.90
Enter the lower dia limit and calibration factor for the 2nd  size class.
Enter here (separated by a comma): 6.0,0.93
Enter the lower dia limit and calibration factor for the 3rd  size class.
Enter here (separated by a comma): 12.0,1.00
Enter the lower dia limit and calibration factor for the 4th  size class.
Enter here (separated by a comma): 30.0,1.06

Do you want to enter another calibration group?
(y=yes,n=no): y

The species codes are:
   1 - Redwood        2 - Douglas-fir     3 - Other conif.       4 - Tanoak
   5 - Alder          6 - Other hwd.      7 - Res. redwd.        8 - Res. conif.
```

```
Enter the codes of the species to be included in the
  2nd Basal Area calibration group,
(separated by commas,terminated by a "/"): 7,8/

Do you want to enter calibration factors by dia size classes?
(y=yes,n=no): n
Please enter the calibration factor in decimal fraction,
(entering 1.12 increases growth by 12 %) : 0.93

Do you want to enter another calibration group?
(y=yes,n=no): n


                    Section for entering Height calibration


Are the same Height calibration factor(s) to be applied
to ALL species? (y=yes,n=no) : n

The species codes are:
   1 - Redwood        2 - Douglas-fir     3 - Other conif.       4 - Tanoak
   5 - Alder          6 - Other hwd.      7 - Res. redwd.        8 - Res. conif.

Enter the codes of the species to be included in the
  1st Height calibration group,
(separated by commas,terminated by a "/"): 1,2/

Do you want to enter calibration factors by ht  size classes?
(y=yes,n=no): y

How many ht  size classes are wanted? Range is 2 to 5 classes.
Entering 1 is the same as not requesting ht  size classes.
Enter here: 2

The lower ht  limit for the 1st  size class is 0.0.
Please enter the corresponding calibration factor in decimal fraction,
(entering 1.12 increases growth by 12 % ): 0.94
Enter the lower ht  limit and calibration factor for the 2nd  size class.
Enter here (separated by a comma): 45.0,1.00

Do you want to enter another calibration group?
(y=yes,n=no): y

The species codes are:
   1 - Redwood        2 - Douglas-fir     3 - Other conif.       4 - Tanoak
   5 - Alder          6 - Other hwd.      7 - Res. redwd.        8 - Res. conif.

Enter the codes of the species to be included in the
  2nd Height calibration group,
(separated by commas,terminated by a "/"): 7,8/

Do you want to enter calibration factors by ht  size classes?
(y=yes,n=no): n
```

```
Please enter the calibration factor in decimal fraction,
(entering 1.12 increases growth by 12 %) : 0.88

Do you want to enter another calibration group?
(y=yes,n=no): n

                              CALIBRATION SUMMARY
                              -------------------


   Calibration Vectors for: Basal Area
   -----------------------------------

  Redwood            Douglas-fir          Res. Redwd.          Res. conif.
size  factor        size  factor        size  factor         size  factor
----  ------        ----  ------        ----  ------         ----  ------
 0.0  0.90 |         0.0  0.90 |         0.0  0.93 |          0.0  0.93 |
 6.0  0.93 |         6.0  0.93 |         0.0  0.93 |          0.0  0.93 |
12.0  1.00 |        12.0  1.00 |         0.0  0.93 |          0.0  0.93 |
30.0  1.06 |        30.0  1.06 |         0.0  0.93 |          0.0  0.93 |
30.0  1.06 |        30.0  1.06 |         0.0  0.93 |          0.0  0.93 |

-------------------------------------------------------------------------------

   Calibration Vectors for: Height
   -------------------------------

  Redwood            Douglas-fir          Res. Redwd.          Res. conif.
size  factor        size  factor        size  factor         size  factor
----  ------        ----  ------        ----  ------         ----  ------
 0.0  0.94 |         0.0  0.94 |         0.0  0.88 |          0.0  0.88 |
45.0  1.00 |        45.0  1.00 |         0.0  0.88 |          0.0  0.88 |
45.0  1.00 |        45.0  1.00 |         0.0  0.88 |          0.0  0.88 |
45.0  1.00 |        45.0  1.00 |         0.0  0.88 |          0.0  0.88 |
45.0  1.00 |        45.0  1.00 |         0.0  0.88 |          0.0  0.88 |

-------------------------------------------------------------------------------


Do you want this summary placed in the report file? (y=yes): y

  Summary placed in the report file

Do you want to save this calibration scheme in an external file?
(y=yes,n=no): y

Open the calibration file
Enter a file name here: demo.cl

  Calibration scheme saved in file: demo.cl                    V page 17

initgo:ex

  Exiting initialization routine
```

```
                                MAIN PROGRAM
                                ------------

  Type "pc" to get a list of available commands
  Current output file is  6 (the screen)
```

VI.B page 21

```
go: gr

      Begin Growth Routine


  MORTALITY ON


Enter the number of 5-year growth cycles desired
  Note: a "-" (minus) prefix shuts off mortality for all cycles entered.
Enter number of cycles here: 1
```

VI.B page 21

```
Both Basal Area and Height calibration schemes are present.
How do you want them applied for the  1 growth cycles requested ?
  0 - Do not apply any calibration scheme
  1 - Apply Basal Area calibration scheme only
  2 - Apply Height calibration scheme only
  3 - Apply both Basal Area and Height calibration schemes
Enter 0, 1, 2, or 3 : 3
```

VI.B page 22

```
Do you want either individual tree growth detail
          or summary info printed?(y=yes): n


go:yd


  YIELD SUMMARY: units = english
  -------------

  stand label = test stand

                 min. DBH    merch top
       cubic ft.    0.0          6
       board ft.    8.0          6

  species       site   init. age
  Redwood       110.       50.
  Douglas-fir   125.       55.
  Other conif.   73.       48.
  Tano  ak       94.       50.
```

species	et	dbar	tpa	basar	cvol	bdvol	bagro	cvgro	bdgro
Redwood	0.00	15.36	150.0	193.0	5.23	26.95	0.0	0.00	0.00
DouglasFir	0.00	16.18	150.0	214.1	9.33	53.20	0.0	0.00	0.00
Totals	0.00	15.77	300.0	407.1	14.56	80.20	0.0	0.00	0.00
Redwood	5.00	16.22	148.1	212.4	5.91	31.08	19.4	0.68	4.14
DouglasFir	5.00	17.46	146.1	243.0	11.09	65.27	29.0	1.76	12.02
Totals	5.00	16.85	294.2	455.5	17.00	96.35	48.4	2.44	16.15 B M
species	et	dbar	tpa	basar	cvol	bdvol	bagro	cvgro	bdgro

go:**ex** *VI page 24*

```
Yield summary saved in demo.yd
Report summary saved in demo.rp
```

APPENDIX E. COMMAND SUMMARY

INITIALIZATION COMMANDS

- pc - print commands
- cm - set cubic foot DBH min.
- ct - set cubic merch top
- bm - set board foot DBH min.
- bt - set board foot merch top
- sc - list species groups and current group indicator
- sp - set species groups
- su - list user defined species groups
- fl - set print flag
- yf - set yield flag
- • cl - set user calibration scheme
- iq - set record quintupling option
- ex - return to main program

MAIN COMMANDS

- pc - print commands

Report Commands

- pi - print initial description
- • sc - print current species group
- • dt - enter DBH dist. routine
- • dc - print DBH class table
- yd - print yield summary
- cg - print current 5-y.r growth
- pm - print DBH mins & merch tops
- • su - print user defined sp. group
- • pf - enter stand profile routine
- st - print stock table
- • sl - print standing log table

Simulation Commands

- • gr - enter growth routine
- ct - enter harvest routine
- ig - add ingrowth to tree file
- • cl - initilize/reset user calibration

File Utility Commands

- cf - change output file number
- sv - save current stand status
- rt - restore stand saved by "sv"
- es - external save of current stand
- ns - start over with new stand
- os - truncate yield summary

- ex - exit from program

HARVESTS COMMANDS

- pc - print harvest commands
- cf - change output file number
- • dt - enter DBH distribution routine
- • pf - enter stand profile routine
- st - print current stock table
- dc - print DBH class table
- r1 - harvest - DBH control
- r2 - harvest - Basal Area control
- r3 - harvest - Free
- r4 - harvest - Sanitation
- • ih - print intermediate harvest since last "ih" call
- • ch - print cumulative harvest since entering cut routine
- • th - print total harvest since beginning simulation
- • hc - print cumulative harvest DBH class table
- hl - print cumulative harvest log stock table
- ex - exit cutting routine

• - information from this command may be routed to the report file.

ERROR REPORTING PROCEDURE

The programs in the CRYPTOS system have been tested extensively prior to their release. However, you may encounter problems we have not encountered in our testing. If so, we'd appreciate hearing from you.

Problems you might encounter fall into two categories: application errors and design errors. Application errors result from using the programs outside the range of conditions intended. Where possible, the programs should alert you to such improper use and ask you to change your specifications. However, the programs will let you do some things that are possible on the computer but meaningless in practice.

Design errors occur when you try to do an operation which should be possible, but it fails. These errors are the ones of primary importance to us, because they may represent a failure of the program. Thus, we ask you to give us a detailed accounting of the problem so that we can reproduce it in our lab and correct it.

Please send the following items to us if you encounter a problem with one of the programs in the CRYPTOS system:

(a) A printed copy of the screen contents showing the error.

(b) A detailed list of the commands that led to the error. (In CRYPTOS, the best way to do this is to make a batch file.)

(c) A copy of the diskette containing:

(1) the stand description or other data file used,

(2) the program that is giving you trouble, and

(3) any other relevant input and output files.

(d) Your name, address, and telephone number.

The materials that you send to us for tracing errors should be copies. You should retain a copy so that we can discuss the runstream with you if necessary. These materials will be discarded when the problem is solved.

Your comments and suggestions concerning the programs in the CRYPTOS system are welcome. It is through this interaction that we can offer the best possible programs for your use.

For information about ordering this publication, write to:

Publications
Division of Agriculture and Natural Resources
University of California
6701 San Pablo Avenue
Oakland, California 94608-1239

or telephone (415) 642-2431

Bulletin 1924

© 1987 by The Regents of the University of California
Division of Agriculture and Natural Resources

All rights reserved.
No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the written permission of the publisher and the author.

Printed in the United States of America.

The University of California, in compliance with the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and the Rehabilitation Act of 1973, does not discriminate on the basis of race, creed, religion, color, national origin, sex, or mental or physical handicap in any of its programs or activities, or with respect to any of its employment policies, practices, or procedures. The University of California does not discriminate on the basis of age, ancestry, sexual orientation, marital status, citizenship, medical condition (as defined in section 12926 of the California Government Code), nor because individuals are disabled or Vietnam era veterans. Inquiries regarding this policy may be directed to the Personnel Studies and Affirmative Action Manager, Division of Agriculture and Natural Resources, 2120 University Avenue, University of California, Berkeley, California 94720, (415) 644-4270.

1m-pr-12/87-HS/ALS